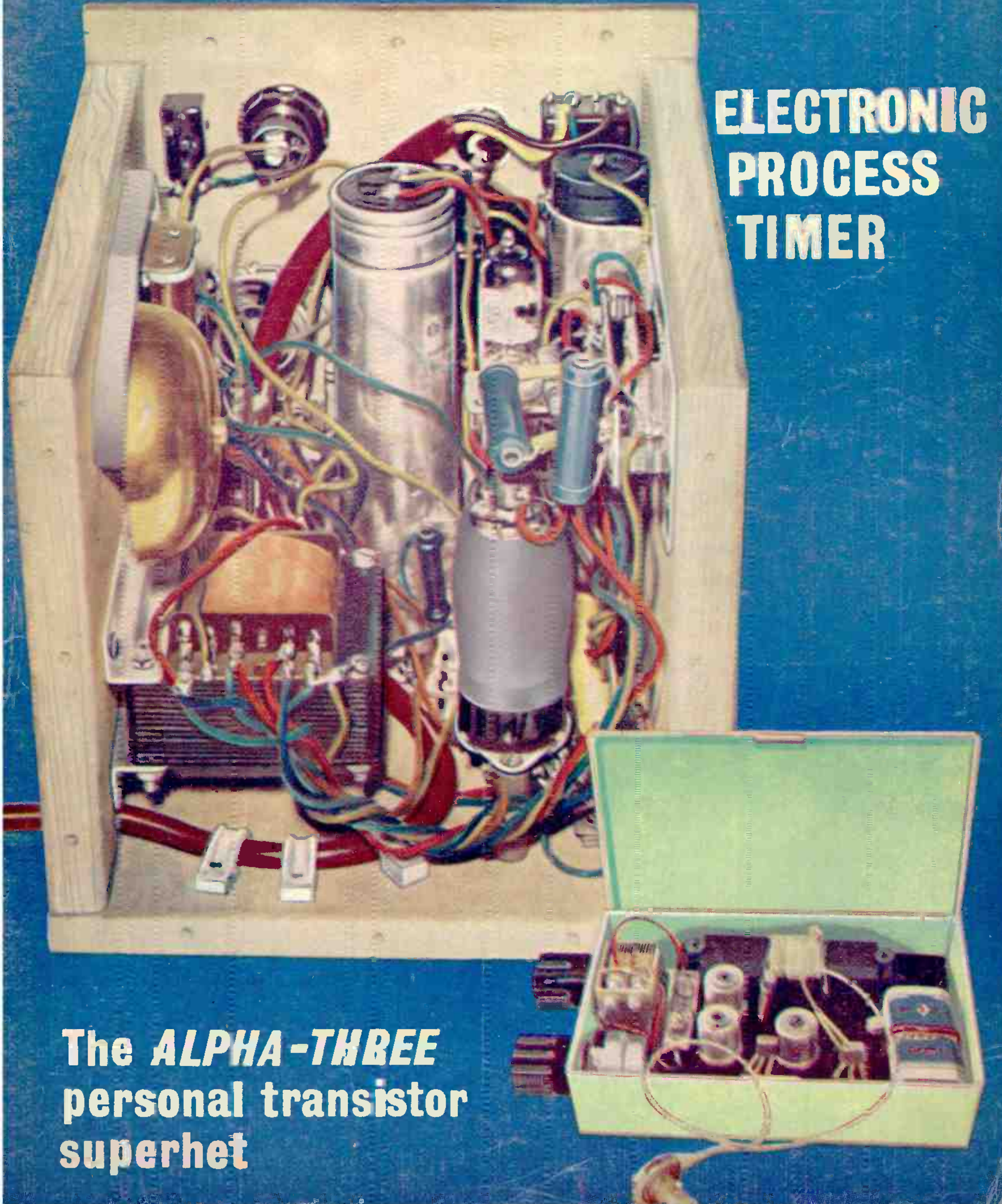
JULY 1962

Practical WIRELESS

2/-

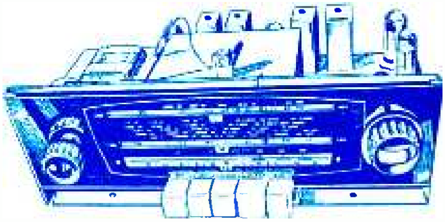


ELECTRONIC PROCESS TIMER

The ALPHA-THREE personal transistor superhet

BRAND NEW AM/FM (V.H.F.) RADIOGRAM CHASSIS AT £14 (Carriage Paid)

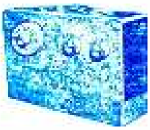
A.C. ONLY. Chassis size 15 x 6½ x 5½ in. high. New manufacture. Dial 14½ x 4in. in 2 colours predominantly gold. Pick-up. Ext. Speaker. Ae., E., and Dipole Sockets. Five push buttons—OFF L.W., M.W., F.M. and Gram. Aligned and tested. O.P. Transformer. Tone Control. 1,000-1,900 M.; 200-500 M.; 88-98 Mc/s. Valves EZ80 rect., ECH81, EF89, EABC80, EL84, ECC85. Speaker and Cabinet to fit chassis (table model), **47/6** (post 2/6). 9 x 6in. ELLIPTICAL SPEAKER, **20/-**, to purchasers of this chassis. **TERMS:**—(Chassis) **£5** down and 5 Monthly Payments of **£2**, or with Cabinet and Speaker **£5.10.0** down and 6 Monthly Payments of **£2**. Cheap Room Dipole for V.H.F., **12/6**. Feeder **6d.** yard. Circuit diagram **2s. 6d.**



THE "CANTATA" 6-TRANSISTOR AND DIODE PORTABLE

COMPLETE KIT FOR ONLY

£7.19.6 (post 3/6)



500mW push-pull output. Ferrite rod aerial. Car aerial socket and coil. M.W. and L.W. full coverage. Operates on two 4.5v. cells. Printed circuit board 8½ x 2½in. All holes drilled and component positions marked. Instructions **2/6** for 16p. (refunded on purchase of kit). Size 9 x 3¾ x 7in. 8 x 2½in. P.M. high quality speaker. Attractive Vinair covered cabinet, two tone. Two batteries **5/6** the pair (Ever Ready 126). Mullard transistors OC44, 2 x OC45, OC81D, and 2 x OC81. Top grade Weymouth Radio Coils and transformers. Alignment service if required **17/6** (inc. post). Write for list of prices. All parts supplied separately. Built in two hours.

BUILD YOUR OWN RECORD PLAYER FOR £12.10.0.

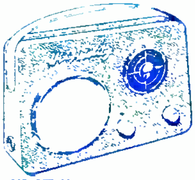
Fully built 2 valve amplifier

B.S.R. 4-sp. autochanger, case 17 x 15 x 8½in. Assembled in 15 mins. Similar cabinet for tape recorder with plain board only **£3**, carr. paid. Attractive colours.

or with 3 valve amplifier 15/- extra

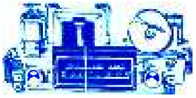
AUTOMATIC RECORD CHANGERS—LATEST MODELS. 4 SPEED. CRYSTAL CARTRIDGE. All **5/-**, extra carr. B.S.R. UA14, **£7.10.0.** Garrard Slimline, Mono. **£8.** Stereo. **£8.5.0.** Motor Board for UA8, UA20, UA14, Slimline, **5/-**, (post 1/6) or **3/6** plus 1/6 when purchased with Autochanger. Motor Board for Collaro C60, **4/-**, post paid.

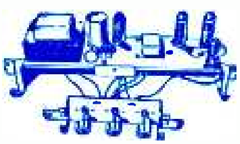
TELEFUNKEN STEREO AMPLIFIERS. 2 ECL82—2 x 2½ watts, 12 x 9 x 2in. piano keys, **£7**, post paid.



6 TRANSISTOR PORTABLE—FULLY BUILT. The "SCALA" for only **£7.19.6.** carr. paid. 8½ x 2 x 5½in. high. Choice of colours. Rexine. M.W. and L.W. Ferrite aerial, PP4 battery 2/3 extra. Printed circuit. Nicely styled. A professional job. 3½in. speaker.

SELF-POWERED VHF TUNER CHASSIS. Covering 88-95 Mc/s. Mullard permeability Tuner. Dims. 10½ x 4½ x 5in. high. ECC85, EF91, EF91 and 2 diodes. Metal Rectifier Mains transformer. Fully wired and tested. Only **£7.14.0** (carr. pd.). Attractive Vynair Cabinet **20/-**. Room dipole **12/6**. 300 ohm twin feeder, **6d.** yd.





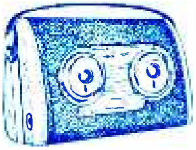
PUSH-PULL AMPLIFIER £5.5.0

(5/- Carr.)

Brand new 200-240 A.C. mains Bass, treble and vol. controls. With valves EZ80, ECC83 and 2-EL84 giving full 8 w. Chassis 12 x 3½ x 3½in. With o.p. trans for 2-3 ohm speaker. Front panel (normally screwed to chassis) may be removed and used as "flying panel". Stereo version 2 x 4 w. same price.

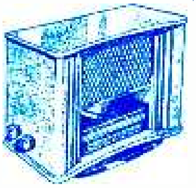
THIS SUPERB SET FOR £10

6-transistor radio covered in sponge clean Duracour fabric, in latest two tone shades M.W and L.W., ferrite rod, provision for car aerial. 2-colour scale. With PP9 battery giving 300 hours use. Weighs under 4 lbs. With carrying handle. 12 x 7½in. high x 4½in. at base tapering to 2in. at top. Brand new, fully guaranteed. **£10.** Carr. paid. Worth £16.



COMPLETE V.H.F./A.M. RADIO FOR £12.10.0

(carr. paid)



Brand new set, in superb walnut cabinet (size 19 x 8½ x 14½in. high). Covering 88-100 Mc/s. 16-49M., and 200-500 M. Mains trans. 200-250 v. Ferrite rod aerial for A.M. (Controls: volume on/off, tone, tuning, w/change). Gram. and ext. speaker position provided. Valves 12AT7, 12AH8, 6BJ6, EABC80, 6BW6 and metal rectifier. Fully guaranteed. Today's Value £20.

TEST LEAD KIT. Leads, Prods, Terminals, Clips, in case, **10/-**, post paid.

TAPE, TOP QUALITY BOXED. 5¾in.—850 ft., **15/-**; 1,200 ft., **17/6**; 7in.—1,200 ft., **17/6**; 1,800 ft., **26/6.** (all plus 1/6 post, 2/- for 2).

COLLARO STUDIO TAPE TRANSCRIPTOR. 3 MOTORS. 3 SPEED. 1⅞, 3¾ and 7½ I.P.S. Push buttons. **£10.17.6** (10/- carr.) incl. spool.

SUPERIOR GRAMOPHONE AMPLIFIER

3 valves, 4 watt

13½ x 7½in. (2½in. front to back). 3 front controls, bass, treble, vol. on-off, 6½in., round speaker; UY85, UF80 and UL84. Mains trans. 200-240ac; fabric covered front. **74/-**, (p.p. 4/-).

GRAMOPHONE AMPLIFIER With 5in. SPEAKER Baffle 12½ x 6in. ECL82 and Rectifier. Tone and Volume On/off switch. Two Knobs. Ready to play. Useful for Stereo ONLY **57/-**, post 4/-.

3-VALVE AMPLIFIER (Inc. RECT.)

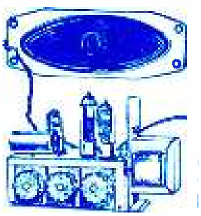
2½ watts. ECC83, ECL82 and EZ80. Controls, volume, bass and treble. On/off switch. Mains and O.P. trans. Size as for Push-Pull Amp. Suitable for microphone, input and for Guitar. **95/-** P. & P. **5/-**

Also acts as telephone amplifier using pick-up coil, price **14/-**. Chassis 12 x 3½ x 3½in. Fixed front panel. Price includes handsome walnut finish polished cabinet, 13 x 7½in. facia containing high quality 3 ohm P.M. speaker 5¼ x 4¼in.

BATTERY ELIMINATOR

For 4 Low Consumption Valves (96 range). 90v. 15mA and 1.4v. 125mA. **45/-** (2/6 post). 200-250v A.C. Also for 250mA. 1.4v. and 90v. 15mA at same price. In two sections H.T. and L.T. to replace existing batteries.

3-VALVE AMPLIFIER (Inc. RECT.)



4 watts. Valves ECC83, EL84 and EZ80. Controls, volume, bass and treble. On/off switch. (Chassis size 6½ x 3 x 2½in.) 6½in. round or 7 x 4in. elliptical speaker. Not suitable for microphone input. A.C. only. **67/-**. P. & P. 3/-.

CHASSIS. BATTERY RADIO. Valves DK96, DF96, DAF96, DL96. Two Short Wavebands 16 to 49 M. and 25 to 75 M. Size 10½ x 4½ x 5in. **£4.16.0**, carr. paid. MW and SW. **£5**, carr. paid. Or as Kit **75/-**.

****

TERMS AVAILABLE ON ITEMS OVER £5

Send 6d. (stamps will do) for 20 page illustrated catalogue. All New Goods. Delivered by return. (C.O.D. 2/- extra).

ALL ITEMS GUARANTEED 12 MONTHS VALVES 3 MONTHS—CLOSED SATURDAY.

GLADSTONE RADIO

"SCALA," CAMP RD., FARNBOROUGH, Hants.

Farnborough 3371

and 247 New Road, Copnor, Portsmouth.

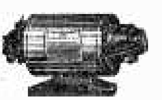
Closed Circuit TV

If you feel like taking a day out we invite you to our studio here at Eastbourne and will demonstrate 405 and 625 systems, as well as under water and other types of installations. We have equipment for sale or loan, and will be glad to discuss any proposals which you may have. You will be interested to note that a transistorised camera for working direct into a domestic TV receiver can now be purchased for little more than the cost of a good photo camera.

Adjustable Thermostat

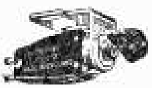
Suitable for Industrial or domestic purposes, such as controlling furnace oven, immersion heater etc. Can also be used as a flamestat or fire alarm. Made by Sunvic these are approximately 17" long and adjustable over a range 0 to 550 F. The contacts are rated at 15 amps., 230 volts, and the adjustment spindle, which comes to the top, can be fitted with a flexible drive for remote control or just a pointer knob for local control. Listed at £3 or £4 each, these are offered at only **12/6** plus 2/6 postage and insurance.

Don't Go Unshaven!



To operate your razor from car battery or suitable for many other uses, we offer Motor Generator 12v. input, 200 v. output, which must have cost at least £10 to make, for only **17/6**, plus 4/6 post and insurance.

Acos Cartridge



For turnover pick-up 10/-. Ditto but Stereo 27/6.

The J.B. Tangential Air Conditioner

The displacement caused by the new Tengential fan is quite amazing, but what is more amazing is the almost complete absence of noise.

Stand the J.B. Air-Conditioner on a window ledge near an open window, and you can have either extraction of bad air, or input of clean, new air, depending upon which way you turn it.

In addition to a fan for moving the air, the unit also contains a heater and control switch, wired such that 500, 1,000 or 2,000 watts of heating may be used.

The total building cost of this air-conditioner is £7.10.0, but is offered at a specially low price during the summer months, this price namely **£6.10.0**, plus 5/- carriage and insurance. The case is very nicely finished in hammered enamel, and when assembled, the unit is indistinguishable from those selling at £12 and more.

Don't miss this special summer offer.

MOST POPULAR PORTABLES or CAR RADIOS

" Works better than my 25 gn. '———' ! "

We hear this remark so many times and feel this is why our Companion portables are growing more and more popular

The 'Good Companion' Mk.II using Transfilters

In the "de-luxe" cabinet as illustrated it costs £10.19.6 to build—but what a set!

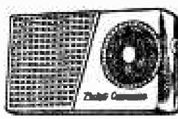
Scan these pages you will find nothing to compare with its specification. It uses transfilters instead of I.F. transformers, has variable feedback as well as all the usual features, A.V.C., Push-pull output, Ferrite Aerial, Slow Motion Tuning, etc. etc., and is a very powerful Medium & Long Wave set, conservatively rated at 750 mW. Every component used is by a famous maker, such as American Philco MADT R.F. transistors—Mullard A.F. transistors—Jackson Brother's tuning condensers—Rola-Celestion loudspeaker—Dubilier—T.C.C.—Morganite resistors and controls. Also full after sales service available.

You will definitely be doing the right thing if you buy a Good Companion.

The "Tremendo Companion"

If you don't mind the battery consumption being a little higher and you want really big output then order The "Tremendo". This has an undistorted output of almost 1¼ watts and is probably the most powerful home constructor set available today. Complete building cost of this is **£11.5.0**, which includes the transfilter (Mk.11 circuit) batteries. cost 3/6 (two required).

The "Pocket Companion"



This is without doubt the most modern and best pocket set available. It uses the very latest I.F. transfilters, Philco R.F. transistors, airspaced tuning condenser in Superhet circuit covering M.W. and L.W. Complete building cost **£6.15.0**. Battery 2/-. Post & Ins. 2/6. Data free with parts or separately 2/6.

T.R.F. POCKET PORTABLES

Still available as previously advertised, all are complete and with cabinet similar to "Pocket Companion".

THE "PIMPERNEL"

Five transistors, 3in. Moving Coil Speaker. **79/6**, plus 2/6 postage and insurance.

THE POCKET "4"

Undoubtedly the easiest to build set available, three transistors and one diode. **42/6**, plus 2/6 postage and insurance.

THE SOLDERLESS "3"

Two transistors, miniature earphone. Assembled like a Meccano set, ideal for juveniles and beginners. **37/6**, plus 2/6 postage and insurance.

CABINET AND PICK-UP

Cabinet for battery record player. Size approx. 9 x 11 x 5in. allows for 7 x 4in. speaker and amplifier. Nicely covered two tone. Must have cost at least £2 to make. New and perfect. Offered whilst stocks last **27/6**, plus 4/6 post and insurance.

Cosmocord Pick-up

As illustrated with cartridge and headrest. Ready, new and perfect. Suitable for 45 or 33 records. Price **12/6**, plus 2/6 post and insurance.

Extra Special Offer

The above two items if ordered together will be supplied for **37/6**, plus 4/6 postage and insurance.

The Pocket "7"

Cheaper than you can make—7 stage, Transistor Superhet Pocket Radio ! !

Made up and ready—for less than the price of a kit. Never before and possibly never again will such a bargain come your way! This uses 7 semi-conductors, the ideal number for a well designed circuit gives maximum quality and volume for minimum operating cost. Carefully designed elegantly styled, the set is a thrill to hold! Luxembourg and station after station all roll in and its amazing how they boom out as you manipulate the finger tip controls!! You will be astonished that such a tiny set can have such a punch but its the push-pull output that does it. You will have Elvis, Cliff, Lonnie, all the stars always at hand. Admire the elegant lines of this precision instrument which comes complete with real hide case and miniature earphone, and all for **£7.19.6.** (Uses a PP3 battery). Or less case and earphone, **£6.19.6.** **Specification:** 7 semi-conductors, ferrite aerial-dust cored Hi-Q coils—printed circuit—gang tuning condenser—moving coil speaker—push-pull output. 8 ohm miniature earphone.

Save While You Listen!

Do you use a transistor set? If so, do you throw your money away? You can save two ways, batteries can be re-charged and the set can be worked off the mains at next to no cost. Our 9 volt battery eliminator (only a few inches long) has leads all ready to match up with the radio or battery and to fix into the light socket, no alterations to set. Expensive batteries can be charged eight or nine times—will give a life-time of entertainment for nothing as the meter can hardly read the current used. Price, complete and ready, only **29/6.**

Supertone Hi-Fi Tubular Amplifier

As you pocket set owners know—the tiny speaker in your set cannot do justice to its components and circuitry—with our Supertone but without any extra drain on battery, you can have real Hi-Fi with music and speech really booming out—you will be amazed at the difference! Can be mounted on wall or ceiling or will sit anywhere. No alteration to set—just plug into phone socket. Price **£2.2.6.**

Transistorised TV Pre-amplifier

As described in Practical Television April and May issues. Complete set of parts including U.H.F. Transistors. Price 70/-.

Introducing the J.B. Range of Transistors

Try these! you will be very pleased—

- JB1. All wave mixer (replaces OC45 etc.) .. 6/6
- JB3. I.F. Amplifier (replaces OC45 etc.) .. 4/6
- JB4. A.F. Driver (replaces OC81D etc.) .. 5/-
- JB6. Output matched pair (replaces OC81 etc.) .. 13/-
- Special offer set of six matched for superhet 25/-
- Special offer set of four matched for Amplifier (1 watt) .. 17/-

A.C./D.C. Multimeter Kit

Ranges: D.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000 A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000 D.C. milliamps 0-5, 0-100, 0-500. Ohms 0-50,000 with internal batteries. 0-500,000 with external batteries Measures A.C./D.C. volts, D.C. current and ohms. All the essential parts including metal case, 2in. moving coil meter, selected resistors, wire for shunts, range selector, switches, calibrated scale and full instructions. Price 24/6, plus 2/6 post and insurance.

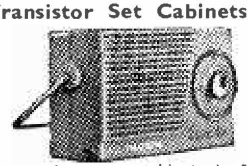
Blueprint Receiver

The Regency (April). All parts available for this receiver 75/-. A suitable cabinet, 25/- extra.

The Taylor Meter Model 127A

A pocket size meter but with a big scale and a sensitivity of 20,000 ohms per volt D.C., therefor an ideal unit for television servicing—robustly made and complete with leads and prods—20 ranges as follows: D.C. current 50 microamps. to 1 amp. D.C. voltages—0-1,000 volt in seven ranges (25 kV) with external probe, optional extra. Volts A.C.—0.2,500 in six ranges. Ohms—0.20 meg. ohm in three ranges (self-controlled). Self-contained, 3½in. movement. Price £10 or 10/- deposit and 23 fortnightly payments of 10/-. Non-callers add 5/-. carriage and insurance.

Transistor Set Cabinets



Very modern cream cabinet, size 5½ x 3 x 1½in. with chrome handle, tuning knob and scale. Price 7/6, plus 1/6 postage and packing.
Special quotations for quantities.

P.W. BLUEPRINT SERVICE

We try to hold stocks of parts for all the P.W. Blueprint sets, and we will be glad to help you. When ordering please mention the month of issue and the number of the Blueprint set in question. Mark your order P.W. Blueprint Service.

"DIPYT" Automatic Headlamp Dimmer

A transistorised device for automatically dipping headlamps so leaving driver's hands and feet free for emergency, could easily avoid an accident. We now offer such a device ready made and tested.

The unit measures 5 x 2 x 5in. and fits under the dash. It is very easy to wire into the circuit and can also be used to control side lamps for parking.

Price of unit is £10.19.6, carr. paid, diagram and instructions free with unit or separate 2/6. (Agents Wanted).

THIS MONTH'S SNIP

BREAKDOWN UNIT. Contains a mass of components, and must have cost the Government at least £20.

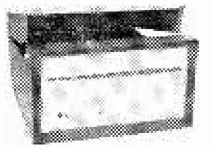
Contents: Over 50 paper tubular and mica condensers values up to .05 mFd. Over 50 carbon resistors, various wattages and values—6 Yaxley switches—6 I.F. transformers, dust covered suitable for TV or rewinding—7 octal valve holders. Many useful sundries—chokes, valve top clips, tag boards, plugs, switch, springs, etc., weighs 6 lbs.

Secure one of these whilst stocks last, price only 9/6, plus 3/6, postage and packing.

TRANSFILTERS

These ceramic devices save alignment problems and improve performance. Use instead of I.F. transformer. Complete with circuit, 8/6 each.

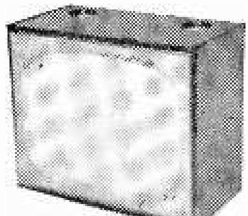
PHILCO RECORD PLAYER CABINET



Two tone, covered with high grade rexine, fitted with rubber feet. The front is particularly nice being made of tygan with a horizontal gold bar. Size approximately 14½in. wide, 8½in. deep, 16½in. long. Will take BSR or similar record player or tape deck and amplifier. Must have cost at least £3 each, our special snip price 35/- each, carriage and insurance 6/6.

TV CABINET

FOR 17" MODEL



Really well made and finished with polyester lacquer. Originally intended for Philco sets. Price

35/- plus 10/- carriage and insurance.

SHELLS available for 21in. models, beautifully polished and finished, but would need a moulded front and back to complete. Price 37/6 each plus 10/- carriage and insurance.

Yaxley Switches

All new and unused and in first class condition

1 pole, 2 way	1/6;	1 pole, 3 way	1/6
1 pole, 4 way	1/9;	1 pole, 5 way	2/6
1 pole, 7 way	3/-;	1 pole, 9 way	3/-
1 pole, 11 way	3/-;	1 pole, 12 way	3/3
2 pole, 2 way	2/-;	2 pole, 4 way	2/6
2 pole, 5 way	3/6;	2 pole, 6 way	3/6
2 pole, 12 way	5/6;	3 pole, 3 way	2/-
3 pole, 6 way	3/6;	3 pole, 12 way	8/6
4 pole, 2 way	2/-;	4 pole, 3 way	3/-
4 pole, 4 way	3/6;	4 pole, 5 way	4/6
4 pole, 6 way	5/6;	4 pole, 11 way	10/6
4 pole, 12 way	11/6;	5 pole, 3 way	3/6
5 pole, 6 way	7/-;	5pole, 12 way	14/6
6 pole, 2 way	2/6;	6 pole, 3 way	3/6
6 pole, 6 way	8/6;	6 pole, 11 way	16/6
6 pole, 12 way	17/6;	8 pole, 2 way	3/6
8 pole, 4 way	4/6;	8 pole, 6 way	11/6
8 pole, 12 way	23/6;	12 pole, 2 way	3/6
12 pole, 5 way	16/6;	12 way fader	3/6

6 pole, 6 way, shorting 3/6

Big stocks of most types
Special prices for quantities.

Blueprint Receiver

The International SW2

All components to make up this receiver as described in the April issue are available. Price 39/6, plus 2/6 postage and insurance. Note this price does not include cabinet, baking tin or headphone.

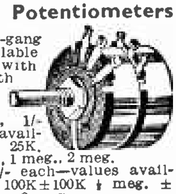
Motor with blower attached

24 volts D.C., but will work on 12 volts. For cooling equipment or can be adapted as car heater. 15/-, plus 1/6.

Rotary Converter

24 volts D.C. to 230 volts, 50 cycle A.C. with automatic regulator, this is complete in a grey steel case for silent running and it is rated 100 watts though this is a Navy rating, which usually can be considerably exceeded. Ideal to operate TV set on boat, etc. These are big units and can only be viewed by prior arrangement. Price £27.10.0 each, carriage at cost.

Morganite Potentiometers



Single and 2-gang types available standard size with good length spindle, all new and boxed. Single types, 1/- each, values available: 5K, 10K, 25K, 50K, 100K, 250K, 1 meg., 2 meg. Gang type 3/- each—values available: 5K±5K, 100K±100K ½ meg. ± ½ meg. 2 meg. ± 2 meg.

Infra Red Monocular Equipment

This is portable equipment, made originally for military use. It is a complete viewing device, having an infra red cell with optical lens system and Zambini pile to provide the EHT. Complete with leather case for easy carrying, these devices are sold in their sealed packages as collected from the Ministry, and they must not be opened during the daylight. Sold as received, believed to be in good working order, but without guarantee. Price £4.10.0, plus 5/- carriage and insurance.

Transistor Components

Send S.A.E. for our new price list, just printed.

ELECTRONIC PRECISION EQUIPMENT LTD.

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

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

★ VALVES ★

by return of post

THE MOST COMPREHENSIVE COMPETITIVE VALVE LIST IN THE COUNTRY

10% DISCOUNT SPECIAL OFFER TO PURCHASERS of any SIX VALVES marked in black type (15% in dozen). Post: 1 valve, 6d., 2-11, 1/-.

NEW LOW PRICES GUARANTEED 3 MONTHS

FREE TRANSIT INSURANCE. All valves are new or of fully guaranteed ex-Government or ex-equipment origin. Satisfaction or Money back Guarantee on Goods if returned unused within 14 days.

OZ4	5/-	6J5GT	4/-	12E1	17/6	DAF96	7/3	EM81	8/6	SU2150	4/6
1A5GT	5/-	6J6	4/-	12J7GT	9/-	DET19	2/9	EM84	9/-	T41	7/6
1A7GT	11/-	6J7	8/6	12K7GT	4/9	DF35	9/9	EM85	10/-	TDD4	7/6
1C5GT	9/-	**6J7G**	4/9	12K8	11/-	**DF91**	3/6	EN31	16/-	U14	8/-
1D5	8/-	6J7GT	7/6	12K8GT	9/6	DF96	7/3	EY51		U18	8/-
1D6	9/9	**6J8**	9/6	12Q7GT	5/-	DH63	6/-	Small	7/9	U22	6/9
1H5GT	9/9	6K6GT	6/6	12SA7	7/-	DH76	5/-	EZ86	7/6	U24	16/-
1L4	3/3	6K7	5/9	12SG7	5/-	DK32	11/-	EY86	5/6	U25	11/6
1LD5	3/6	**6K7G**	2/3	12SH7	3/6	DK91	5/6	EZ35	6/6	U26	9/9
1LN5	4/9	6K7GT	4/6	12SJ7	5/6	DK92	7/-	EZ41	7/-	U31	7/-
1N5GT	9/9	6K8GT	8/9	12SK7	4/9	DK96	7/3	EZ80	6/-	U33	14/-
1R5	5/6	6K25	7/6	**12SN7GT**	7/9	DL33	8/-	EZ81	6/6	U35	12/6
1S4	8/-	6L1	12/6	13D3	9/-	DL35	9/-	FW4/500	8/-	U37	26/-
1S5	4/6	6L6G	6/6	14S7	14/9	DL65	6/-	FW4/800	8/-	U50	5/9
1T4	3/6	6L18	9/-	19AQ5	7/6	DL75	6/-	GT1C	7/-	**U52**	4/9
2A3	6/6	6L19	11/-	19BG6	19/-	DL82	9/-	GZ32	8/9	U76	5/6
2A7	9/6	6LD3	8/-	20D1	9/6	DL91	8/-	GZ34	12/6	U78	5/-
3A4	4/9	6LD12	6/9	**20F2**	9/6	DL92	6/-	HABC80	9/6	U191	12/6
3A5	9/-	6LD20	7/9	20L1	16/-	DL94	6/9	HL41DD		U281	9/6
3D6	4/6	6N7	7/6	20P1	8/9	DL96	7/3		8/3	U282	15/-
3Q4	7/-	6P1	7/6	**20P3**	12/6	EABC80	6/9	HN309	19/-	U301	15/-
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3V4	6/9	**6Q7G**	6/-	25A6G	8/-	**EB41**	7/-	1W4/500	7/6	U339	11/-
5R4GY	12/6	6Q7GT	8/6	**25L6G**	6/9	**EB91**	3/-	KLL32	8/6	U801	19/-
5T4	8/-	6R7G	8/6	25L6GT	7/9	EBC33	4/9	KT32	6/9	UABC80	8/-
5U4G	4/9	**6SA7**	5/6	25Y5G	8/-	EBC41	8/-	KT33C	4/6	UAF42	7/9
5V4G	7/9	**6SG7**	4/9	25Z4G	7/-	EBC81	7/9	**KT36**	12/6	UB41	7/9
5Y3G	5/9	6SH7	3/-	25Z5	8/-	EBF80	7/9	**KT44**	7/6	UBC41	7/9
5Y3GT	5/9	6SK7	5/-	25Z6G	8/-	EBF83	9/6	**KT45**	8/6	UBC81	9/6
5Y4G	11/-	6SL7GT	5/9	30C1	7/-	EBF89	8/6	KT61	8/6	UBF80	8/-
5Z4	11/-	6SN7GT	4/6	30F5	6/-	EBL21	12/6	KT63	5/9	UBF89	7/6
5Z4G	7/6	6SQ7	5/9	30FL1	9/6	EBL31	17/6	KT76	8/6	UBL21	14/6
5Z4GT	11/-	**6SS7**	3/6	30L1	6/9	EC91	4/6	KTW61	5/9	UCC84	14/6
6/30L2	9/-	6U4GT	10/6	30P4	9/6	ECC31	7/6	KTW62	5/9	UCC85	7/-
6A6	4/9	6V6G	5/-	30P12	7/6	ECC32	4/-	KTW63	5/9	UCF80	15/-
6A7	10/-	6V6GT	6/-	30P16	6/6	ECC33	4/6	**KTZ63**	5/6	UCH21	12/-
6A8G	8/6	6X2	7/9	30PL1	9/6	**ECC34**	9/-	**L63**	2/9	**UCH42**	7/3
6A8GT	13/6	6X4	5/-	35L6GT	8/6	ECC35	6/-	**LN152**	7/-	UCH81	8/-
6AB8	7/-	6X5G	5/-	35T	25/-	ECC40	14/-	MU14	7/6	UCL82	9/9
6AC7	3/3	6X5GT	5/6	35W4	6/9	ECC81	5/6	N37	11/-	UCL83	13/6
6AG5	3/-	6Y6G	7/6	35Z4GT	5/6	ECC82	6/-	N78	13/-	UF41	7/6
6AG7	7/6	7A7	8/6	35Z5GT	8/-	ECC83	6/6	N108	16/-	UF42	5/6
6AK5	5/-	7B6	9/-	41	7/6	ECC84	8/-	N152	8/6	UF80	7/-
6AL5	3/-	7B7	7/9	42	7/6	ECC85	7/9	P41	4/6	UF85	7/6
6AM6	3/-	**7C5**	7/3	50C5	9/-	ECC88	16/-	P61	2/9	UF86	14/6
6AQ5	6/-	7C6	7/6	50CD6	19/-	ECC91	4/-	PABC80		UF89	7/-
6AT6	5/9	7H7	7/3	50L6GT	8/6	ECF80	8/6		11/6	UL41	7/-
6AU6	7/6	7K7	9/6	52KU	10/6	ECF82	8/6	PCC84	6/9	UL44	11/-
6B7	8/6	7Q7	8/6	53KU	10/6	ECH21	12/6	PCC85	8/3	UL46	9/9
6B8G	3/-	7R7	10/6	61SPT	11/-	ECH35	7/6	PCC88	14/-	UL84	7/-
6BA6	5/9	7S7	9/-	62BT	13/6	ECH42	8/6	PCC89	9/-	UM80	9/6
6BE8	5/9	7V7	7/9	75	6/6	ECH81	7/9	PCF80	7/-	UR1C	8/-
6BG6G	15/-	7Y4	6/9	78	6/6	ECH83	8/3	PCF82	7/3	UU6	12/6
6BH6	6/-	7Z4	7/-	80	5/9	ECL80	6/-	PCF84	16/-	UU7	9/6
6BJ6	6/-	**8D3**	3/-	83	9/6	ECL82	9/6	PCL82	7/3	UU8	17/-
6BR7	9/6	10C1	11/6	185BT	19/6	ECL83	11/7	PCL83	10/6	UY1N	11/-
6BW6	7/6	10C2	14/6	803	19/-	EF22	7/-	PCL84	7/6	UY21	11/-
6BW7	5/6	10C14	8/-	807(A)	5/6	EF36	3/3	**PEN45**	8/6	UY41	6/-
6BX6	4/9	**10F1**	5/9	808	7/6	EF39	4/6	PEN46	5/-	UY85	6/6
6C4	3/6	10F9	10/6	813	55/-	EF40	12/-	**PL33**	8/3	VP41	5/6
6C5	5/6	10L14	7/-	832A	14/-	EF41	8/-	PL36	9/6	VR105	6/9
6C6	3/9	10LD3	7/9	866A	11/6	**EF42**	7/6	PL38	16/6	VR150	6/9
6C9	11/-	10LD11	14/6	954	2/-	**EF50-BR**	2/-	PL81	8/6	W61M	11/-
6CD6G	19/6	10LD12	8/-	956	2/6	**USA**	3/-	PL82	6/6	W76	4/9
6CH6	7/6	10P13	11/-	9001	2/-	**EF54**	3/3	PL83	6/6	W81	7/3
6D2	3/-	**10P14**	9/-	9002	4/9	**EF80**	4/9	PL84	8/-	X61M	11/-
6D3	9/6	10P18	7/-	ATP4	2/9	EF85	6/6	PL820	8/6	X63	8/6
6D6	4/3	12A6	4/9	AZ31	8/-	EF86	9/-	PX4	12/6	X65	11/-
6F1	4/9	12AC6	15/-	AZ41	11/-	EF89	6/9	PX25	9/6	X66	11/-
6F6G	5/9	12AD6	17/-	**B36**	7/9	**EF91**	3/-	PY31	9/-	X76M	11/-
6F12	3/-	12AE6	13/9	C1C	9/6	**EL92**	4/6	PY32	10/-	X78	21/-
6F13	6/9	12AH8	9/-	CBL1	26/6	EF96	3/-	PY80	6/9	X79	16/6
6F14	9/6	12AT6	7/6	CBL31	21/-	EL32	4/6	PY81	6/6	X81M	9/-
6F15	9/6	12AT7	5/6	CCH35	14/-	**EL33**	7/9	PY82	6/-	Y63	6/3
6F16	8/-	12AU6	9/6	CL33	9/6	EL35	7/-	PY83	7/-	**Z63**	4/9
6F19	6/6	12AU7	6/-	CY31	9/-	EL41	8/-	PZ30	9/6	**Z66**	9/6
6F23	6/6	12AX6	6/6	D77	3/6	EL42	8/9	R18	11/-	Z152	4/9
6F32	6/6	12BA6	7/6	D152	5/9	EL83	11/-	R19	11/-	Z719	4/9
6F33	6/6	12BE6	7/6	DA30	12/6	EL84	7/-	**SP41**	2/6	ZD152	7/9
6J5	4/3	12BH7	9/9	DAC32	9/9	**EL91**	4/-	**SP61**	2/6		
6J5G	3/-	12C8	6/6	DAF91	4/6	EM80	7/9	SU25	16/-		

Tubes

HIGHEST QUALITY—COMPARE OUR PRICES

Carr. & Ins. 12/6.

MOST MULLARD, MAZDA, COSSOR, EMITRON, EMISCOPE, BRIMAR, FERRANTI TYPES. PROCESSED IN OUR OWN FACTORY

GUARANTEED	6 Months	12 Months
12in.	£2. 0.0	£3. 5.0
14in.	£2.10.0	£3.15.0
15/17in.	£3. 5.0	£4.10.0
21in.	£3.15.0	£5.15.0

NEW TYPES	
MW 31/74	£4-0-0
MW 36/24	£5-0-0
CRM 172 MW 43/64	£6-0-0

13 CHANNEL T.V.s

Table Models. Famous Makes. Absolutely Complete. These sets are unequalled in value due to huge purchase direct from source. They are untested and not guaranteed to be in working order. Carr. etc. 15/-.

12in. **£2.19.0** 14in. **£4.19.0**

F.M. TUNER KITS. Well known make Comprising F.M. Tuning Head, guaranteed none drift. Frequency coverage 88-100 mc/s. OA81 balanced diode output, Magic Eye Tuning, Two I.F. Stages and discriminator, £6.9.6. P.P. 4/-.

P.V.C. CONNECTING WIRE. 100 yds., 30 mil: Special Price 7/6. 200 yds. 30 mil: special price, 12/6. 25ft. Coil, 1/-. 5 Coils different colours, 4/-. Connecting flex. Prices as above.

TRANSISTORS. Red spot 3/6 ea. White Spot 4/6 ea. Yellow Spot 2/9 ea. Germanium diodes 9d. ea., 8/- doz.

PICK-UP CARTRIDGES. "Acos" 65.3, 22/6. "Sonotone", 17/-. "Steig and Reuter", 17/6. Power Point, 17/-.

TAG STRIPS. From 3 way to 12 way Mixed parcels of 25—3/9. The best and cheapest way to buy!

HEADPHONES. Ex-Govt. quality with Jack-plugs, 7/6 pair. P.P. 1/6.

ACETATE TAPE. The highest quality, guaranteed. 5in. 600ft., 15/-, 5¾in. 1,200ft., 21/6, 7in. 1,200ft., 23/6, 7in. 1,800ft., 32/6. Also new empty spools, 3in., 1/9, 5in., 3/-, 5¾in., 3/6, 7in., 4/6.

NEW SPEAKER CABINETS covered in attractive Rexine, Gold Metal front 11/-. Or complete with 7 x 4 Speaker, 19/-. P.P. 1/6.

TRAV-LER TAPE RECORDER Superior, Transistorized, Portable Fast Rewind. Built-in High Output Speaker. Unrepeatable. Listed 29 gns. OUR PRICE 15 gns.

UA20 Autochangers. Latest B.S.R. 10 mixed records. Brand New. Unrepeatable, £6.19.0. Also UA14. A Proven Choice £7.19.0. P.P. 4/-.

"GARRARD" Slimline. Very latest Compact Autochanger. Just released. Amazing value, £8.19.0. Also available, Garrard Model 209, £9.17.6. P.P. 4/-.

100 RESISTORS 6/6

100 CONDENSERS 10/-

Miniature Ceramic and Silver Mica Condensers 3 pF to 5,000 pF. LIST VALUE OVER £5.

A.M./F.M. RADIOS. Latest Super German press button, long, medium, short and F.M., normally approx. £30, OUR SPECIAL DISCOUNT PRICE 19gns.

LINE TRANSFORMERS. Most types available from stock from 19/-. Also frame and blocking oscillator transformers. S.A.E. enquiries.

VALVE HOLDERS B7G, 6d. ea., with Screen 8d. ea. B9A, 6d. ea. with Screen 8d. ea.

IVORY/GOLD KNOBS 1" Diameter, half price 1/2, 5 for 4/6, 1½" 1/3, 5 for 5/-.

SPECIAL TEMPORARY OFFER. Due to huge Bulk Special Purchase we are offering MW 31/74 Tubes at the unrepeatable price of 29/-. MW 36/24 ditto, 39/-. P.P. 12/6. The above are guaranteed for 6 months.

RECORDERS. "Verdik" 4 Track Collaro 3 Speed Transcription Deck, Superior reproduction, Streamlined Portable Case. Complete with Mike. Market value approx. **£45. OUR SPECIAL PRICE 29gns.**

PERSPEX fronts for **17in. T.V. Sets.** Brand new, 7/6. P.P. 1/6.

RESISTORS, your selection, **4/6 doz.** Condensers, Silver Mica and **Ceramic, 6/- doz.** Most values in stock.

CO-AX. Standard and low loss, **25 yds., 12/6;** 50 yds., 22/6; 100 yds., **42/6.** Co-ax Plugs 1/3. Wall outlet **boxes 3/6.**

EXTERNAL I.T.V. Converters, with Power **Pack. Very compact, 39/-.** P.P. 2/-.

4-SPEED RECORD PLAYERS. Latest Turntable, together with lightweight Staar Galaxy dual sapphire crystal turnover pick-up head. Amazing value (pick-up only 19/-). **£3.10.0. Carr. 3/-.**

PORTABLE RECORD PLAYERS. Takes all sizes Records, all speeds, amplifier, auto-changer, Garrard new "Slimline" Gram. In two-tone **Case. All absolutely new. 14 gns.**

MIRROR GALVANOMETERS. Evershed and Vignoles, 45 second swing, **high** sensitivity, heavy gunmetal cases, **with** spares, in transit case, unused. **£8.10.0.**

P.M. SPEAKERS. 3 ohm, top **makes,** Performance guaranteed. **6½in., 8in.,** 8/-. 5in., 7 x 4in., 11/-.

ASSAULT CABLE. 1,000 yds. Covered Steel Telephone Wire. Ideal for gardening, 9/-. P.P. 4/-.

AVO MODEL 40. Universal Standard test meter, limited quantity, **£8.10.0.**
12 VOLT Blowers, ex-Gov., 19/6.
MICRO-SWITCHES, 4/6 each.

VOLUME CONTROLS. 5K to 2 Meg from 3/3 to 5/9 each.

TRANSISTOR INTERCOM. High sensitivity, complete with **batteries,** usually £9 DISCOUNT PRICE £7.15.0,

B.B.C./I.T.A. TUNERS

Famous makes complete with PCF80. PCC84 valves 38 M/c I.F. Fantastic value **19/-**

CONDENSERS. 25 Mixed, **Electrolytic.** Many popular **sizes. List Value £6** Our Price 10/-.

SOLDERING IRONS. "Pifco" **with** built-in Searchlight, 22/-. **"Ceka" with** angled bit, 16/9.

GET 15. G.E.C. High Power, **Contact** cooled, manufacture **matched pr Transistor with Push-Pull Input & Output Transformers. Knock out price 29/-.** P.P. 1/6.

Post: 2 lbs. 2/-, 4 lbs. 2/6, 7 lbs. 3/6, 15 lbs. 4/- etc. No C.O.D. ALL ITEMS LESS 5% and POST FREE IN DOZENS. **LIST OF 1000 SNIPS, 6d.**

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AUDIOTRON HI-FI TAPE RECORDER KIT

REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR

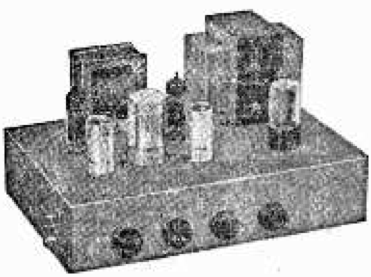
The Recorder incorporates the latest Collaro Studio Tape Transcriptor. The Audiotron High Quality Tape Amplifier with negative feedback equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best quality Tape and a Handsome Portable carrying Cabinet with latest attractive two-tone polychrome finish, size 14½ x 15 x 8½in. high, and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £60-£80 class. S.A.E. for leaflet.

25½ GNS. Carr. 17/6

H.P. TERMS. Deposit £5.7.6 and 12 monthly payments of 39/9 Cash price if settled in 3 months.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

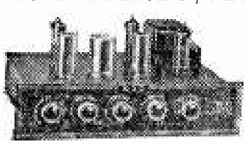
PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES



Two input sockets with associated controls allow mixing of "mike" and gram, as in A10. High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, 5Y3. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ± 3 D.B. 30-30,000 c/s. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For **STANDARD or LONG PLAYING RECORDS.** For **MUSICAL INSTRUMENTS** such as **STRING BASS, GUITARS,** etc. **OUTPUT SOCKET** with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12-9-7in. For A.C. mains 200-250 v. 50 c.p.s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/-. (Or factory built 51/- extra).

If required louvred metal cover with 2 carrying handles can be supplied for 18/9. **TERMS ON ASSEMBLED UNITS. DEPOSIT** 24/9, and 9 monthly payments of 24/9. Send S.A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets. Speakers. Microphones, etc., with cash and credit terms.

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



A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts, suitable for all crystal stereo heads. Ganged Bass and Treble 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. **8 Gns.** Full constructional details and price list 2/6. Carr. 10/-. Kit can be assembled, ready for use. 59/6 extra.

BRADMATIC RECORDING HEADS. High Impedance Record/Playback 22/-. Low Impedance Erase. 12/6.

COLLARO JUNIOR 4-speed Single Player Unit and Crystal Pick-up with hi-fi Turnover head. Only £3.19.6.

PICK-UP ARMS. Complete with latest Acos/hi-fi Turnover head and rest. Only 29/11.

CRYSTAL MICROPHONES. Hand type NP110 14/9, R.T.C. 19/9, Acos Mic 40 25/9, Acos Mic 45 29/9, Stick type Acos 39-1 39/9, BM3 with neck band and heavy table stand 59/9. Lapel type 35/9.

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

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

B.S.R. UA8 4-speed AUTO-CHANGERS with hi-fi turnover head. £6.19.9. Carr. 4/6.

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

R.S.C. BATTERY CHARGING EQUIPMENT

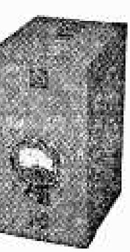
All for A.C. Mains 200-250v., 50ccs Guaranteed 12 months.

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

PARMEKO POTTED CHOKES
200 mA, 12 H 100 ohms 16/9
120 mA, 30 H 200 ohms 16/9
120 mA, 8 H 10 ohms 13/9

SOLDERING IRONS. 230-250 v. 30 watts. First quality. For Radio work, 19/9. Spare elements and bits available.

Assembled 6/12v. 4-5 amps.



Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Louvred steel case with stoved blue hammer finished. Fused and ready for use with mains and output leads. **69/9** Carr. 5/-. Terms: Deposit 13/3 and 5 monthly payments 13/3. 6/12 v. 3a., all facilities as above. Only 59/9, carr. 3/9.

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

BATTERY CHARGER KITS Consisting of Mains Transformer. F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses. Fuse-holders, Grommets, panels and circuit. Carr. 3/6 extra.
6v. or 12v. 1 amp.......... 24/9
As above, with Ammeters 32/9
6 v. 2 amps............... 25/9
6v. or 12v. 2 amps......... 31/6
6 v. or 12 v. 2 amps. inclusive of Ammeter........ 42/9
6 v. or 12 v. 4 amps......... 49/9
6 v. or 12 v. 4 amps. with Ammeter and variable charge rate selector.............. 59/9

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

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

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

TOP SHROUDED DROP THROUGH
250-0-250v. 70mA, 6.3v. 2a, 0-5-6.3v. 2a 17/9
350-0-350v. 80mA, 6.3v. 2a, 5v. 2a .. 18/9
250-0-250v. 100mA, 6.3v. 2a, 6.3v. 1a .. 21/9
250-0-250v. 100mA, 6.3v. 3.5a, C.T. .. 19/9
250-0-250v. 100mA, 6.3v. 4a, 5v. 3a .. 25/9
300-0-300v. 130mA, 6.3v. 4a, 6.3v. 1a, for Mullard 510 Amplifier 29/9
300-0-300v. 100mA, 6.3v. 4a, 5v. 3a .. 26/9
350-0-350v. 100mA, 6.3v. 4a, 5v. 3a .. 26/9
350-0-350v. 150mA, 6.3v. 4a, 0-5-6.3v. 3a 29/9

FULLY SHROUDED UPRIGHT
250-250v. 60mA, 6.3v. 2a, 0-5-6.3v. 2a. Midget type 2½-3-3in. 17/11
250-0-250v. 100mA, 6.3v. 4a, 5v. 3a .. 27/9
300-0-300v. 100mA, 6.3v. 4a, 5v. 3a 27/11
300-0-300v. 130mA, 6.3v. 4a, C.T. 6.3v. 1a, for Mullard Amplifier 33/9
350-0-350v. 100mA, 6.3v. 4a, 5v. 3a 27/11
350-0-350v. 150mA, 6.3v. 4a, 5v. 3a .. 35/9
425-0-425v. 200mA, 6.3v. 4a, C.T. 5v. 3a 55/-

FULLY SHROUDED (continued)—
425-0-425v. 200mA, 6.3v. 4a, C.T., 6.3v. 4a C.T., 5v. 3a 59/9
450-0-450v. 250mA, 6.3v. 4a C.T. 5v. 3a.. 69/9

OUTPUT TRANSFORMERS
Midget Battery Pentode 66:1 for 3S4, etc. 4/6
Small Pentode, 5,000Ω to 3Ω 4/6
Small Pentode 7/8,000Ω to 3Ω .. 4/6
Standard Pentode 5,000Ω to 3Ω .. 5/9
Standard Pentode 7,8,000 to 3Ω .. 5/9
10,000Ω to 3Ω 5/9
Push-Pull 8 watts, EL84, or 6V6 to 3Ω or matched to 1-Ω 9/9
Push-Pull 10-12 watts to match 6V6 or EL84 to 3-5-8 or 15Ω 19/9
Following types for 3 and 15 Ω speakers:
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MIDGET MAINS Primaries 200-250 v. 50 c/s.
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SMOOTHING CHOKES
150 mA, 7-10 H 250 ohms.. .. .. 11/9
100 mA, 10 H 200 ohms 8/9
80 mA, 10 H 350 ohms 5/9
60 mA, 10 H 400 ohms 4/11

CHARGER TRANSFORMERS All with 200-230-250 v. 50 c/s Primaries: 0-9-15 v. 1½ a. 12/9; 0-9-15 v. 2 a. 14/9; 0-9-15 v. 3 a. 16/9; 0-9-15 v. 5 a. 19/9; 0-9-15 v. 6 a. 23/9; 0-9-15 v. 8 a. 28/9.

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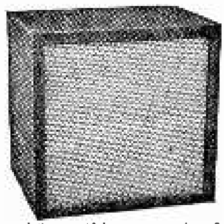

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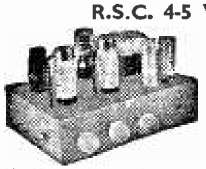

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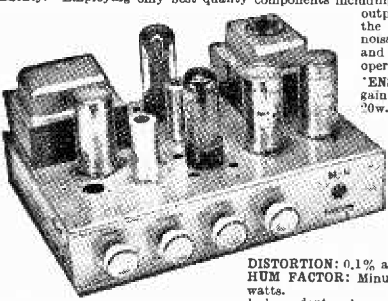

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TRANSMITTER RECEIVERS. "Type 38" with 5 valves. New but untested. No guarantee, 25/- each. Post paid.
ATTACHMENTS FOR "38" TRANSMITTER-RECEIVER; Headphones 15/6; Throat Microphones, 4/6; Junction Boxes, 2/6; Aerials, No. 1, 2/9, No. 2 5/3, Webbing, 4/-; Haversacks, 5/6; Valves—ARP12 4/6. ATP4, 3/6. Set of five valves, 19/-. Postage on each item 1/6 extra (except valves).
TYPE "18" RECEIVING PORTION ONLY with 4 valves. S.W. 6-9Mc/s, 35/- each.
ATTACHMENTS FOR "18" TRANSRECEIVER. Headphones, 15/6; Microphone 4a, 12/6; Aerials, 5/-; Morse Key, 6/6; Valves—ARP12, 4/6, ATP4, 3/6, AR8, 7/6; Set of six valves, 25/-. Official booklet "19" T.R. Circuits, etc., 6/6 post paid. Postage extra (except valves) 1/6 each item.
QUARTZ CRYSTALS. Types F.T. 241/243 2-pin ½in. space.
FREQUENCIES: (F.T.243) 5706 kc/s to 8625 kc/s. **FUNDAMENTAL** (F.T.241) 20 Mc/s to 38.9 Mc/s. (54th and 72nd Harmonics) 4/6 each. Lists available of frequencies stocked.
CRYSTAL BASES. F.T.241, F.T.243, 1/6 each.
CRYSTAL CASES. F.T.241/243. 10/6 per dozen.
DYNAMOTORS for attaching to B.C. SERIES COMMAND RECEIVERS. 28v. D.C. to 250v. D.C. 17/6.
VARIOMETERS for "19" Sets. NEW. 21/- each.
RECORDING BLANKS. New 13in., 6/- each or 15 complete in Tin, £4.
BOMBSIGHT COMPUTERS. Ex-R.A.F. Wealth of gears, motors, blowers, etc. Ideal for experimenters, £3.12.6, carr. paid.
RESISTANCES. 100 Asstd. Useful values, new, 12/6 per 100.
CONDENSERS. 100 Ass. Mica Elec., Tub., etc. New 15/- per 100.
LUFBRA HOLE CUTTERS. Adjustable. ⅞in. to 3½in., 7/9.
VISUAL INDICATORS (10Q4). Type 3 with 2 meter movements, 2 neons. New 12/-.
MAGNETS. Strong Bar, 2in. x ½in., 1/6 each.

POST OR CARRIAGE EXTRA, FULL LIST OF RADIO BOOKS, ETC., 3d.

SOUTHERN RADIO SUPPLY LTD.

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CLYNE RADIO LTD.

THE COMPONENT SPECIALISTS

18 TOTTENHAM COURT ROAD, W.1 — MUSeum 5929/0095
162 HOLLOWAY ROAD, LONDON N.7 — NORth 6295/6/7
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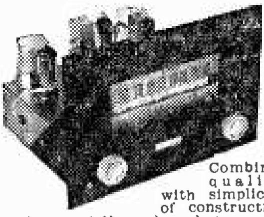
All post orders etc. to 162 HOLLOWAY ROAD, LONDON N.7

A QUALITY F.M. TUNER UNIT TO BUILD YOURSELF!



Combines quality with simplicity of construction (only specially selected top-grade components are used). The refinements provided, and the performance achieved are equal to many commercial models at twice the price. ★ Guaranteed non-drift. ★ Permeability tuning. ★ Freq. coverage 88-100 Mc/s. ★ Self powered using a good quality mains transformer and valve rectifier. ★ Fully drilled chassis. ★ F.M. Tuning Head by famous maker. ★ OA81 Balanced Diode output. ★ Magic-eye tuning indicator. ★ Two I.F. Stages and Discriminator. ★ Attractive maroon and gold glass dial. ★ Valves used: ECC85, two EF80s, EZ80 (rectifier) and magic-eye. ★ Attractive metal front panel as illus. finished in a choice of black crackle, glossy hammer green or grey enamel. ★ Everything supplied down to the last nut and bolt. All parts sold separately.

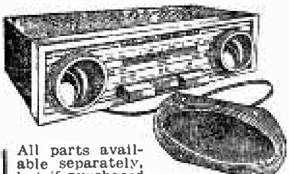
Special inclusive price for all components, full assembly instructions, circuit diagram, etc. **£6.12.6**

Plus 5/- P. & P. Full assembly instructions, etc., available separately if required at 1/6 post free.

The "HIGHWAYMAN"

At last a quality Car Radio to build yourself, at an economical price. Look at these features:—

★ Attractive styling. ★ Push-pull output. ★ 3 latest Mullard transistors plus valves type EBF 83 and ECH 83. ★ No Buzz. High Output and sensitivity. ★ Printed circuit (newest type). 7" x 4" High flux p.m. speaker. ★ Medium and Long Waves. ★ Push Buttons for fingertip control. ★ Extremely low Battery consumption (less than ½ amp). ★ Easy to fit any make car (Positive earth only). ★ 12 volt operation. ★ Compact size measures only 7" x 7" x 2" deep. ★ Easy assembly, supplied with dial and drive already mounted.



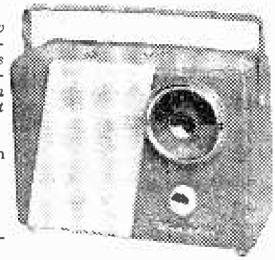
All parts available separately, but if purchased at one time, the whole will be supplied at a special inclusive price of only

£10.19.6 Plus 4/- P. & P.

Parts list and comprehensive instruction booklet 2/6, post free. (Deducted from cost if complete parcel purchased later.)

NEW! NEW! The "CRUSADER"

Our new four transistor plus diode portable with big set quality?



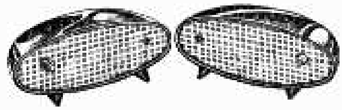
★ Full Medium Wave coverage.
★ Completely self contained.
★ Five inch P.M. Speaker.
★ Genuine high grade Mullard or Ediswan Transistors.
★ New components throughout.
★ Attractive two-tone blue/grey Vynide-covered cabinet size 8 x 5½ x 3½in. with adjustable carrying handle.
★ Eyeletted chassis simplifies construction.
★ Longer life with larger size PP7 battery.

★ SPECIAL FEATURES! ★
SUPPLIED WITH JACK SOCKET FOR DIRECT CONNECTION TO CRYSTAL MICROPHONE FOR USE AS **BABY ALARM WITHOUT ANY MODIFICATION!** ALSO FOR DIRECT CONNECTION TO CRYSTAL PICK-UP FOR USE AS A **GRAMOPHONE AMPLIFIER!** SUPPLIED COMPLETE WITH RECESSED SOCKET FOR DIRECT CONNECTION TO **CAR AERIAL!**

All required components including full instructions, solder, battery, etc. at special inclusive price of **ONLY 95/-** Plus 3/- P. & P.
All parts available separately
Itemised parts list and full assembly instructions 1/6 post free.

THE "BABYCALL"

At last! A Baby Alarm without untidy connecting wires. Can be used anywhere and transferred from room to room at will.

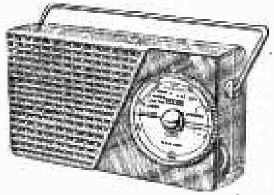


Consisting of two completely separate units—No extra wires or wiring between units—just plug the "receiver unit" into *any* mains socket in the house (or next door) and you will immediately receive "loud and clear" sounds that the remote microphone unit is picking up (from wherever it is plugged into). Operates by using the "house mains wiring" as the connecting link. Completely safe. Each unit is contained in an attractive modern "Slim line" type moulded cabinet. Handsome appearance, with Vynair front panel.
TCC Printed circuit board. TCC Capacitors. No "live" chassis. High flux loudspeaker. Easy to assemble. Dimensions 10" x 4" x 4½" (deep) Each Unit.
Complete Kit of Parts, including instruction booklet at special inclusive price of £5.19.6, plus 3/6 postage and packing. Itemised parts list and full assembly details 1/6, post free.

N.B. This is a non-repeatable offer. Limited quantity only. Purchased complete from manufacturer. Worth Double ! !

NEW! NEW! The "COURTESAN"

Our New 3 transistor plus 2 diode pocket receiver with *full* Medium *and* Long Wave Coverage.



★ No external aerial and earth required.
★ Latest 2½"—75 ohm speaker.
★ First grade Mullard transistors.
★ Condenser tuning.
★ Volume control with on/off switch.
★ Easy assembly on pre-tagged circuit board.
★ Attractive red polystyrene cabinet measures 5¼ x 3¼ x 1¼", chrome handle, attractive gold and black dial.
★ Luxembourg, Hilversum, etc., guaranteed in reception areas.

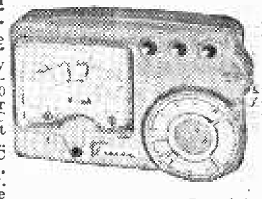
ONLY 63/- Plus 2/6 P. & P.

All parts available separately, itemised parts list and full assembly instructions 1/6, post free.

INEXPENSIVE TEST GEAR

Two Ideal Pocket Instruments for Amateur or Student

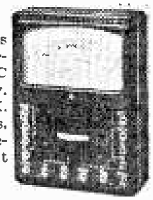
MODEL T11



Size only 3½" x 2¾" x 1¼" Meter Size 1¼" x 1¼" Sensitivity 285 micro-amps —1000 ohms per volt AC/DC DC Current 1,25,250 m/a. DC and AC volts 10,50, 250 1,000 v. Resistance 50 ohm—100 K Battery 1.5 v-U12. Complete with test prods, battery and full instructions.

Outstanding Value at **57/6** Plus 2/6 P. & P.

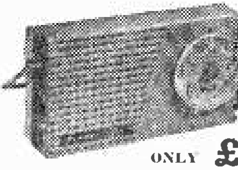
MODEL TK.50



Size 5" x 3½" x 1¼" 1000 ohms per volt. AC/DC. DC Current 1-250 m/a DC and AC volts. 10, 250, 500 and 1000 v. Resistance 0-10K, 0-100K. Complete with test prods, battery and full instructions. Outstanding buy at

63/- Plus 2/6 P. & P.

The "CLYMAX"



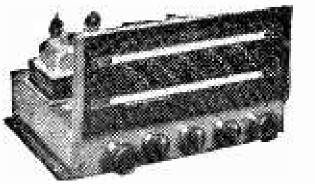
At last a 6-transistor pocket size superhet for Medium and Long Wave at a price you can afford. All required components

ONLY £6.16.6

Nothing more to buy! Plus 3/6 P. & P.

★ Completely self contained. No external aerial or earth required. ★ Full medium wave coverage, plus switched Light programme on Long Wave. ★ Push-pull output—250 milliwatts. ★ Matched set of latest type Mullard transistors. ★ Genuine 3in. P.M. Speaker. ★ High-Q Coils. ★ Ferrite rod aerial with high selectivity. ★ Size: 5½ x 3½ x 1⅞in. Two-tone cabinet. ★ Precision etched printed circuit with components references clearly marked. Alignment service available. All parts available separately. Full assembly instructions and individually priced parts list. 2/- post free.

ARMSTRONG AF208 AM/FM RADIOGRAM CHASSIS



★ Full VHF Band (87-108 Mc/s and Medium Band, 187-570M) ★ 7 Valves ★ 5 Watts Output ★ 15db Negative Feedback ★ Separate wide range Bass and Treble Controls ★ 2 Compensated Pick-up Inputs ★ Frequency Response 30-22,000 c.p.s. ±2db ★ Tape Record and Playback Facilities ★ Continental Reception of Good Programme Value ★ For 3, 7½ and 15 ohm speakers. Send S.A.E. for leaflet.

PRICE **£22.18.0** Carr. Free

LATEST "EMI" 4 SPEED SINGLE RECORD PLAYER

Acos Hi-Fi Pick-up for L.P. and/or 78. 7, 10 and 12in. records. Silent motor, heavy turntable, auto stop. Complete on Baseplate.

Special offer **£6.5.0.** post free.

SINGLE-PLAYER BARGAIN

Ready-built, complete with BSR TU9 4-speed gram pick-up unit. Handsome portable case. 3-watt amplifier with 2 valves and speaker. List price £12.12.0. OUR PRICE £8.19.6. Fully guaranteed in manufacturer's sealed cartons.

New Boxed VALVES 90-day Guarantee

1R5	7/6	6K8G	7/6	EA50	1/6	EZ80	7/6
1S5	7/6	6L6G	10/6	EABC80	8/6	E1148	1/6
IT4	6/-	6N7M	6/6	EB91	6/-	HABC80	12/6
2X2	3/6	6Q7G	8/6	EBC33	8/6		
3S4	7/6	6SA7	6/-	EBC41	8/6	HVR2A	6/6
3V4	7/6	6SJ7M	6/6	EBF80	10/-	MU14	9/-
5U4	7/6	6SN7	6/6	ECC84	9/6	PCC84	9/6
5Y3	7/6	6V6G	6/6	ECF80	9/6	PCF80	9/6
5Z4	9/6	6X4	7/6	ECH42	10/6	PCL82	11/6
6AM6	5/-	6X5	6/6	ECL80	10/6	PEN25	6/6
6B8	5/-	12A6	7/6	ECL82	10/6	PL81	12/6
6BE6	7/6	12AT7	8/-	EF39	5/6	PL82	10/6
6BH6	9/6	12AU7	8/-	EF41	9/6	PY80	7/6
6BW6	9/6	12AX7	8/-	EF50	5/6	PY81	9/6
6D8	6/-	12BE6	8/6	EF80	8/-	PY82	7/6
6F6	7/6	12K7	6/6	EF86	12/6	SP61	3/6
6H6	3/6	12Q7	6/6	EF92	5/6	UBC41	9/6
6J5	5/6	35L6	9/6	EL32	5/6	UCH42	9/6
6J6	5/6	35Z4	7/6	EL41	9/6	UF41	9/6
6J7G	6/6	80	9/6	EL84	8/6	UL41	9/6
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SETS OF VALVES

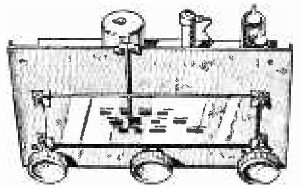
DK96, DF96, DAF96, DL96, 8/6 each or 27/6 set.
1R5, IT4, 1S5, 3S4 or 3V4 19/6
6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5. 27/6
ECH42, EF41, EBC41, EL41, EZ40. 37/6
ECH81, EF89, EBC81, EL84, EZ80. 39/6
12K8, 12K7, 12Q7, 35L6, 35Z4. 35/-

NEW ELECTROLYTICS — FAMOUS MAKES

TUBULAR		TUCULAR		CAN TYPES	
1/350V	2/-	50/350V	5/6	16/450V	5/-
2/350V	2/3	100/25V	3/-	32/350V	4/-
4/450V	2/3	250/25V	3/-	100/270V	5/6
8/450V	2/3	500/12V	3/-	2,000/6V	4/-
16/450V	3/-	8+8/450V	3/6	5,000/6V	5/-
32/450V	3/9	8+16/450V	3/9	32+32/350V	5/-
25/25V	1/9	16+16/450V	4/3	32+32/450V	6/-
50/25V	2/-	32+32/350V	4/6	32+32+32/350V	7/-
50/50V	2/-			50+50/350V	7/-
				64+120/350V	11/6
				100+200/275V	12/6

COMPLETE RADIO £4.19.6 post free

4 Mullard valves, 5in. speaker, frame aerial. 4 pre-set stations. 1 long, 3 med. wave. **Superhet Circuit. BRAND NEW.** Size 9 x 6 x 5½in. high. Tested by us ready for use. 200/250 v. A.C.-D.C. Mains.



DE LUXE MODEL as above but with illuminated dial. Fully tunable over Medium and Long Wave. 5 inch speaker. Bargain £5.19.6, post free. Tested by us before despatch.

MAINS TRANSFORMERS 200/250 v. A.C.

Postage 2/- each transformer.

STANDARD, 250-0-250, 80 mA, 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier 6.3 v. 1 a. 5 v. 2 a. or 4 v. 2 a. 22/6, ditto, 350-0-350 .. 29/6
MINIATURE 200 v. 20 mA, 6.3 v. 1 a. .. 10/6
MIDGET, 220 v. 45 mA, 6.3 v. 2 a. .. 15/6
SMALL, 220-0-220, 50 mA, 6.3 v. 2 a. 17/6
STD., 250-0-250, 65 mA, 6.3 v. 3.5 a. .. 17/6
HEATER TRANS. 6.3 v. 1½ amp. .. 7/6
Ditto, tapped sec. 2, 4, 6.3 v., 1½ amp. 8/6
Ditto, sec. 6.3 v. 3 amp 10/6
GENERAL PURPOSE LOW VOLTAGE, 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24, 30 v. .. 22/6
AUTO TRANSFORMERS, 150 w. .. 22/6
0, 120, 200, 230, 250 v., 500 w. .. 82/6
MULLARD "510" Mains transformer .. 30/-

O.P. TRANSFORMERS. Heavy Duty 50 mA. 4/6. Multiratio, push-pull, 7/6. Ditto, 10 w., 15/6. Miniature, 3S4m etc., 5/9. **L.F. CHOKES** 15/10H. 60/65 mA, 5/-; 10 H. 85 mA, 10/6; 10 H., 150 mA, 14/-.

TELEVISION REPLACEMENT Line Output Transformers from 45/- each, New Stock

and other timebase components
Most makes available
S.A.E. with all enquiries.

FULL WAVE BRIDGE SELENIUM RECTIFIER: 2, 6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a., 17/6. **CHARGER TRANSFORMERS.** Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ amps., 15/6. 2 amps., 17/6; 4 amps., 22/6. Circuit included. **4 AMP CAR BATTERY CHARGER** with ampmeter Leads, Fuse Case, etc., for 6 v. or 12 v., 69/9.

BOOKS list S.A.E.

40 Circuits for Germanium Diodes 3/-
"W.W." Radio Valve Data, 6/-.
High Fidelity Speaker Enclosure, 5/-
Valve and TV Tube Equivalents, 9/6
TV Fault Finding, 5/-.
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Radio Valve Guide. Books 1, 2, 3 or 4, 5/- each.
Transistor Superhet Receivers, 7/6.
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Master Colour Code Chart, 1/6.
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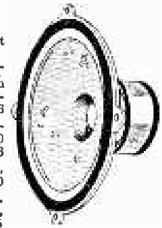
C.R.T. BOOSTER TRANSFORMERS

For Cathode Ray Tubes having heater cathode short circuit and for C.R. Tubes with failing emission. Full instructions supplied.
Type A. Optional 25% and 50% Boost. 2V or 4V or 6.3V or 10.8V or 13.3V. Mains input. 12/6

LOUDSPEAKER P.M. 3 OHM. 2½, 3, 4.in, 19/6 5in. Rola, 17/6; 8in. Plessey, 19/6; 7in. x 4in. Rola, 18/-; 6½in. Rola, 18/6; 10 x 6in. 27/6; 10 in. Rola/30/-; 4in. Tweeter, 25/-; 12in. R.A. 30/-; 13½ x 8in., 45/-.
STENTORIAN HF1012. 10in. 3-15 ohms, 10 w., 95/-

BAKER SELHURST LOUDSPEAKERS

Details S.A.E.



12in. Baker 15w. Stalwart 3 or 15 ohms, 45-13,000 c.p.s. 90/-
12in. Baker Stalwart, Foam Suspension, 15 ohms, 40-13,500 c.p.s. .. £6
12in. Stereo, Foam Suspension, 12w., 35-16,000 c.p.s. £6.17.6
12in. Baker Ultra Twelve, 20 c.p.s. to 25 kc/s. £17.10
15in. Auditorium, 35 w.. Bass. 20 c.p.s. to 12 kc/s, £15

TWIN GANG TUNING CONDENSERS. 365 pF, miniature 1in. x 1½in. x 1¾in., 10/-. 500pF Standard with trimmers, 9/-; midget, 7/6; with trimmers, 9/-
SMALL 3 gang 500 pF, 17/-.
SINGLE 25 pF, 50 pF, 75 pF, 100 pF, 160 pF, 5/6. Solid dielectric 100, 300, 500 pF, 3/6.

CONDENSERS. New stock. 0.001 mfd. 7 kV; T.C.C., 5/6; Ditto, 20 kV, 9/6; 0.1 mfd., 7 kV, 9/6. Tubular 500 v. 0.001 to 0.05 mfd., 9d., 0.1, 1/-; 0.25, 1/6 0.5/500 v., 1/9. 0.1/350 v., 9d. 0.1/2,000 v. 0.1/1,000 v., 1/9; 0.1 mfd., 2,000 volts, 3/6.

CERAMIC CONDS. 500 v. 0.3 pF to 0.01 mfd., 9d. **SILVER MICA CONDENSERS.** 10% 5 pF to 500 pF, 1/-; 600 pF to 3,000 pF, 1/3. Close tolerance (± 1 pF) 1.5 pF to 47 pF, 1/6. Ditto 1% 50 pF to 815 pF, 1/9; 1,000 pF to 5,000 pF, 2/-.

465 kc/s SIGNAL GENERATOR **Total cost 15/-.** Uses B.F.O. Unit, ZA 30038 ready made. **POCKET SIZE** 2½ x 4½ x 1in. Slight modifications required, full instructions supplied. Battery 8/6 extra 69V 1½V. Details S.A.E.

Wavechange Switches. 2 p. 2-way long spindle, 3/6; 8 p. 4-way 2 wafer, long spindle, 6/6; 2 p. 6-way, 4 p. 2-way, 4 p. 3-way, long spindle, 3/6; 3 p. 4-way, 1 p. 12-way, long spindle, 3/6.

Wavechange "MAKITS". Wafers available: 1 p. 12 wafer, 2 p. 6 wafer, 3 p. 4 wafer, 4 p. 3 wafer, 6 p. 2 wafer, 1 wafer, 8/6; 2 wafer, 12/6; 3 wafer, 16/-; additional wafers up to 14, 3/6 each extra.

Toggle Switches, s.p., 2/-; d.p., 3/6; d.p.t.d., 4/-. Ex. Govt. s.p.d.t., 1/-.

CRYSTAL MIKE INSERT
6/6
Precision engineered.
Size only 1½in. dia. x ¼in.

ACOS 39-1 DE LUXE STICK MIKE 35/-

Valveholders. Pax. int. oct., 4d. EA50 6d. B12A, CRT, 1/3. Engl. and Amer. 4, 5, 6 and 7 pin, 1/-. MOULDED Mazda and int. oct., 6d.: B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6. B9A with can, 1/9. Ceramic EF50, B7G, B9A, int. oct., 1/-. 7BG, B9A cans. 1/- each.

THE ORIGINAL
RADIO COMPONENT

Our written guarantee with every purchase.

Bus 133 or 68 pass door
S.R. Station Selhurst

Volume Controls

Long spindles. Midget 5 K ohms to 2 Meg. No. Sw. D.P.Sw. 3/- 4/6 Linear or Log Tracks.

80 ohm CABLE COAX

Semi-air spaced ¼in. Stranded core. 40 yds. 17/6 60 yds. 25/- **6d.yd.**

Fringe Quality Air spaced. **1/- yd.**

TELESCOPIC CHROME AERIALS. 13in. extending to 43in., 8/6 ea. Coax Adaptor Plug, 1/6 extra.
TRIPLEXERS Bands I, II, III 12/6
COAX PLUG .. 1/- **LEAD SOCKET**.. 2/-
PANEL SOCKETS 1/- **OUTLET BOXES** 4/6
BALANCED TWIN FEEDER yd. 6d. 80 or 300 ohms.
DITTO SCREENED per yd. 1/6. 80 ohms only.
WIRE-WOUND POTS. 3 WATT. Pre-set Min. TV Types. All values 10 ohms to 25 K. 3/- ea. 30 K., 50 K., 4/-. (Carbon 30 K. to 2 meg., 3/-).
WIRE-WOUND 4 WATT Pots. Long spindle. Values, 50 ohms to 50 K., 6/6; 100 K., 7/6.
PHILIPS TRIMMERS, 0-10 pF, 3-30 pF, 1/-.
TRIMMERS, Ceramic. 30, 50, 70 pF, 9d.; 100 pF, 150 pF, 1/3; 250 pF, 1/6; 500 pF, 750 pF, 1/9.
TRIMMER, 1000 pF, with knob, 2/-.
RESISTORS. Preferred values. 10 ohms to 10 meg., ¼ w., 4d.; ½ w., 4d.; 1 w., 6d.; 1½ w., 8d.; 2 w., 1/-.
HIGH STABILITY. ½ w., 1%, 2/-. Preferred values. 10 Ω to 10 meg. Ditto 5%, 100 Ω to 5 meg., 9d.

	WIRE-WOUND RESISTORS 25 ohms—10,000 ohms	
5 watt		1/3
10 watt		1/6
15 watt		2/-
12.5K to 50K 10 w	.. ..	3/-

AMERICAN "BRAND FIVE" PLASTIC RECORDING TAPE

			Spare Plastic Reels
Double Play	7in. reel, 2,400ft.	60/-	
	5in. reel, 1,200ft.	37/6	
Long Play	7in. reel, 1,800 ft.	35/-	3in. 1/6
	5¾in. reel, 1,200ft	23/6	4in. 2/-
	5in. reel, 900ft.	18/6	5in. 2/-
Standard	7in. reel, 1,200ft	25/-	5¾in. 2/-
	5in. reel, 600ft	16/-	7in. 2/6

"Instant" Bulk Tape Eraser and Head Defluxer. 200/250 v. A.C.. 27/6.

CRYSTAL SET BOOKLET, 1/-.
CRYSTAL DIODE G.E.C., 2/-. **GEX34**, 4/-. **OA81**, 3/-.
HIGH RESISTANCE PHONES. 4,000 ohms, 15/- pr.
SWITCH CLEANER. Fluid squirt spout, 4/6 tin.

HIGH GAIN TV PRE-AMPLIFIERS BAND I B.B.C.

Tunable channels 1 to 5. Gain 18db. ECC84 valve. Kit price **29/6** or **49/6** with power pack. Details **6d.** (PCC84 valves if preferred.)
BAND III I.T.A.—Same prices. Tunable channels 8 to 13. Gain 17dB.

Paxolin Panels, 10 x 8 in., 2/-.
Miniature Contact Cooled Rectifiers. 250V 50mA, 7/6; 250V 60mA, 8/6; 250V 85mA. 9/6; 200mA, 21/-; 300mA. 27/6.
TV etc., Silicon Sub-Min. Rectifier. 125V. 300mA. 6/6; 250V, 300mA. 14/6.
Selenium Rect. 300V 85mA. 5/-.
Coils Wearite "P" type, 3/- each.
Osmor Midget "Q" type, adj. dust core, from 4/- each. All ranges.
Teletron D.W.R. L. and Med. T.R.F. with reactions. 4/- Med wave D.R. 3/6.
Ferrite Aerials, M., 8/9; M. and L., 12/6.
Osmor Ferrite Rod Aerials. L. and M. for transistor circuits, 10/- each.
Ferrite Rods, 8 x ⅜in., 3/-; 8 x 5/16in., 3/-.
H.F. Chokes. 2/6. **Osmor QC1.** 6/9.
T.R.F. Coils, A/HF, 7/- pair: HAX, 3/-, Repanco DRR2. 4/-. DRX1. 2/6.
Radio Screwdriver, 5in., 6d.
Neon Mains Tester Screwdriver, 5/-
Solder Radiograde, 4d. yd., ½lb. 5/-
Black Crackle Paint. Air drying, 3/- tin.

Aluminium Chassis, 18 s.w.g. Plain undrilled, 4 sides, riveted corners, lattice fixing holes, 2½in. sides, 7 x 4in. 4/6; 9 x 7in., 5/9; 11 x 7in., 6/9; 13 x 9in.. 8/6; 14 x 11in., 10/6; 15 x 14in., 12/6; 18 x 16 x 3in., 16/6.
Aluminium Panels, 18 s.w.g., 12 x 12in. 4/6; 14 x 9in., 4/-; 12 x 8in., 3/-; 10 x 7in., 2/3, 8 x 6in., 2/-.

6 TRANSISTOR RADIO MED. & LONG WAVE KIT

First class components to make a 6 transistor 2 wave band superhet chassis. Ideal for portable or table radio. All parts including BVA transistors ferrite aerial, printed circuit, 8¼in. x 2¾in., but EXCLUDING speaker and cabinet. P. & P. 2/6. Simple instructions 1/6 (Free with kit).
Speakers, 35 ohm, 7 x 4in. 25/- extra or 3¼in. round 19/6 extra. **£4.5.0**

TV Plug-in "V" Aerial 16/6

JACKS. English open circuit, 2/6. Closed circuit, 4/3. Grundig type, 3 pin, 1/3.
JACK PLUGS. English, 3/-; Screened, 4/-. Grundig, 3 pin, 3/6.
Wirewound Ext Speaker Control, 10 Ω 3/-.
ALADDIN FORMERS and cores, ¼in., 8d.; ⅜in., 10d. 0.3in. **FORMERS** 5937 or 8 and cans TV1 or 2, ⅜in. sq. x 2½in. or ½in. sq. x 1½in., 2/- with cores.
SLOW MOTION DRIVES. 6:1, 2/3.
SOLON IRON, 25W, 200V or 230V, 24/-.

JASON FM TUNER COIL SET.

29/-. H.F. coil, aerial coil, oscillator coil, two i.f. transformers 10.7 Mc/s, detector transformer and heater choke. Circuit and component book using four 6AM6, 2/6. **Complete Jason FMT.1 Kit.** Jason chassis with calibrated dial, components and 4 valves, £6.5.0.

MAINS DROPPER. 3 x 1¼in. With adjustable sliders. 0.3A, 1,000 ohms, 4/3; 0.2A, 1,000 ohms, 4/3.
LINE CORD. 0.3A 60 ohms per foot, 0.2A 100 ohms per foot, 2-way, 1/- per foot; 3-way 1/- per foot.
MIKE TRANS. 50-1, 3/9; 60:1, potted, 10/6.
P.V.C. Conn. Wire, 8 colours, single or stranded, 2d. yd. Sleeving, 1.2mm, 2d.; 4mm, 3d.; 6mm. 6d. yd.
SPEAKER FRET. Gold cloth, 17 x 25in., 5/-; 26 x 35in., 10/-. **Tygan**, various colours, 52in. wide, from 10/- ft.; 26in. wide, from 5/- ft. Samples, S.A.E. Expanded Metal, Gold, 12 x 12in., 6/-.

I.F. TRANSFORMERS 7/6 pair

465 kc/s slug tuning miniature can 1¾ x ¾ x ¾in. High Q and good band width. Data sheet supplied.

"REGENT" 4 VALVE

"96" RANGE VALVES

KIT PRICE **£6. 6. 0.** carr. 4/-

PRINTED CIRCUIT BATTERY PORTABLE KIT

Medium and long wave. Powerful 7 x 4in. high Flux Speaker. T.C.C. Printed Circuit and condensers. Components of finest quality clearly identified with assembly instructions. Osmor Ferrite Aerial Coils. Rexine covered attache case cabinet. Size 12in. x 8in. x 4in. Batteries used B126 (L5512) and AD35 (L5040). 10/9 extra. Instructions 9d. (free with kit).

MONARCH RECORD PLAYER

The Brilliantly Successful *Monarch* World's finest 4-speed Autochanger

BUILD IT YOURSELF using **4-SPEED BSR MONARCH AUTOCHANGER READY BUILT 3W. AMPLIFIER, HANDSOME PORTABLE CASE. HIGH FLUX LOUD-SPEAKER. FULL INSTRUCTIONS SUPPLIED.**
Total Price **£12.10.0**
Carr. and ins. 5/-.

RECORD PLAYER BARGAINS

Post 2/- each

4 Speed Autochangers:	
Collaro C60	£7.19.6
BSR, U.A.14	£7.10.0
BSR, U.A.12, Stereo/Mono ..	£8.5.0
Garrard "Autoslim"	£7.19.6
4 Speed Single Players:	
Garrard Mk. II	£8.0.0
Model 4SP	£6.17.6
Garrard 4 HF Transcription	£17.19.6

Garrard Stereo Heads £2 extra.
All Sapphire Stylii available from 6/-.

ARDENTE TRANSISTOR TRANSFORMERS

Type D3035, 7.3 CT: Push Pull to 3 ohms for OC72, etc., 1 x ¾ x ⅝in., 9/6.
Type D3034, 1.75 : 1CT. Push Pull Driver for OC72, etc., 1 x ¾ x ⅝in., 9/6.
Type D3058, 11.5 : 1 Output to 3 ohms for OC72, etc., 1 x ¾ x ⅝in., 9/6.
Type D167, 18·2 : 1 Output to 3 ohms for OC72, etc., ¾ x ½ x ⅝in., 12/-.
Type D239, 4.5 : 1 Driver Transformer, ¾ x ½ x ⅝in., 10/-.
Type D240 8.5 : 1 Driver Transformer, ¾ x ½ x ⅝in., 10/-.

ARDENTE TRANSISTOR VOLUME CONTROLS

Type VC1545, 5K with switch, dia. 0.9in., 8/-
Type VC1760, 5K with switch, dia. 0.7in., 10/6
Deaf aid ear piece xtal or magnetic. 7/6.

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COILS AND TRANSFORMERS FOR A 2-WAVE TRANSISTOR SUPER-HET WITH PRINTED CIRCUIT AND FERRITE ROD AERIAL

Long and Medium Wave Aerial—RA2W. On 6in. rod, 7/16in. diameter, 208pF tuning. 12/6.
Oscillator Coil P50/1AC. Medium wave. For 176pF tuning, 5/4.
1st and 2nd I.F. Transformers—P50/2CC. 470 kc/s, 11/16in. dia. by ⅞in. high, 5/7.
3rd I.F. Transformers—P50/3CC, to feed diode detector, 6/-. Spare Cores 6d. each.
Driver Transformer—LFDT2. 1 5/16 x ¾ x 1⅛in., 9/6.
Printed Circuit—PCA1. Size 2¾ x 8¼in. Ready drilled and printed with component positions, 9/6.
7 x 4in., 35 ohm Speaker, 25/-.
3¼in. round 35 ohm speaker. 19/6.
These components are approved by transistor makers and performance is guaranteed.
Constructor's Booklet 2/-.

NEW MULLARD TRANSISTORS

Audio OC71 6/- R.F. OC44 8/9
OC72 7/6 OC45 8/6

Sub-miniature Electrolytics (15V). 1µF, 2µF, 4µF, 5µF, 8µF, 16mfd. 25µF, 50µF, 100µF, 2/6. Diodes OA70, OA81, 3/-. GEX34, 4/-.

B.B.C. Pocket 2 Transistor. M.W. and L.W. Radio Kit, 22/6. Phones 7/6 or deaf aid earpiece, 7/6. Batt. 2/3.

"P.W." POCKET 6 TRANSISTOR KIT MK.II WITH LATEST OSMOR MODIFICATIONS. ALL PARTS, PRINTED CIRCUIT AND NEW CABINET, OSMOR DESIGNED KIT, £8.15.0.

COMPONENT SHOP SPECIALISTS

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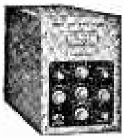

SB-10U

SINGLE SIDEBAND ADAPTOR, Model SB-10U. May be used with most AM transmitters. Less than 3 w. R.F. input power required for 10 w. output. Operation on 80, 40, 20, 15 and 10 m bands on USB, LSB or DSB £37.6.0

THE "MOHICAN" GENERAL COVERAGE RECEIVER. Model GC-1U. Fully transistorised, including 4 piezo-electric transfilters. The very latest and an excellent portable or general purpose receiver for the Amateur and short-wave listener £38.15.0


GC-1U

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

VAR. FREQ. OSCILLATOR. Model VF-1U. Calibrated 160-10 m. fundamentals 160-40 m. Ideal DX-40U and similar transmitters £11.2.0

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

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

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

PORTABLE SERVICE OSCILLOSCOPE. Model OS-1. Compact portable scope ideal for servicing and general work. Y amplifier sensitivity 10 mV/cm; response. 3 dB 10 c/s-2.5 Mc/s. Time base 15 c/s-150 kc/s. Printed circuits. Case 7⅞ x 4¾ x 12½in. long. Wt. only 10½ lb. £19.10.0

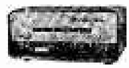
5in. OSCILLOSCOPE. Model O-12U. Wide-band amplifiers essential for TV servicing. F.M. alignment etc. Vertical freq. response 3 c/s-5 Mc/s without extra switching. T/B covers 10 c/s-500 kc/s in 5 ranges £36.10.0

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

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

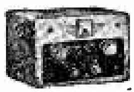
HI-FI EQUIPMENT CABINETS. Range available to meet various needs. Details on request. (MALVERN equipment cabinet illustration bottom left) from £11.12.6 to £18.10.0

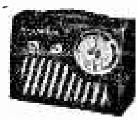
GRID DIP METER. Model GD-1U. Coverage from 1.8 Mc/s to 250 Mc/s. Complete set of plug-in coils provided £10.9.6

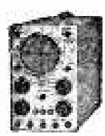

F.M. TUNER


S.33


S.88


DX-40U


UXR-1


OS-1


SSU-1

AMATEUR TRANSMITTER. Model DX-100U. Covers all amateur bands. 160-10 m. 150 w. D.C. input. Self contained including power supply. Modulator, V.F.O. (illustration bottom right). £71.10.0

SHORTWAVE TRANSISTOR PORTABLE. Model RSW-1. Two short bands, trawler and medium £21.6.0

6-TRANSISTOR PORTABLE. Model UXR-1. Prealigned I.F. transformers, printed circuit, 7 x 4in. high flux speaker. Real hide case ... £14.3.0

HI-FI F.M. TUNER. Tuning range 88-108 Mc/s. Tuning Unit (FMT-4U) with 10.7 Mc/s I.F. output (£3.2.0 inc. P.T.) I.F. Amplifier (FMA-4U) complete with cabinet and valves (£11.11.0). Total £14.13.0

6-W STEREO AMPLIFIER. Model S-33. 3 w/chl. inputs for radio/tape and gram., Stereo or Mono, ganged controls. Sensitivity 200 mV. ... £12.8.6

HI-FI 16W STEREO AMPLIFIER. Model S-88. 20 mV basic sensitivity (4 mV model available, 7/6 extra). Ganged controls. Stereo/Mono gram.. radio and tape recorder inputs. Push-button selection. Two-tone grey metal cabinet £26.12.6

TRANSCRIPTION RECORD PLAYER. Model GL-58. Goldring—Lenco four speed unit. G.60 pick-up arm and infinitely variable speed adjustment between 33 and 80 r.p.m. with fixed speed at 16 r.p.m. Balanced turntable (3½ lb.). Stereo ... £19.12.6

HI-FI SPEAKER SYSTEM. Model SSU-1. Ducted-port bass reflex cabinet "in white". Twin speakers. Pedestal model £11.15.0. Bookcase model £10.14.0

"COTSWOLD" HI-FI SPEAKER SYSTEM. Acoustically designed enclosure "in the white". 26 x 23 x 15½in. 12in. bass speaker with 2in. speech coil, elliptical middle speaker. Pressure unit covers the full freq. range of 30-20,000 c/s., complete with cross-over unit, level control, etc. ... £21.19.0

COMPLETE MATCHED STEREO OUTFIT. Includes RP-1U record player, S-33 amplifier and twin SSU-1 speaker systems. (Pedestal speaker legs optional £2.2.0) £44.9.0

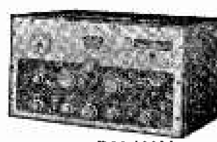
STEREO CONTROL UNIT USC-1. Luxury model with press-button inputs to suit any pick-up or tuner and most tape-heads. Output 1.3 v. R.M.S. per channel. Printed circuit construction ... £18.18.6


MALVERN

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

"PACKAGED DEALS" of Hi-Fi equipment including TAPE DECKS, RECORD PLAYERS and DECCA ffss PICK-UPS.

STEREO HEAD PREAMPLIFIER USP-1. Ideal for boosting tape-head output and low output pick-ups (e.g. Decca ffss) £6.17.6


DX-100U

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Practical Wireless

Vol. XXXVIII No. 665 JULY, 1962

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Contents

TRANSISTOR SETS

THE word "transistor" has acquired a particular meaning in the lay mind—to the radio enthusiast and the technically knowledgeable, it means a semiconductor device, but to the man in the street it stands for any form of miniature radio receiver. Over the past few years, the use of these small receivers has grown enormously and has certainly revived interest in sound radio; nowadays, it appears to be the "done thing" to have at least one transistor set (or "transistor"). Naturally, as time goes on these receivers are being continually improved in running costs, sensitivity, and more particularly in the volume of sound which they will produce. In fact, some sets give so much output that they are considered objectionable; it was last summer when objections to the invasions of privacy by sounds from portable radios reached their height and several towns passed bye-laws prohibiting the playing of portable radio receivers in public places. In London, buses carried notices pointing out that the operation of portable receivers could not be permitted.

The bye-laws and the notices in public places gradually seemed to take effect last year, and, late in the summer, it was rare to hear portable sets playing in the open air. However, no doubt many more receivers have been bought this year, and to their owners they will still be novelties. This seems to us to be the main reason for the annoyance caused by these sets; their owners play them in many instances not because they are interested in or really require to hear the programmes, but because they are using a new gadget. For the radio enthusiast who builds his own portable receiver, the same sort of problem does not arise since he is accustomed to such circuits and they have no novelty value for him.

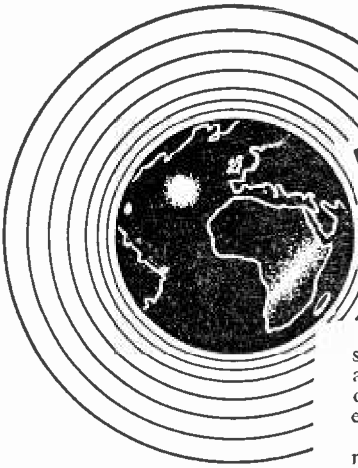
It is to be hoped that as transistor radios become even more commonplace, their indiscriminate use will be reduced. Unless this happens, more definite steps must certainly be taken to discourage the playing of portable receivers in public places.

THE PILKINGTON COMMITTEE

At the annual conference in Bournemouth of the Radio and Television Retailers' Association, an attack was made on the Pilkington Committee by several speakers. In the words of one, "the delay of its report was enough to put any industry on the rocks", and another speaker said that the Postmaster-General must act swiftly when the Committee reported—"any further delay in forming a clear policy would be disastrous to the industry".

Whether or not commercial broadcasting will be introduced is not known at the time of writing, nor has any hint been given of the future of sound broadcasting in this country. With all committees, reports take a long time to produce since often it is difficult for members of the committee to meet sufficiently regularly; however, in view of the very urgent nature of the problems which the Pilkington Committee was set up to investigate, the opinion is widely held that the final report should have been made sooner or that an interim report should have been issued.

Our next issue dated August, will be published on July 6th.



ROUND THE WORLD of WIRELESS

NEWS AT HOME AND ABROAD

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of March, 1962, in respect of wireless receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland. The numbers include Licences issued to blind persons without payment.

Region	*Total*
London	644,942
Home Counties	599,079
Midland	432,793
North Eastern	463,909
North Western	398,851
South Western	353,924
Wales and Border Counties	204,995
Total England and Wales	3,098,493
Scotland	332,583
Northern Ireland	107,431
Grand Total	3,538,507

New Technical and Programme Facilities for Broadcasting House

THE BBC's new eight-floor Broadcasting House extension, occupying some 1¼ acres in Portland Place, London, contains a number of new and improved technical and programme facilities in addition to extensive and much needed office accommodation.

A large modern Control Room has been built which is now the BBC's main London Control Room for sound broadcasting where the Home, Light and Third Programmes and Network Three are assembled. For this, a range of specialised equipment such as control desks, amplifiers, and switching systems has been designed and installed by BBC engineers.

The various sections of the new Control Room were brought into operation progressively. The most careful planning and execution of the transfer of the connections of some 900 lines was necessary to ensure the smooth changeover of facilities from the old Control Room without interruption to any of the services. In this, BBC engineers, with the close co-operation of Post Office engineers, were able to provide the circuits to the new Control Room as and when required.

The extension building also contains a new television switching centre which is the focal point for the vision circuits of the BBC television distribution network feeding regional studio centres and transmitting stations throughout the country.

As a final stage in these developments, work has started on the construction of new sound studios on the basement floor of the extension building and it is proposed also to provide a television news interview studio in this area. The sound studios will include two drama suites as well as general purpose talks and discussion studios.

Cabling for Railway Colourlight Signalling System

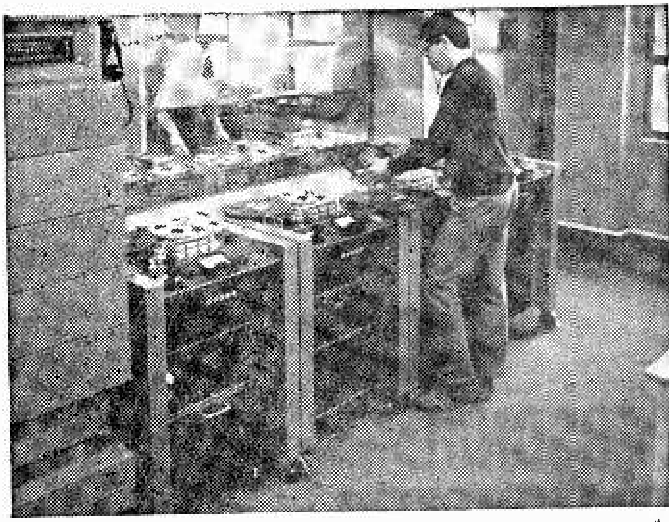
A CONTRACT to supply and install cable as part of the colourlight signalling system now being installed by AEI-GRS Ltd. for the London Midland Region of British Railways has been awarded to the Con-

The sound control room of the new Broadcasting House extension in London. This room houses the Technical Operations Supervisor's desk (on the right) and the Main Control desk.

struction (Cables and Lines) Division of Associated Electrical Industries Ltd.

The contract will involve the supply, installation and termination of more than 100 miles of twin 660V cable and multi-core 250V cable. The cable will be laid alongside the railway track between Colwich and Rugby and will provide the power for the signalling and route interlocking system.

The cable is to be produced by AEI Cable Division and will be manufactured at its Lydbrook, Gloucestershire, factory.



Four of the fifteen remotely-controlled machines for recording news despatches in the new Broadcasting House extension.

"Call Nurse" Equipment for Harlow New Town Hospital

A CONTRACT for patients' communication system in Harlow New Town Hospital has been placed with Hadley Telephone and Sound Systems Ltd.

The contract forms part of the hospital's construction programme, which provides for 169 beds in a maternity wing and general ward block.

The Hadley equipment to be installed will include the "call nurse" patient-to-nurse visual and sound signalling system, and this will be the first major installation to use the new multi-service unit, which can be held easily in the patient's hand and which provides at a touch a micro-speaker and nurse-calling push button, a radio programme selector switch, volume control and an over-bed light switch. In the Harlow hospital the units will give five-channel radio—BBC Home and Light programmes, sound for BBC and Independent Television and a channel for hospital internal broadcasting.

Mullard maser for GPO Satellite Communication Ground Station

A TRAVELLING wave maser amplifier designed and built by scientists at Mullard Research Laboratories was installed recently at the GPO Satellite Communication Ground Station at Goonhilly Downs, Cornwall.

Operating at 4170Mc/s, the maser will be used in the first stage of the receiver to amplify signals relayed across the Atlantic via the communications satellite Telstar, expected to be launched in June from Cape Canaveral.

Because of its ability to amplify without introducing appreciable noise the maser enables the power of the satellite transmitter — and consequently the payload requirements of the launching rocket—to be reduced so that this form of communication becomes practicable.

The signal applied to the maser input is expected to be of the order of 10^{-12}W or even less. Conventional, thermionic devices if used to amplify a signal of this small magnitude would produce an unacceptably high noise level. However, the maser behaves as a virtually noiseless amplifier since it operates at a very low temperature (in the present case about 2°K—i.e., −271°C) and, moreover, does not depend for its operation on an electron beam. To maintain it at the required temperature the device is immersed in liquid helium.

Radar Display Units

THIRTY radar displays, type 3A, manufactured in RCA Great Britain Ltd.'s Sunbury-on-Thames factory to Ministry of Aviation specifications, are being supplied as a part of the 10 fully transistorised Solartron radar simulator systems for the Royal Swedish Air Force.

The type 3A radar display is a general compatibility radar display utilising a 12in. tube and housed in a rectangular "table top" cabinet. It has a maximum/minimum range display ratio of 6:1 with a minimum range of 10 nautical miles. It can be used as a display for radar equipment operating in any band and for radar simulators.

Private Automatic Telephone Exchange

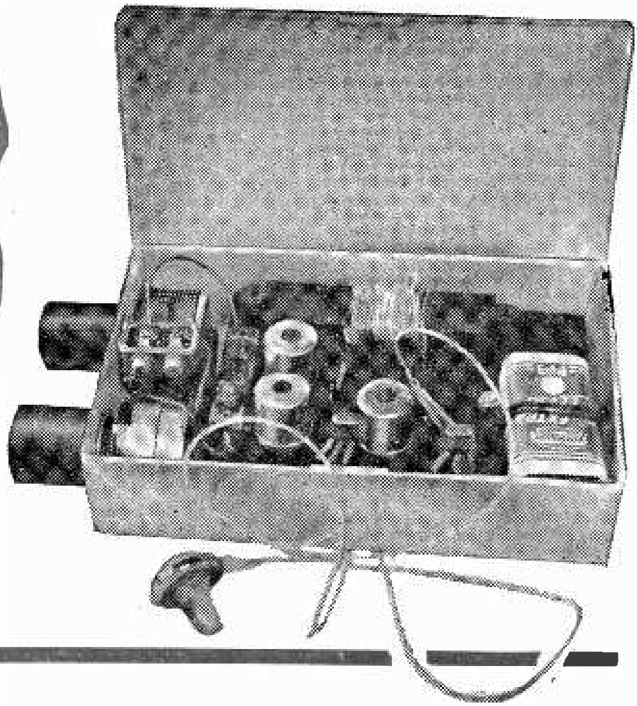
A PRIVATE automatic branch telephone exchange for export only and of particular value to small business concerns overseas where an inexpensive and reliable communication system is required, has been introduced by telecommunications division of Associated Electrical Industries Ltd. The equipment will provide nine internal extensions and three lines to the local exchange.

The essential feature of the system is that the manual operator normally required to receive incoming exchange calls is no longer necessary since all incoming calls are routed to one or more selected extensions.

Automatic transfer facilities enable the exchange caller to be transferred from one extension to another in the same system if required. Outgoing calls via the public exchange can be dialled directly from any extension, and all internal calls are automatically connected by dialling. In the event of a power failure each exchange line is automatically connected to a selected extension.

The P.W. Alpha 3

PERSONAL TRANSISTOR SUPERHET



INDIVIDUAL listening with earphones, a single earpiece, or a miniature "personal" phone makes quite sure that others are not disturbed, and this type of reception is often very convenient. The set described here is for this purpose and has the control knobs at one end of the case so that the completed receiver will easily slip into a pocket.

The case holds a "personal" type of earphone, so that the whole set is self-contained. If a pair of headphones with two earpieces is preferred this is quite in order. A lightweight pair of earphones can give very good results indeed with very good quality reproduction. A single headphone, attached to a length of thin twin flex, could also be used.

Circuit

The receiver is a superhet and the circuit is shown in Fig. 1. A home-wound ferrite slab

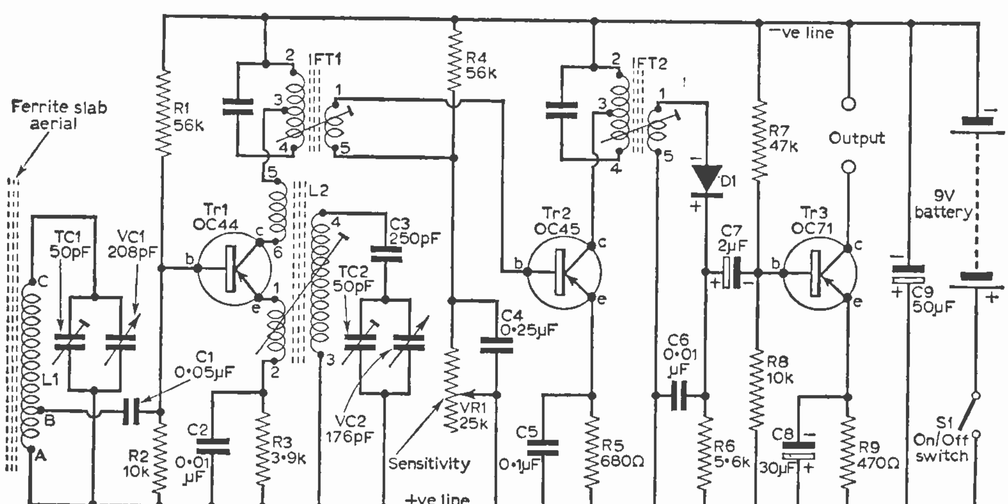
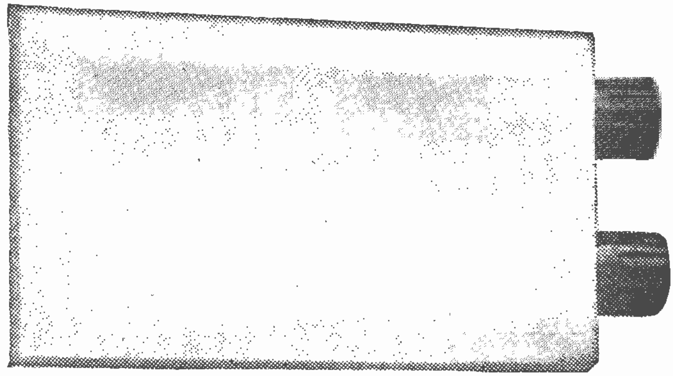


Fig. 1—The circuit of the receiver.

aerial tunes medium waves, but a ready-made rod or slab aerial would be equally satisfactory. The circuit is simplified and has one I.F. stage, followed by the diode detector and an audio amplifier. A 25k potentiometer, with switch, acts as sensitivity control. The circuit is for use with a 6V to 9V battery and a small 9V battery such as the PP3 will have a long life. Selectivity is very much better with this type of circuit than with the simple type of TRF receiver which is often employed for headphone reception.



The receiver in its closed case.

The receiver fits in a plastic box approximately 3½in. x 6in. x 1¾in. (outside dimensions). This allows sufficient free space to make construction easy. Holes are drilled at the end of the box to take the tuning condenser and potentiometer. The condenser is fixed with short 4B.A. bolts, a washer or two being placed between box and condenser if necessary. About two washers will also be needed between the potentiometer and box. The spindle is sawn off to match the length of the condenser spindle. This can most readily be done while holding the *unwanted* end of the spindle in a vice.

Aerial

The ferrite slab is 3in. x ¾in. x ⅛in. and fits in slots filed in two pillars of insulating material, as in Fig. 2. These pillars can be of wood, solid ebonite or similar material, or they may be cut from insulated tubing. Solid pillars will need drilling to take the securing screws. These screws should be short. Metal pillars or any form of metal brackets are not recommended.

For the winding, 26s.w.g. DCC copper wire can be used and is easy to handle. Beginning at point "A", twelve turns are wound on in a compact pile. The wire is then bared for a short distance and twisted to form a connecting point for the lead "B"; then 46 more turns are wound on, forming them into a pile as winding progresses. The whole winding of 58 turns is 1in. long and near the centre of the slab.

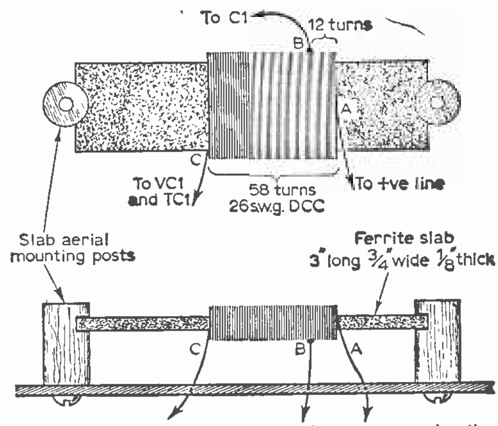
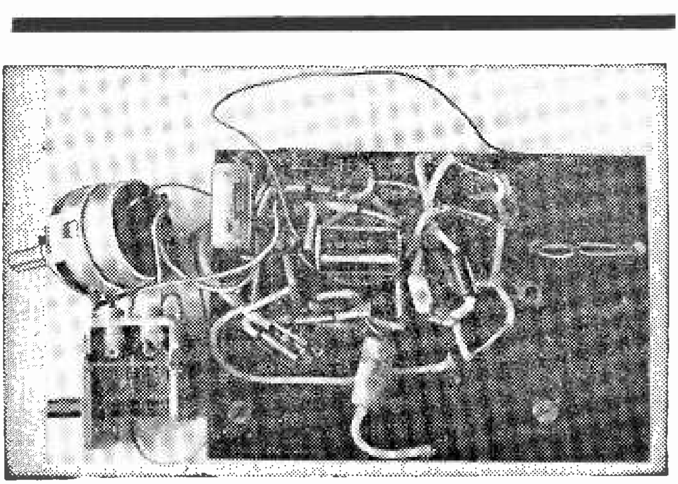


Fig. 2—The aerial winding and mounting details.

Satisfactory alignment is achieved by adjusting the oscillator coil core to suit the inductance of the aerial winding, which is fixed. If the winding is held together with Sellotape it can be moved along the slab, if needed, when first testing the receiver.

If a ready-made aerial is used it may have a separate base coupling winding. If so, connect this winding from the 0·05μF condenser (C1) to the "earth" line. The larger winding is wired to the tuning condenser in the usual way.



The receiver panel when the wiring is nearing completion.

Receiver Panel

This is approximately 3¼in. x 4½in., so that it fits in the case with a little clearance, and it is cut from $\frac{1}{16}$in. paxolin. It is placed in the case and a 4B.A. clearance hole is drilled through both panel and case in the position shown for the

COMPONENTS LIST

Resistors:

R1 56k
R2 10k
R3 3·9k
R4 56k
R5 680Ω
R6 5·6k
R7 47k
R8 10k
R9 470Ω
VR1 25k with s.p. switch

Capacitors:

C1 0·05μF
C2 0·01μF
C3 250pF
C4 0·25μF
C5 0·1μF
C6 0·01μF
C7 2μF 6V
C8 30μF 6V
C9 50μF 9V

VC1, VC2 208, 176pF tuning capacitor with two 50pF trimmers (TC1, TC2) and internal screen.

Tr1 OC44 Tr2 OC45 Tr3 OC71

Aerial, see text; oscillator coil, white and blue coded IFT's (Osmor); two knobs; medium or high impedance earpiece or phones; plastic box; 9V battery; etc.

panel-securing nut in Fig. 3 A ¾in. 4B.A. bolt with three nuts will then allow the finished receiver to be held in position.

Fig. 3 shows the layout of parts on the panel. An elastic band passes through two holes and holds the battery. Clearance holes are drilled for the oscillator coil and I.F. transformer pins, and rough edges are cleaned up as necessary with a small file or a larger drill so that the cans fit flush with the panel. The aerial mounting is shown in Fig. 2. The two 50pF trimmers have their tags soldered together and passed through a hole, this point being wired to the receiver "earth" line.

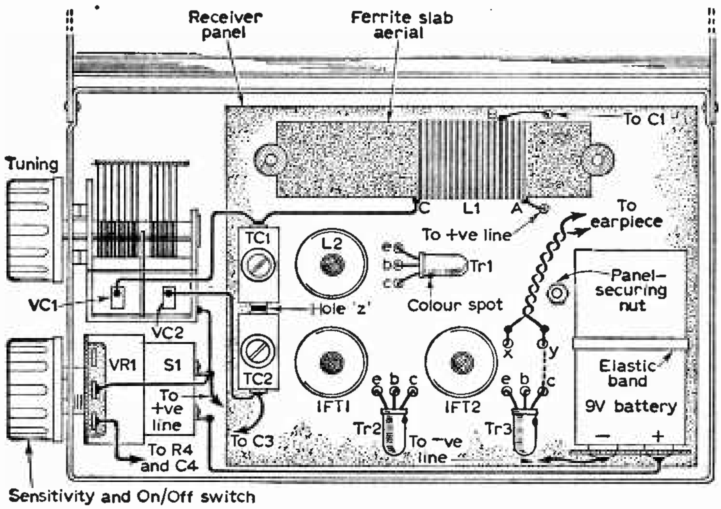


Fig. 3—The controls and panel layout inside the case.

Take care to position the oscillator coil correctly or all connections here will be wrong. Note that the first I.F. transformer is coded with a white spot and the second transformer with a blue spot. These items are held in place by bending out the long tags attached to the screening cans. These tags are wired together and to the earth line. It may be found helpful to scratch numbers by the pins on the underside of the panel.

(To be continued)

BRITISH STANDARD MEMORANDUM *on Light-current semiconductor devices (B.S.3494 : Part 1 : 1962)*

THE British Standards Institution has been preparing a memorandum on light-current semiconductor devices, and the first part was published during May (B.S.3494: Part 1).

This first part lists the ratings, characteristics and other parameters of light-current semiconductor devices which are regarded as the minimum data that should be quoted by the manufacturer when describing his product for general sale. Part 2, will deal primarily with methods of measuring the characteristics listed in Part 1.

To facilitate the comparison of semiconductor devices offered by different manufacturers it is necessary that the data sheets describing the performance of those devices should contain, as a minimum, information on the essential ratings and characteristics. The information should be quoted in the same terms by all manufacturers; adoption of the recommendations given in Part 1 will assist in achieving this.

Part 1 does not specify the numerical values of ratings and characteristics.

Devices primarily intended for use in industrial power equipment are not included in the memorandum. Similar information relating to power diodes, which are not covered by the memorandum, will be published separately.

Copies of this standard may be obtained from the British Standards Institution Sales Branch, 2 Park Street, London W.1., price 6s. each.

SERVICING TAPE RECORDERS

THE RECORDING, PLAYBACK AND ERASE HEADS.

(Continued from page 124 of the June issue)

By T. S. Smith

LAST month we investigated the basic requirements of magnetic recording tape and the need for correct head alignment; we will start this month's article by looking in greater detail at the heads themselves and the circuits that feed them.

We have already discovered that three head functions are required: one for recording—converting the signal voltages to magnetic flux changes and transferring these permanently on to the magnetic tape—the second for replay—converting the magnetic programme pattern on the tape back into signal voltages—and the third for erasing programme material that is no longer required so as to leave the tape "clean" for the next recording.

The three heads have much in common and, as has been told in past articles, the recording and playback functions are nearly always carried out by the same head on most domestic machines. The average tape recorder thus has two heads, one for recording and playback and the other for erase. The basic construction of a recording playback head was shown in Fig. 1 of the first article of this series (page 1037, March, 1962), and this illustration also reveals how the changes in magnetic flux across the working gap transfer magnetic signals on to the tape.

Gap Spacing

In some cases, however, there may be only one winding (as opposed to the two windings shown on the diagram mentioned) and there may not be a rear gap, depending upon the precise design of the head. The most important feature is the front gap. This must be highly engineered so that it is straight and uniform, and to facilitate these requirements a non-magnetic "spacer" is inserted between the two halves of the pole pieces.

Although the spacing of the rear gap is nowhere near as critical as that of the front gap, fairly close spacing is nevertheless required as a means of keeping the reluctance of the magnetic circuit within the pole pieces as small as possible. The pole pieces themselves are composed of a material possessing a high permeability and Mu-metal is often used. The sensitivity of the heads is also related to the magnetic permeability of the pole pieces as well as to the number of turns on the winding and the current in the winding. The number of turns also governs the impedance of the head—a high impedance head has considerably more turns than a low impedance head but, as the latter is fed to or from a transformer, the correct signal voltage step-up is achieved. In other words, the voltage across a low impedance head is smaller than that across a high impedance head, but in the former case the signal current is greater.

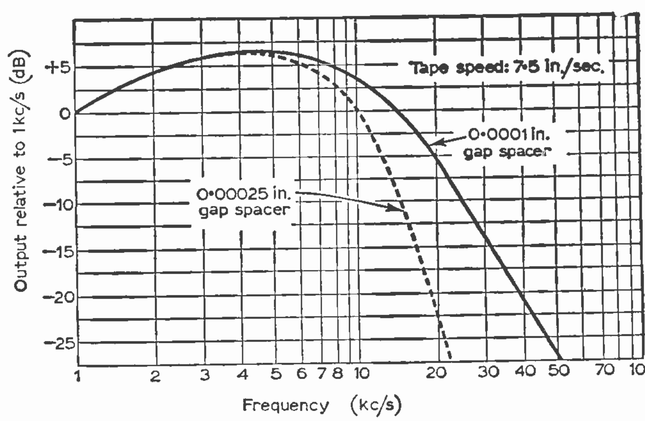


Fig. 13—How the high-frequency response of a replay head is improved by reducing the width of the working gap.

Frequency Response

The high-frequency response at a given tape speed is very closely related to the width of the working gap in the playback head in particular. The dimension of the gap of the recording head is also important, of course, but not so much as that of the playback head. However, since composite recording/playback heads are invariably used, the recording gap width requirement is adequately catered for within the gap requirements of the playback function.

From the high-frequency aspect, therefore, we can consider primarily the playback action. Past articles have explained that the signal EMF generated across the winding is proportional to the *rate of change* of magnetic flux. Thus, with a tape of constant recording over the audio spectrum, the signal EMF across the playback winding will rise with frequency at the rate of 6dB per octave up to a certain frequency which is governed by the gap width and other factors, as will be discussed.

6dB Per Octave

An increase of one octave is a two-to-one rise in frequency which, since the output is proportional to the rate of change of flux, gives a two-to-one rise in signal EMF (voltage) across the replay winding and, because a two-to-one voltage ratio is exactly the same thing as a rise of 6dB, it becomes perfectly clear why the replay signal voltage rises at the rate of 6dB per octave. This happens at all speeds, but the advantage of higher speeds is that the point at which the 6dB per octave rise ceases extends further into the higher audio-frequency spectrum. This is because the peak occurs when the wavelength of the tape signal is about twice the gap width. Thus, if the gap has an effective width of, say, 0·0005in., the wavelength would be 0·001in., which at a tape speed of 7½in./sec would represent a frequency of 7·5kc/s. At 3¾in./sec the peak would occur at approximately 3·75kc/s and at approximately 15kc/s at 15in./sec.

Other Factors

Unfortunately, the effective gap width is somewhat greater than the thickness of the spacer, and because of this and other things like imperfect contact between the head and the tape and losses in the head due to eddy currents and hysteresis, the peak output usually occurs at a lower frequency than that calculated in relation to the gap width.

This is illustrated by the curves in Fig. 13 which show the relative replay responses for a head of 0·0001in. gap and for a head of 0·00025in. gap under equal recording conditions. It will be seen that the peak occurs in both cases at about 5kc/s, but that the curve of the head with the 0·0001in. spacer does not fall off so rapidly as the other and extends further into the high-frequency spectrum. These curves are taken from the Gresham range of heads which employs Mu-metal pole pieces.

The main reason why the effective gap width is not equal to the thickness of the gap spacer is because of imperfect contact between the spacer and the faces of the pole pieces. However, new manufacturing techniques now make it possible to achieve an effective gap width which is considerably closer to the spacer thickness than was possible on early heads. These have also made possible the recent "low speed" recorder, the production of which several years ago would have been considered almost impossible. Machines claimed to have a top response approaching 15kc/s at 3¾in./sec are now readily available, and quite good quality sound can be produced at a tape speed as low as 1⅞in./sec—using transistors.

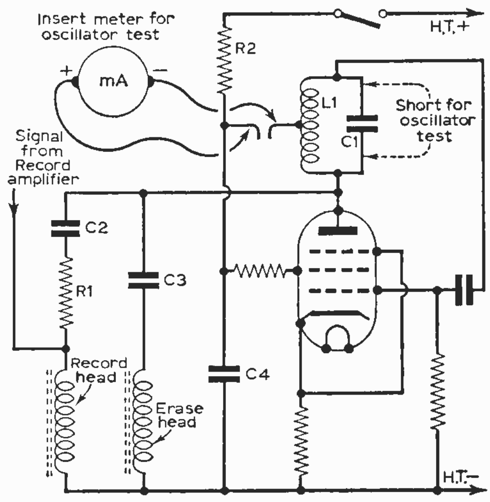


Fig. 14—The basic circuit of a Hartley oscillator.

TV Recorders

Many of these improvements have resulted from developments in the field of video tape recorders and, while we are still on the subject of frequency response, a quick look at such recording systems would not be amiss. The Ampex machine uses a replay head gap somewhat less than one-quarter thousandth of an inch, and at a head-to-tape velocity of 1,500in./sec a response up to 4Mc/s is maintained. The tape itself is moving longitudinally at a speed of 15in./sec, but the effective high tape speed is achieved by the head rotating and scanning the tape over its width.

The British system, on the other hand, operates in the more conventional manner and at a tape speed of 200in./sec gives a response which at 2·5Mc/s is only 3dB down. As would be expected, considerable wear occurs on the head at such high tape speeds, and on both machines the heads need replacing after about 100 hours of use!

The gap width of the British system is 0·00002in. and at such a small dimension the ordinary type of spacer is rarely used. Instead quartz or some other non-magnetic material is "sputtered" or vacuum deposited between the interfaces of the pole pieces. This technique is now being examined for use on sound replay heads and it should not be very long now before further improvements are found in the domestic and professional recorder, leading to enhanced high-frequency response at low speeds.

Poor Top Response

The tape is held in close contact with the head either by pressure pads or by the tape being run through special guides either side of the head, so that the tape is under slight pressure against the pole pieces. The former arrangement is the most popular, but the latter arrangement has much to commend it and will possibly be found more in machines of the future.

Apart from incorrect azimuth adjustment, as dealt with last month, another common cause of poor top response is inadequate contact between the tape and the head. The working surface of the head sometimes picks up oxide deposits from the tape after considerable use which hold the tape away from the gap. As the deposits are likely to become very hard with time a magnifying glass is often necessary to detect them, and extreme caution should be exercised when removing them.

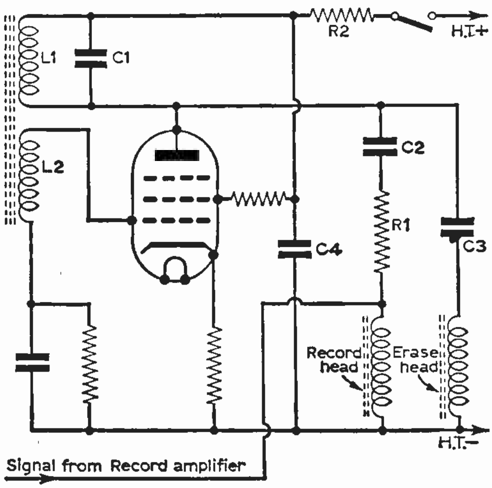


Fig. 15—The basic circuit of a Meissner oscillator.

Removal of Oxide Deposits

On no account should a pointed instrument be employed to pick away the deposits from the pole laminations or gap. The best thing is to endeavour to dissolve the deposits with a good quality lighter fuel or carbon tetrachloride. A piece of lint-free cloth should be soaked in the solvent and applied with reasonable pressure to the working area of the head. Care should be taken to avoid either solvent coming into contact with the tape, and lighter fuel (petrol) should be kept well clear of rubber drive wheels. Carbon tetrachloride does no harm to rubber, however, and is useful for roughening and cleaning such drives.

During the course of servicing the head in the foregoing manner it may be discovered that the pole surface is badly stepped, indicating wear. While consistent wear over the area in contact with the tape is of little consequence (provided it is not too severe, of course, and has not widened the gap), unbalanced wear, resulting in a sloped face, nearly always calls for head replacement. Again, a magnifying glass or small miscroscope is useful for investigating head wear. The gap should not normally be visible to the naked eye, and if it is—except for the erase head gap—the head may need replacement.

Excessive head wear coupled with impaired H.F. response may also be caused by incorrect adjustment of the pressure pads or tape guides. With the pinch roller disengaged from the capstan, the tape should pass the centre of the head (with the pressure pads released) without kink or curl. If this does not happen then the guides should be adjusted in height to give the desired effect. The guides often wear badly themselves, but this can usually be overcome without cost by rotating them so that a fresh surface is presented to the tape.

Optimum Pressure

Too much tension on the pressure pad will not hold the tape any straighter nor will it enhance the high-frequency response; it will simply wear out the heads long before the end of their life is really due. If excessive pressure appears to give a better top response, then the trouble is caused either by a worn head or oxide deposits adjacent to the gap (or incorrect azimuth adjustment). On the other hand, too low a pressure will impair the H.F. response, but the pressure should be as low as possible consistent with optimum H.F. response.

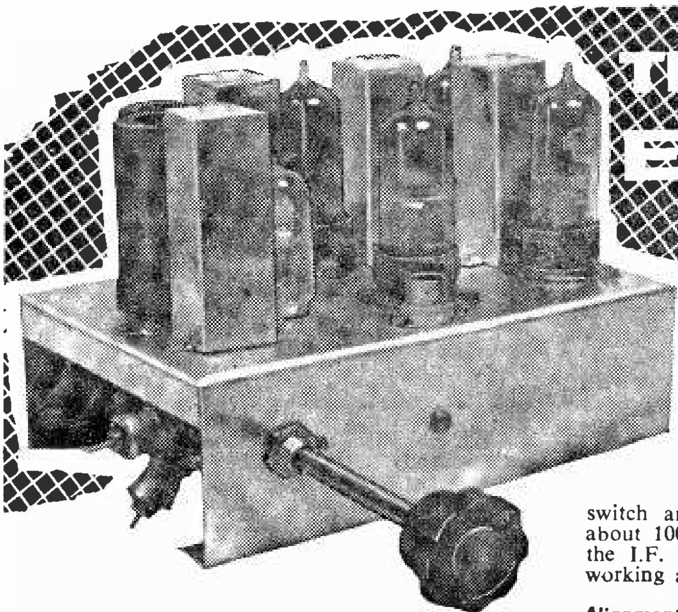
It is surprising just how the H.F. response falls when contact of the tape with the head is reduced. The loss in dB can be computed approximately by multiplying the gap distance between the tape and the head by 55 and then dividing the answer by the wavelength of the signal being reproduced. Thus, with a one tenth of one thousandth of an inch loss of contact on a tape running at $7\frac{1}{2}$in./sec recording a signal at 7·5kc/s, the cut would be 5·5dB. Varying pressure of the tape against the head is also a cause of noise modulation, and this could result from a twisting tape or wear of the head.

Erasing

The erase head, although of similar design to the recording/playback head, has a considerably wider gap of some five thousandths of an inch or so. The pole pieces may be either of laminated Mu-metal or ferrite and the supersonic erase signal is applied at fairly high power to a comparatively low impedance winding. To supply sufficient erase power the oscillator often incorporates a pentode valve (or power tetrode) to feed between 200 and 500mA of erase current into the winding of the erase head, and as we have already seen (Fig. 5, page 1123, April, 1962, issue), the output valve in the playback amplifier may take over as bias and erase signal oscillator on record.

In Fig. 14 is given the circuit of a Hartley oscillator, which is very popular in tape recorders. The frequency is governed by the tuned circuit comprised of L1 and C1, and a good test for oscillation is to insert a milliameter in series with the H.T. feed to the anode circuit, as shown. The reading should be noted and, if there is an appreciable rise in anode current when C1 is short-circuited, this is proof enough that the circuit is oscillating with the short removed.

(Continued on page 227)



The P.W. EVEREST TUNER

By S. F. Raymond

(Continued from page 145 of the June issue)

A SWITCH-TUNED, VHF/F.M. TUNER.

IN last month's article, the circuit of the tuner was described and the functions of the various stages explained. However, one of two constructional points remain to be described. Firstly, the receiver is small in size and therefore the heat generated by the valves must be dissipated as efficiently as possible so that the chassis does not become unduly hot during operation. To this end, V2 and V6 are fitted with screening cans and these cans are blackened inside and out so that heat is lost from them as quickly as possible. (Blackened surfaces both radiate and absorb heat more quickly than polished surfaces.) The cans may be blackened with photographer's matt black paint which is quick drying and gives a good surface. The skirts of the other valveholders can also be painted inside and out with the black paint taking care that no paint reaches the insulation of the valveholders or the contacts.

Testing and Alignment

When the tuner has been completed, it is wise to carry out a few tests before alignment is begun. Firstly, with all the valves removed, a meter should be used to check that a reading of infinite resistance is obtained across the 6·3V power supply leads—with the valves removed, there should be nothing to complete the circuit. The meter should also be used to check that there are no short circuits in the H.T. line. Having established that all is well in the above respects, V3, V4, V5 and V6 should be inserted and the heater supply switched on when the valves should be observed to light. An H.T. supply of about 150V is required for the unit and this should be connected via a switch and a milliammeter having an f.s.d. of about 100mA. When this supply is switched on, the I.F. amplifier stages of the receiver will be working and these may be aligned first.

Alignment with a Wobbulator

The easiest method of aligning an F.M. receiver is with a wobbulator and this method will be outlined first, but not in great detail since it is assumed that those readers having access to a wobbulator will also know how to use it.

To align the I.F. stages, a signal should be injected from the wobbulator into the grid circuit of V3. This signal should have a centre frequency of 10·7Mc/s and this frequency should be marked on the display of the response on the oscilloscope either by using the internal marker of the wobbulator or by the use of an additional signal generator. The output voltage for the I.F. amplifier characteristic is derived from the limiter grid resistor—from Test Point 2 (T.P.2) on the circuit diagram (Fig. 1 on the Blueprint). R17 is included at this point to prevent any instability from arising when the lead is connected. Using the marker generator, the response of the I.F. amplifier should be adjusted so that it is centred on 10·7Mc/s and sensibly flat from about 10·625Mc/s to about 10·775Mc/s, say 3dB down at the extremes of the pass-band.

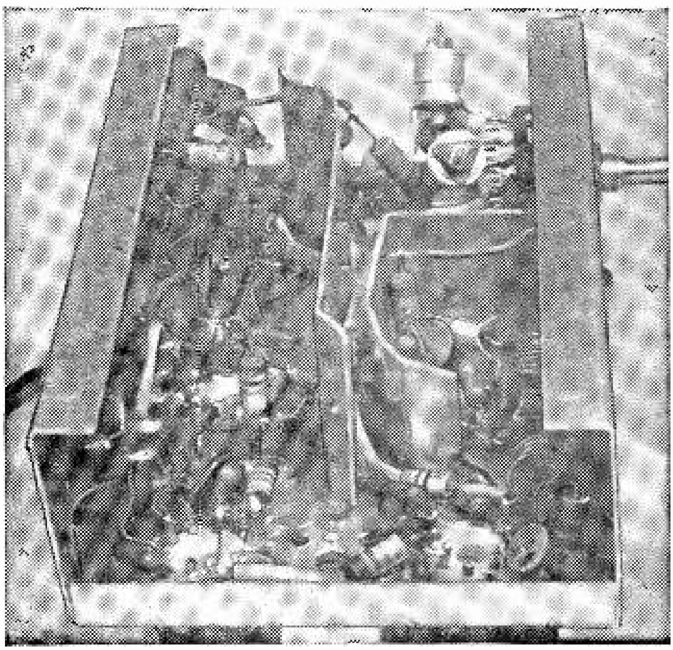
The next step is to align the discriminator and for this display, the voltage is derived from T.P.3 (see the circuit diagram). If a double-beam oscilloscope is used, one beam can be used for the I.F. amplifier and the other for the discriminator—this procedure will facilitate optimum adjustment of the circuits.

It should be noted that on the circuit diagram, the "hammer heads" which represent the dust cores in the coil cans have been turned upside down in some cases. This has been done to facilitate adjustment of the cores and inversion of the "hammer heads" denotes that the core concerned is at the bottom of the can and reached from the underside of the chassis.

The cores in the discriminator section (IFT3) should be adjusted for maximum symmetry of the response curve. (Note that a brass core is required for the secondary.) The primary core affects the tuning point of the discriminator and the secondary core the linearity of the response. The response should be centred at about 10·7Mc/s and be linear for ±75kc/s at least. No more details will be given of the alignment procedure using a wobbulator since there are many books available which cover the subject in great detail.

Alignment Using a Signal Generator

To align the I.F. amplifier and discriminator using a signal generator, an unmodulated signal of 10·7Mc/s frequency should be injected into the grid circuit of V3. A sensitive voltmeter should be connected between T.P.2 and chassis (positive lead to chassis) and the cores of the I.F. transformers adjusted for maximum response, reducing the input from the generator as the circuits come into line—the coupling between the generator and V3 may be reduced gradually also.



The underchassis wiring of the Everest

The frequency of the injected signal should now be varied from about 10·6Mc/s to 10·8Mc/s and the cores of the transformers altered to give a flat response from about 10·625Mc/s to about 10·775Mc/s—in other words, the meter reading should remain sensibly constant as the frequency of the input signal is varied from about 10·625 to about 10·775Mc/s. It should be noted that considerable trial and error may be necessary before this condition is obtained.

When this part of the alignment has been completed, the meter may be transferred to T.P.3. The voltage at this point may be positive or negative with respect to chassis and the meter should initially be switched to a high range. The leads may then be reversed if necessary so that the needle of the meter moves in the usual direction.

With the signal generator set to give an unmodulated signal of 10·7Mc/s, the core of the primary winding of IFT3 should be set to give maximum reading of the meter. The secondary core should now be adjusted so that the meter reading drops to zero—it is probable that in order to obtain this zero reading, a brass core will have to be inserted into the top of IFT3 instead of a dust core.

As the core is screwed in and the meter reading drops to zero, the meter leads should be reversed. When the core is screwed in further, the meter reading should again rise; if it does not, a position should be found for the core where this does occur. The secondary core should now be adjusted so that a small reading is obtained on the meter and then the primary core should be rotated until this reading is maximum. The secondary may now be adjusted until the reading is zero once again, reducing the range of the meter as zero is approached.

Finally, the signal generator should be altered from about 10·6Mc/s to about 10·8Mc/s. It will be found that the meter reading varies (as the frequency is altered) both in magnitude and polarity and it will be necessary to reverse the leads of the meter as the frequency passes through 10·7Mc/s. It should be found that the voltage at about 10·625Mc/s has the same value but opposite polarity as that at about 10·775Mc/s. If this condition cannot be obtained, then the core of the primary should be altered by about half a turn, the secondary re-adjusted and the test tried again. Eventually, by trial and error, it should be possible to achieve the desired result.

Oscillator Adjustment

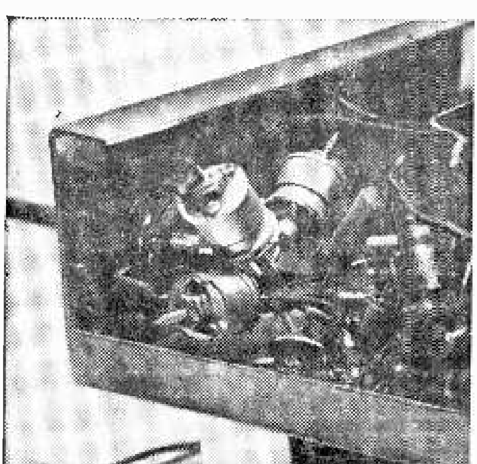
The meter and signal generator may now be disconnected and the power supply switched off. Valve V2 may then be inserted into its holder. The crystal unit may also be inserted into the B7G valveholder provided. A micro-ammeter of f.s.d. about 100μA is connected between T.P.1 (positive to chassis). It is best to solder the meter connections in position in case the leads should become detached and contact the H.T. line. The programme switch should be turned to the Light Programme position and the trimmer TC1 screwed up almost completely. A dust core should be inserted into the top of the former of L2. This dust

The P.W. EVEREST TUNER

CONTINUED

core should be screwed gradually into the former until the reading on the meter is observed to increase suddenly. If this does not happen, then remove the dust core and alter the setting of TC1 until the meter reading is seen to increase. If TC1 has to be almost completely unscrewed to obtain this condition, remove the can of L2 and increase the spacing between the turns. Then, return TC1 to its initial setting and insert the dust core. When the correct position has been found for the dust core, TC1 may be adjusted for maximum deflection of the meter.

The programme switch is then rotated to the Home Service position and TC2 adjusted for maximum reading of the meter. This will occur with the trimmer almost completely unscrewed. The switch may then be set for the Third Programme and TC3 adjusted for maximum meter reading—this will occur with the trimmer at about its mid-way position.

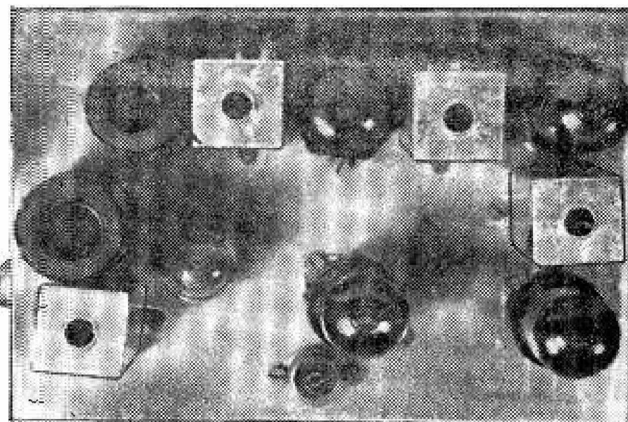


The arrangement of the concentric trimmers around the programme switch.

The R.F. Stage

The power supply may be switched off and V1 inserted. With this valve in position, the current consumption should be about 40mA and this should be checked on the meter.

If an aerial is connected, the local Light Programme transmission should be heard when an amplifier is connected to the output of the tuner. The R.F. stage and the input tuned circuit of the mixer are broad in tuning and therefore no variable tuning has been incorporated in the circuits. The aim is to adjust the tuning of the R.F. and mixer stages so that the F.M. band is adequately covered. To do this, it is necessary once again to connect the meter to T.P. 2. With the programme switch set to the Light Programme, the spacing of the turns of L1 is adjusted for maximum reading of the meter. The switch is then set to the Home Service and the spacing of the turns of L3 adjusted for maximum reading of the meter. The switch is then set to the Third Programme (make sure beforehand that there are transmissions in progress) and the meter reading should be the same as obtained on the other two programmes. By repeated adjustments on all three programmes, the turns spacing of the coils should be altered until equal readings are obtained on all three.



This view of the complete tuner shows clearly the layout of the valves and transformers on the top of the chassis

To achieve optimum results, the I.F. transformers and the discriminator may be adjusted finally with the tuner switched to one of the three positions. The same type of adjustments are required as detailed above in the alignment instructions.

In conclusion, it must be pointed out that this receiver is not intended for the inexperienced radio constructor who would be wise not to attempt it—the advanced constructor will find little trouble in building the tuner but nevertheless it is useful to visit the local reference library and read about the operation and adjustment of F.M. receivers before completing the set so that the abbreviated alignment instructions given above may clearly be understood. ■

A 4-valve Signal Tracer

THIS INSTRUMENT WILL ALSO PROVIDE A SIGNAL FOR TESTING AUDIO AMPLIFIERS

By V. E. Holley

(Continued from page 137 of the June issue)

THE circuit was described in detail in the last issue and in this month's article, the constructional details will be given.

An additional facility, which was not required in the prototype can be provided by bringing the grid of V3 out to a fifth jack socket as in Fig. 2(b), so that the valve becomes available for use as an indicator for alignment of receivers, etc. (see page 136, last month).

Construction

The form of construction is not critical. The layout of the original was somewhat influenced by the fact that the chassis had previously been used for another purpose. However, the resulting arrangement, which is shown in Fig. 4, proved quite convenient. The valve V2 must be screened, as also must the choke, Ch1; the latter, if not already screened, can be dealt with quite simply by wrapping it in corrugated cardboard and enclosing it in a can of suitable size, the lid of which can be bolted to the chassis.

The bracket shown in Fig. 5 is a simple and effective method of mounting the aerial. Rubber grommets are fitted into the two $\frac{7}{16}$in. holes, the ferrite rod is passed through them and the metal is then closed up to produce a good tight fit. Suitable material is aluminium sheet of 18s.w.g., and this is also suitable for the chassis. The tuning indicator, V3, is fitted at the end of about 9in. of four-core flexible cable and can be mounted in any desired position. It is not necessary to use the EM84 as in the prototype; almost any other type will serve equally well.

Components and Wiring

The only critical components are C1 and C8. Both should be mica and C1 should be ± 5%.

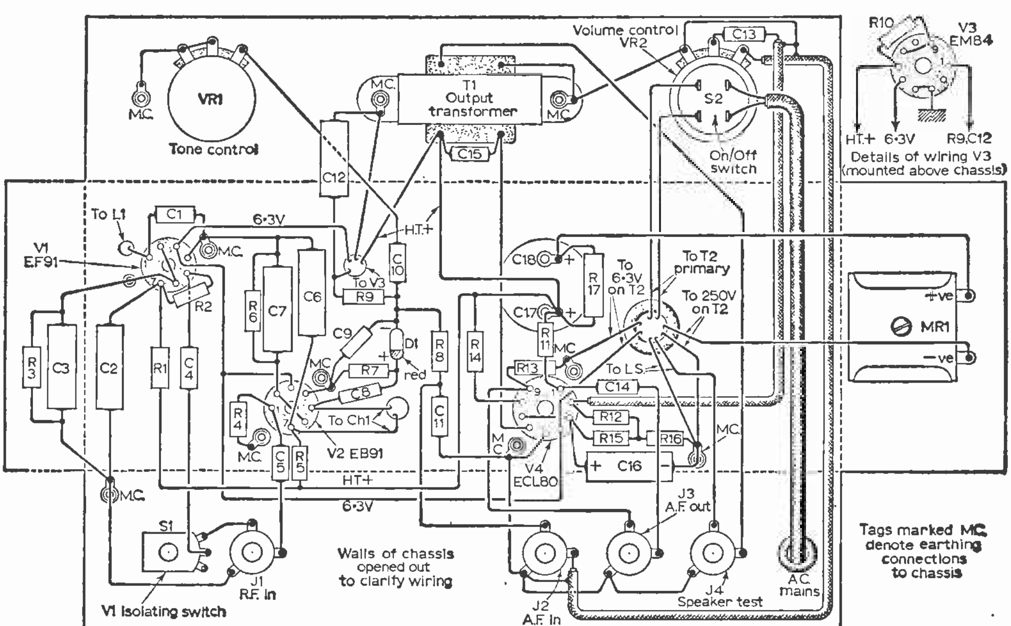


Fig. 4—The underchassis wiring diagram.

The value of C8 is not important, but its insulation must be above suspicion. The usual tolerances are satisfactory for the remaining components and the constructor may use anything he has to hand which can be fitted in. Capacitors in the H.T. circuits must be of 350V rating as they will receive the full peak voltage from the rectifier while the valve cathodes are warming up. The wattage rating for resistors was shown in the components list last month.

Valves other than EF91 can be used for V1 and V2, but they must be capable of operation with 200V on the screens or it will be necessary to provide additional voltage dropping and decoupling circuits for them.

A complete wiring diagram is given in Fig. 4 and shows the approximate position of each component in the chassis. The wiring has been opened out to show the connections clearly so that some of them appear much longer than in fact they are. Tinned copper wire of 22s.w.g. is suitable for all the wiring except the four flexible connections to V3.

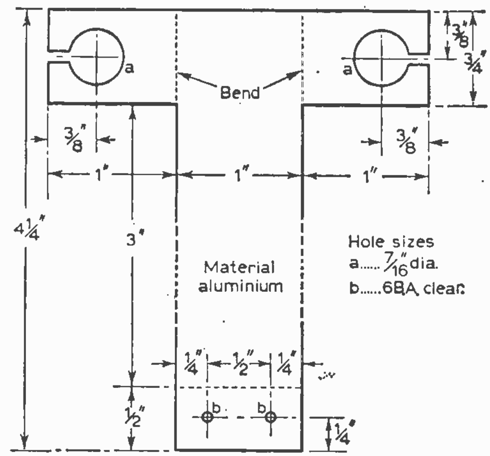
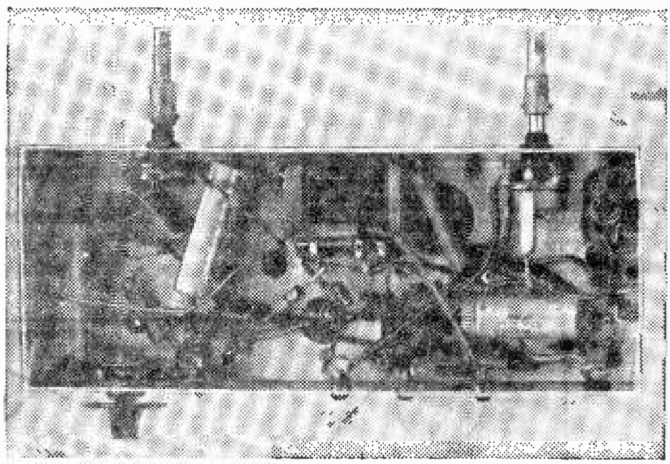


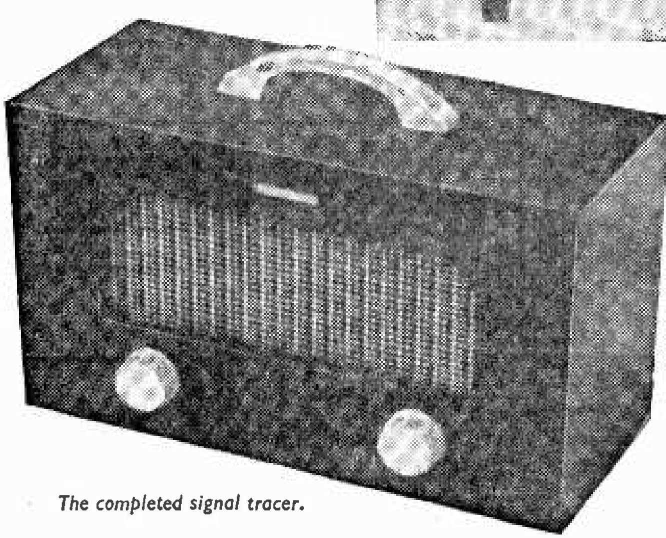
Fig. 5—Details of the ferrite rod aerial mounting bracket.


Above—An underchassis view of the instrument.

Testing

When the wiring is complete and has been checked against the circuit diagram, test with a meter between C18 and chassis to see that there are no shorts in the H.T. circuits. If all is well, switch on and check that voltage is present at the screens and anodes of all the valves. Measure the H.T. circuits. If all is well, than 210, R17 must be increased in value to bring it down to this figure.

Alignment is limited to adjusting the position of the aerial coil upon the rod for maximum voltage at the diode load as shown by the tuning indicator. It may be necessary, in order to achieve resonance, to make a small alteration in the value of C1 and of course, the value given in Fig. 1 holds good only for the Light programme on 200kc/s. The coil should be secured on the rod with a little hot bees-wax when the optimum position has been found.


The completed signal tracer.

Test Leads

Test leads should be no longer than conveniently necessary, and for A.F. work should be of screened cable. For R.F. tracing, the effect of the tracer upon the circuit to which it is connected must not be forgotten and the test

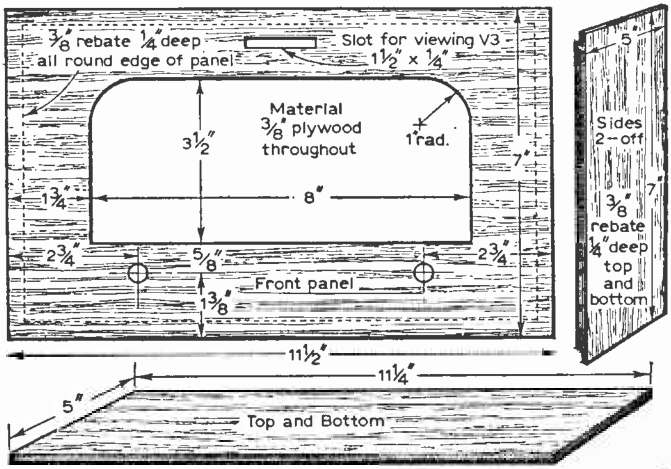
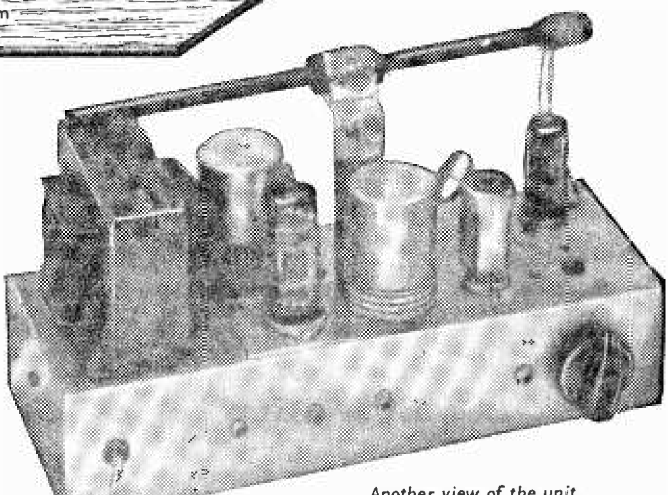


Fig. 6—The constructional details of the cabinet.

both in daylight and after dark at quite unexceptionable quality. The tracer, in fact, was viewed with unqualified approval as a handy portable receiver, and as a result had to be provided with a tone control (VR1) and the polished plywood cabinet shown in the illustration on the opposite page.

Since a cabinet of some kind will be needed anyway, the measurements and form of construction are given in Fig. 6. A 7in. x 4in. elliptical speaker was mounted behind the large front aperture and V3, the tuning indicator behind the smaller one above it where, having no other function in receiver service, it does duty as a pilot light. A cream plastic carrying handle and two control knobs to match add to the appearance. ■



Another view of the unit.

leads should be two single conductors so as to avoid introducing too much additional capacity. To check the tracing performance, clip the "hot" test lead to the grid of the first valve of the receiver and the other to its chassis; any signal present should be heard quite easily and can be followed through the I.F. stages to the signal diode. The A.F. test lead will then trace it through to the output transformer.

Receiver Performance

Though not originally intended for reception, apart from the provision of a test signal, the performance as a receiver was surprisingly good. In a not very favourable reception area, the single-tuned circuit proved adequate for interference-free reception

New Electronics Company for Nigeria

IT was announced recently, by the L.M. Ericsson Company of Sweden and Marconi's Wireless Telegraph Company Limited of England, that they have together formed a new company in Nigeria, to be known as the Nigerian Telecommunications Corporation.

An official inauguration ceremony took place at the Federal Palace Hotel, Lagos.

The purpose of the new Corporation is threefold: to provide an "on-the-spot" organisation which can deal rapidly and efficiently with all aspects of telecommunication requirements; to promote the expansion of technical education in Nigeria, and to introduce local assembly of some types of telecommunication units rather than import them already assembled.

The L.M. Ericsson Company is known for its telephone equipment. Since 1960 L.M. Ericsson has been represented in Nigeria by the Industrial Products Company (West Africa) Ltd.

The Marconi Company is at present responsible for the maintenance of much of the Nigerian Federation telecommunications network. In 1956, under contract from the Department of Posts and Telegraphs, the Company set up a Telecommunication School at Oshodi, Lagos, in which 217 students are currently under training on four-year courses. The initial (1956) intake of trainees have now completed their course and have taken over as maintenance engineers in the Nigerian P and T. Other Nigerian engineers are undergoing training at the Marconi Works in England.

How Transistors Work

By B. N. Rolfe

(Continued from page 165 of the June issue)

A BASIC NON-MATHEMATICAL EXPLANATION

As a conclusion to this series we shall now deal essentially with fault finding in transistor equipment, but before useful work can be carried out it is necessary to have available a testmeter giving a range of fairly low voltage full-scale deflections. An ideal instrument would be a multimeter with low voltage ranges of 0—1, 0—5, 0—10 and 0—20 and with a sensitivity of 20,000Ω/V. This would require a meter movement which itself had a full-scale sensitivity of at least 50μA.

Sensitivity

A multimeter based on such a movement would also probably give full-scale deflection on the lowest current range at 50 or 100μA. This would be extremely useful for oscillator checking and for other tests in which the circuit current is small. Further full-scale current ranges of 250μA, 1mA, 10mA, 100mA and 1A would be very useful, as also would a range of "ohms" measurements from about 1Ω to 10M.

Such an instrument would allow almost the whole of any item of transistorised equipment to be analysed from the static (or D.C.) point of view. To secure a reasonable indication of what is wrong—or not wrong—in a transistor stage it is essential to be able to measure small differences in relatively low voltages (and currents). We must also always keep in mind that transistors are current-operated devices—that is, the current is the prominent factor with the relatively low impedances encountered in transistorised circuits compared with the lower currents and higher impedances in valve equipment.

Loading

This impedance difference is also somewhat important when injecting signals from a signal generator and when measuring output on an output meter or A.C. voltmeter. Valve circuits put a negligible load across the termination of a signal generator (owing to their high impedances compared with the low output impedance of most signal generators) and therefore the voltage indicated by the R.F. attenuator on the signal generator may be taken as applied to the circuits.

This may not be so with transistor circuits. Two things could happen here: one is that the low impedance output of the generator could load the transistor input circuits heavily and in certain cases alter the base current distributions sufficiently to put the stages virtually out of action. Secondly, the low impedance of the transistor input circuit could load the generator termination so that the signal actually appearing across the "loaded" termination was considerably below the value indicated on the attenuator of the signal generator.

Whilst the former condition may be apparent, the latter may simply give a false impression of receiver sensitivity and lead to fault tracing in a fault-free circuit. In some service manuals

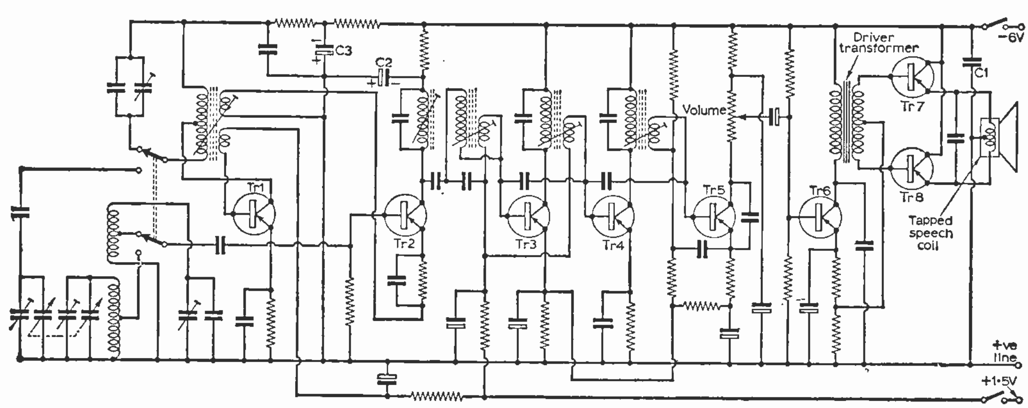


Fig. 29—The circuit diagram of a transistor portable which uses a centre-tapped speech coil coupled direct to the output transistors, Tr7 and Tr8, without a transformer.

relating to transistor sets the approximate sensitivity is given in terms of signal voltage applied across a specific value of load resistance. A load value typical in this respect is 500Ω, and an I.F. sensitivity value, for example, may be 5mV for an output of 50mW (audio, of course).

Alternative Method

In some manuals, instead of a definite output power being specified, the voltage across the speech coil of the loudspeaker for "standard" output may be given. It will be understood that the signal generator must be modulated (usually to a depth of 30% at 400c/s) in order to produce A.F. across the speaker. The reason for a voltage being given instead of a power is because the speech coil impedances differ considerably—from valve sets to transistor sets—and there is also quite a difference between the speech coil impedances of transistor sets of different models.

Output Loading

The power output across a load of impedance Z is equal to E^2/Z, where E is the r.m.s. voltage measured on an A.C. voltmeter. With valve sets Z is usually in the region of 3Ω (at 1,000c/s), while in transistorised sets the speech coil impedance may be 30, 60, 120Ω or some entirely different value, depending upon the design of the output stage. In some cases the speech coil may even be centred-tapped to facilitate connection to a push-pull output stage of a circuit such as that given in Fig. 29 (Tr7 and Tr8). Here there is no

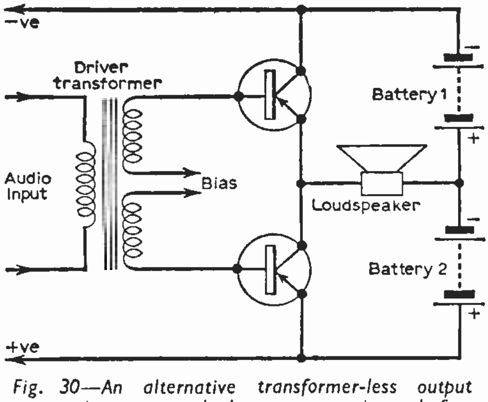


Fig. 30—An alternative transformer-less output stage using a tap on the battery system instead of on the speech coil. This is sometimes called a "D.C. series" output stage.

output transformer, so the loudspeaker impedance must be of a sufficiently high value to match into the emitter circuits of the two transistors.

An alternative "transformer-less" push-pull output stage is shown in Fig. 30. This is sometimes called the "D.C. series" output stage as distinct from the "D.C. parallel" arrangement shown in Fig. 31. The latter uses a loudspeaker transformer in the normal manner, while the former uses neither a transformer nor centre-tapped speech coil, the push-pull effect being given by the centre tap on the batteries.

It is now fairly clear why it would be difficult for the manufacturers to stipulate a "standard" output in terms of power in relation to servicing operations on their sets. It is far easier to indicate an A.C. voltage across the speech coil, for then the impedance does not need to be considered after the first computation at the factory.

However, if neither a voltage reference nor impedance value is given, the power output of most class B output stages can be discovered in a very interesting manner. The idea is first to measure the current consumed by the output stages under zero signal conditions, then measure the current when a signal is applied to give the required audio output. The difference in current (in milliamperes) should then be multiplied by three-quarters of the battery voltage and the resulting figure will approximate to the power output in milliwatts. Let us take an example. Suppose we find that the current increases by 20mA when a signal is applied and that the set is working from on 8V battery. Three-quarters of 8 is 6 and 6 times 20 is 120. Thus, the output power could be taken as 120mW. This is not highly accurate, of course, but it is sufficiently accurate for most servicing activities provided (a) that the output stage is of the true class B type and of D.C. parallel mode and (b) that the signal applied is a pure sine wave. For example, the A.F. could be the modulation signal derived from an A.M. signal generator.

Generator Input Loading

The sensitivity of a receiver (or section of a receiver) is usually given in terms of signal required to produce a "standard" output when the signal is modulated to a depth of 30% at 400c/s. This is easy to check with valve equipment where one can be fairly sure that the voltage given on the attenuator of the signal generator and R.F. output controls is being applied to the set or circuits under test.

With transistorised equipment the generator may have to be "loaded" by, say, 500Ω to feed into the base circuit of a transistor stage. There is no difficulty in securing such a loading, since if the signal generator is normally loaded at, say, 70Ω then it is necessary simply to include a series resistor of 430Ω to increase the impedance to 500Ω, as shown in Fig. 32, but now what happens to the output voltage?

Let us suppose that the generator produces the voltage indicated on the attenuator across 70Ω within the instrument (e.g., without an external 70Ω load resistor). The signal voltage is thus being applied across the 430Ω resistor and the 500Ω load in series, and the load (i.e., the input circuits of the set) will receive only approximately half the voltage indicated on the R.F. controls of the generator. On the other hand, if the generator requires an external 70Ω load to give the signal voltage outputs indicated on the R.F. controls, then by running the generator without a load the voltage across the two series resistive elements will be twice that indicated, and the signal across the 500Ω load will be approximately equal to that indicated on the R.F. controls.

These points are well worth bearing in mind when dealing with transistorised equipment and padding the generator for suitable load values.

There is another very important point and that is the signal output lead of the signal generator must be isolated from the transistor circuits by two capacitors (one in each conductor). If such isolation is not adopted there is a strong possibility that D.C. continuity through the attenuator

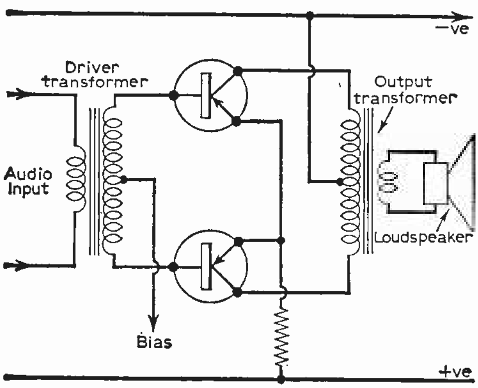


Fig. 31—The more conventional output stage, using a loudspeaker transformer. This is a "D.C. parallel" arrangement, as distinct from the series circuit of Fig. 30.

and R.F. controls of the generator will disturb the base current of the stage to which the generator is connected.

General Tests

Experience has shown that there are two major causes of trouble in transistorised sets, these being poor insulation in interstage coupling electrolytics and alteration in value of the base potential-divider resistors. Transistors sometimes fail when they are fairly new, but once they have been in operation for some time they rarely give trouble

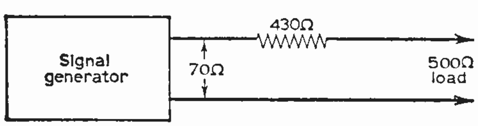


Fig. 32—How the output of a signal generator may be "padded" to give a higher impedance. Care must be taken when using this arrangement, however, since some of the signal voltage is lost across the series resistor and all (or that indicated on the R.F. controls) may not be applied across the load—see text.

unless, of course, they are damaged or overloaded by incorrect servicing techniques.

It most definitely pays to obtain the service manual or service sheet for the receiver under repair. A good idea of the operation of the various stages can be gleaned simply by measuring the voltages across the emitter resistors and comparing them with the voltages given in the manual or service sheet. The voltage is normally fairly low here, usually around one volt or below, hence the reason for a low-reading voltmeter.

Very low or zero voltage across an emitter resistor should lead to a check of the base bias and collector voltage, and if these are normal then one can be fairly certain that the associated transistor is faulty—probably open-circuited. A reading which is higher than normal should, again, lead to a check of the base bias, for excessive base current could cause the symptom. And this may be promoted either by a leak in a coupling electrolytic (in an A.F. stage, for example) or by an alteration in value of one of the base resistors.

Specific Tests

Signal tracing is practised extensively in servicing transistorised equipment and can quickly lead to the stage which is at fault. There are two methods, one by using the loudspeaker as the "signal detector" and the other by using an R.F. probe and A.F. amplifier. In the latter the signal (modulated) is applied to the input of the set, and the detector probe used to extract the signal at various points in the circuit towards the loudspeaker. The detected signal is then applied to an A.F. amplifier and separate loudspeaker. By moving the probe along the circuit the point at which the signal fails to pass can quickly be discovered.

The other method requires the actual signal (from a signal generator) to be moved from point to point in the set, starting at A.F. in the output stage, until a point is reached where the signal fails to pass through the stages under test. As an example, suppose that an A.F. signal could be heard in the loudspeaker when applied to the base of Tr6 in Fig. 29, and yet could not be heard when applied to the base of Tr5. As Tr5 is the detector stage (dealing also with A.F.) it would follow that the trouble lies either in Tr5 itself or in an associated component.

Similarly, if an I.F. signal could be passed through the set from the base of Tr4 but not from the base of Tr3, then the trouble would lie in Tr3 stage or associated components. If an I.F. signal could be passed through the set from Tr1 base circuit, and yet the set is completely dead to aerial signals, the trouble would almost certainly lie in the oscillator section of Tr1. Tr1 itself could be defective, but the most likely cause would be either in the oscillator coil or associated components or in the base or emitter components.

Distortion in the output should first lead to a check of the battery voltage and, if it is normal, to a check of the two push-pull output transistors. Motor-boating is also invariably caused by a worn battery, but the trouble may be aggravated by a low value or open-circuit H.T. by-pass capacitor such as C1 in Fig. 29.

Impaired battery life should also lead to a check of C1, for this could be slightly leaky without detracting too much from the efficiency of decoupling. Other H.T. decoupling capacitors such as C2 and C3 in the circuit should also be checked. ■

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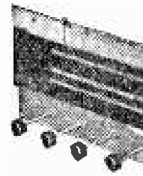

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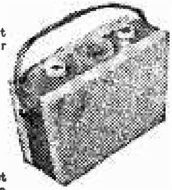

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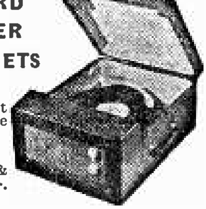

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Elect. Condensers—Midget Type 1 mfd-50mfd ea. 1/9, 100 mfd. 2/-; 12V wkg.
Condensers—.01mfd. to .04mfd. 9d.; .05mfd. to .1mfd. 1/-; .25mfd. 1/3; .5 mfd. 1/6.
Tuning Condensers—JB"OO" 208 pF + 176 pF 8/6, with Trimmers 9/6. Single 365pF 7/6. Sub min. ¼in. J.B. Dile min. .0001, .0003 or .0005 7/- each.
Midget Vol. Control—with edge control knob, 5K ohms with switch, 4/9. Ditto less switch 3/9.
Speakers P.M.—2in. Plessey 75 ohms 15/6. 2½in. Continental 8 ohms 13/6, 2½in. E.M.I. 3 ohms 17/6. 7 x 4in. Plessey 35 ohms. 23/6.
Ear Plug Phones—Min. Continental type. 3ft. lead, jack plug and socket. High Imp. 8/-. Low Imp. 7/6.

Condensers—Silver Mica. All values, 2pF to 1,000pF, 6d. each. Ditto. Ceramics 9d. Tub. 450V T.C.C., etc., 0.001 mfd. to 0.01 and 0.1/350V., 9d. 0.02-0.1/500V 1/-. 0.25 Hunts 1/6. 0.5 T.C.C. 1/9, etc., etc. **Close Tol. S/Micas**—10% 5pF-500pF 8d. 600-5,000pF 1/-. 1% 2pF-100pF 9d. 100pF-500pF 11d. 575pF-5,000pF 1/6. **Resistors—Full Range** 10 ohms-10 megs-ohms 20% ¼ and ½ W 3d., ¼W 5d. (Midget type modern rating) 1W 6d., 2W 9d. **Hi-Stab** 10% ¼W 5d., ½W 7d. 5% ¼W 9d., 1% ¼W 1/6.

ENAMELLED COPPER WIRE—¼lb. reels. 14g-20g. 2/6; 22g-28g. 3/-; 30g-40g. 3/9. Other gauges quoted for.
Speakers P.M.—3 ohms 2½in. Elac. 17/6. 3½in. Goodmans 18/6. 5in. Rola 17/6. 6in. Elac 18/6. 7 x 4in. Goodmans, 18/6. 8in. Rola 20/-. 10in. R. & A. 25/-, 10 x 6in. Goodmans 25/-. E.M.I. Tweeter. 29/6. 12in. R. & A. 35/-.
Ersin Multicore Solder 60/40 3d. per yard. ½lb. 2/6, etc.

Volume Controls—5K-2Meg-ohms. 3in. Spindles Morganite Midget Type. 1½in. diam. Guar. 1 year. LOG or LIN ratios less Sw. 3/-. DP. Sw. 4/3. Twin Stereo less Sw. 6/6. DP Sw. 8/-.

W/W Resistors 25 ohms to 10K, 5W 1/3, 10W 1/6, 15W 2/-. **Preset T/V Pots, W/W** 25 ohms -50 K 3/-, 50 K-2 Meg. (Carbon) 3/-.

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3S4	7/6	EF80	8/-	PCL84	12/6
3V4	7/6	EF86	12/6	PL81	12/6
DAF96	9/-	EL84	5/6	PL82	9/6
DF96	9/-	EY51	9/6	PL83	10/6
DK96	9/-	EY86	10/-	PY32	12/6
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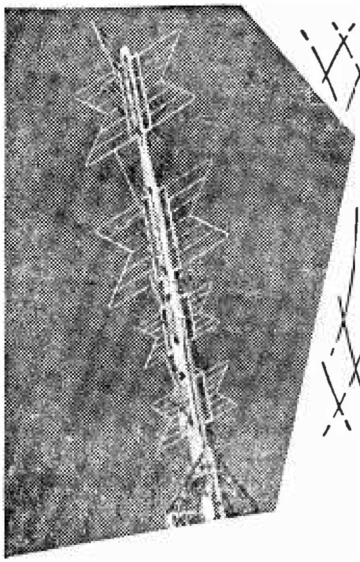


On Your Wavelength

By THERMION

Electronic Games

I AM very surprised that I have not received a single reply to my notes which were published back in December concerning electronic games. Primarily this related to the simple noughts and crosses game which, as probably most of my readers know, may be constructed even in a simple electric form — that is, with sets of on/off switches and battery. What had caused the comment was a report of an electronic form employing hundreds of transistors, which it was claimed, could, in effect, think and work out suitable replies to any move made by the human player and could beat him every time. I wondered if any of my readers had experimented with either this or any other game, and, as I say, I am surprised to have heard nothing from any source. What does this mean? Does it indicate that this particular branch of electronics holds no interest for the home constructor, is too expensive, or that no other games may be adapted for electronic operation? What I now have in mind is an electronic version of "Nim", in which in place of matches it would be possible to use strips of light (slots in a piece of hardboard, for instance) which could be extinguished by a system of switches. This would be easy to make up and would save laying out the matches each time, a simple master switch serving to cancel the on/off switches, which could be of the two-way type. Surely there must be other games, and it would be interesting to see whether these notes arouse any interest amongst the many keen experimenters who I know read these pages.

Vintage Sets

I recently was treated to a very pleasing demonstration of a vintage set, which, apart from the pleasure of hearing it, also made me think about modern developments. This set was of American origin and was made well before the last war, standing about 5ft high and being made from 1in. timber. It was most ornate in design and looked really old fashioned. But when I heard it in operation I had a real shock. The quality was really first class with a most remarkable range of tone, a beautiful round full bass, free from resonance, and a clean, crisp top. It apparently had a switch with two settings, one giving nine valves, and the other only five — a sort of "ordinary/quality" switch. I gathered it employed a push-pull output stage (driving an energised speaker) with two power triodes in each leg, and, what is more amazing, I was assured that all the original valves were still being used. This was a standard commercial receiver of the day and I can assure you that the quality would put to shame many of the receivers which I have heard in recent times and which are so-called "hi-fi" receivers.

Speaker Hints

Speaking of loudspeakers, there is an interesting field for experiment in the method of feeding two or more units in equipment designed for high quality. The usual scheme entails a cross-over network designed to feed all frequencies below a certain value to the large unit, and frequencies above to a tweeter or small unit. Now these networks usually work out very expensive in view of the very large chokes which are needed, but I recently heard of two novel methods of building cross-overs which have many advantages over the usual inductance and capacity networks, and which are productive of much better results. One of these entails the use of a simple two valve amplifier (an output valve of the 6V6 class), all values in the amplifier being of such a range that they would accept only frequencies above 2,000c/s. This is certainly a novel approach to the subject and could be productive of some interesting results. The other scheme was on a similar basis, but utilised transistors, each stage also being designed to cover a limited frequency range. I wonder how many hi-fi fans would go to the length of building up similar arrangements in order to make the most of their audio installation?

The P.W. Troubadour

(Continued from page 142 of the June issue)

A SEVEN TRANSISTOR, DUAL-WAVE, SUPERHET RECEIVER

By T. R. Huxley

WHEN wiring has been finished according to Fig. 4 (on Blueprint 3, last month), the ferrite rod can be fitted. Its mounting cradle is held by a 4B.A. bolt near the loudspeaker opening. A spare nut or two must be put between the mounting cradle and the panel, so that the rod windings are clear of the trimmers. The M.W. winding is near the tuning condenser, the L.W. winding being to the right in Fig. 6. The coloured leads are then cut down, and soldered to the appropriate points, as in Figs. 2 and 6.

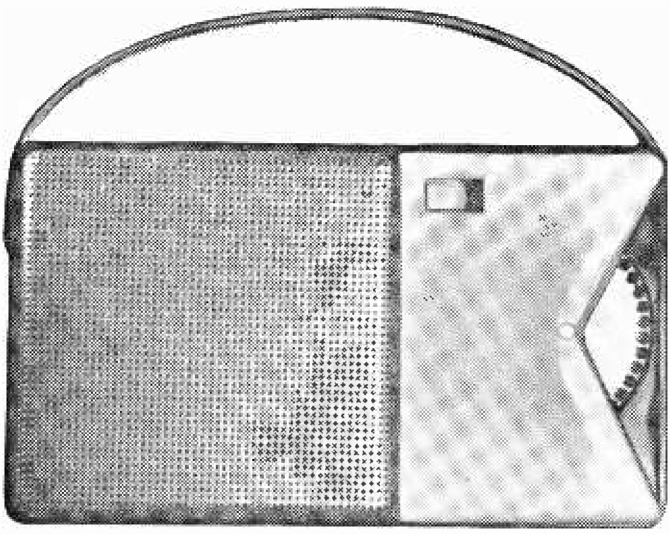
Loudspeaker

Four short countersunk bolts secure the loudspeaker to the inside of the cabinet. Two flexible leads are taken from the loudspeaker, to the receiver. Viewing the cabinet from behind, the loudspeaker tags should be to the right, or they will probably come into contact with other wiring.

One loudspeaker lead goes from the positive end of C17; the other lead is taken from the junction of R23 and the output transformer secondary. The remaining transformer secondary lead is also wired to the positive side of C17.

When the receiver is first tested, switch on, leaving the volume control at minimum volume. If the set oscillates, switch off at once, and reverse the secondary leads of the output transformer T2—that is, the lead originally taken to R23 now goes to the positive line, and the lead previously taken to the positive line goes to R23 and the loudspeaker. The oscillation should then be eliminated.

For initial testing, the set is left out of its case, so the loudspeaker leads need to be reasonably long. Subsequently, these can be cut down somewhat, if necessary, as a few inches of flex will allow the receiver to be taken out, and the loudspeaker to be left in its permanent position. The four bolts holding the unit should be tight.



The receiver's attractive case.

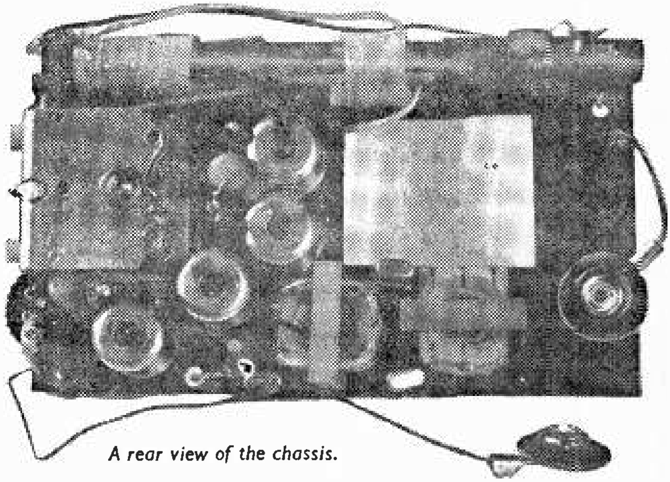
Battery

The battery rests to the right of the loudspeaker magnet in Fig. 2, and plenty of space is available. It is absolutely essential that the battery is always properly connected—positive to volume control switch, and negative to C17. Positive and negative snap fasteners should thus be used.

Check that the negative clip cannot come into contact with the tags on the L.W. part of the aerial rod. The lead from C17 can be very short, so that the clip holds the battery in position, or the clip can be insulated with tape.

When the set is first tested, a meter in one battery lead should show about 7mA to 10mA, with no signal tuned in. Transistors differ slightly, and this modifies the current. In particular, best possible results from the set, with individual output transistors depend on R21 and R22. The values given should be satisfactory. But if the output pair take much over 2mA to 3mA or so, with no signal, R22 should be slightly reduced in value. If this stage draws an extremely low current and reproduction is distorted, R22 needs slightly increasing in value. Quite probably no change will need to be made to R22.

For average loudspeaker volume, current will rise to peaks around 15mA to 25mA or so. With maximum volume, peaks may be around 40mA. Current consumption depends on volume. This means that economical running at reasonable volume is possible, yet very good volume is obtainable when wanted, though at increased battery drain.



A rear view of the chassis.

Alignment

This is most readily carried out in three stages — intermediate frequency amplifier, then medium waves, and finally long waves. If a signal generator is to be used, this can provide a modulated output, and a meter in one battery lead will indicate maximum when adjustments are correct.

If the set is adjusted by ear, keep volume down, by selecting weak signals, or by turning the set so that the directional effect of the aerial rod reduces signal strength. During these adjustments, keep the volume control turned up fairly well. If volume is kept down by means of the volume control, accurate adjustment by ear will be less easy.

When a signal generator is used, its output can be reduced, as sensitivity increases, but, if the set is aligned by listening to programmes, local stations will only do for initial, rough adjustment, and weak stations should then be sought, for more critical trimming.

The cores should be adjusted with an insulated tool made from a narrow strip of paxolin, or something similar. The same tool will fit the oscillator coil core.

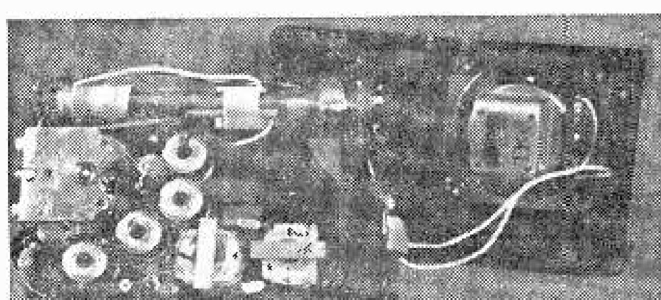
With the generator, apply a 470kc/s signal to the black lead tag of the aerial, and adjust the three IFT's for maximum efficiency. Without a generator, tune in any transmission which can be heard, and adjust the IFT's for best results. Watch that no core is right out, or fully in, as this may bring the circuits too far away from 470kc/s. Once the three IFT's have been tuned up for maximum results, leave them untouched.

Detailed instructions for ganging aerial and oscillator stages with a signal generator need not be given, because the constructor with a generator will probably be aware of the method of using it. Briefly, trimming (TC1 and TC2) is carried out at a high frequency (low wavelength) on the M.W. band, and inductance adjustments are carried out at a low frequency (high wavelength). These inductance adjustments are made by rotating the oscillator coil core, and moving the M.W. winding on the rod. The L.W. band is similarly treated, except that TC3 is the aerial trimmer, while TC4 is the oscillator padder trimmer.

Alignment on Stations

To align without a generator, move the slide switch to the left (Fig. 4) for M.W. reception. Unscrew TC1 and TC2 fully. Screw the oscillator coil core roughly level with the top of its can, and place the M.W. winding with its tags roughly level with the end of the rod.

It should then be possible to tune in some stations. Choose one heard at moderate volume



The chassis complete and connected to the loudspeaker, ready for mounting in its case.

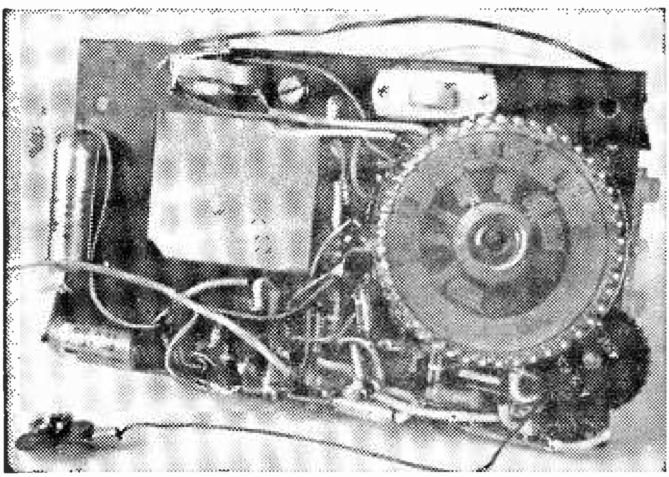
with the tuning condenser nearly right open. Adjust TC1 and TC2 with an insulated blade, meanwhile, if necessary, keeping the station in tune with the tuning control. It should be found that TC1 and TC2 should "tune" to a definite point which gives best results.

A station is then found with the tuning condenser nearly closed. The M.W. winding is then slid along the rod, and this should give a tuning effect, results being much improved at the correct position.

As one adjustment has some influence on the other, it is usual to repeat the procedure a number of times.

Long Waves

With the set switched for long-wave reception, the Light Programme should be heard at about the middle of the band. If not, adjust TC4 until this is so. If this station can only be received with the tuning condenser nearly closed, screw the oscillator coil core down a half turn or two. On the other hand, if the Light Programme is too near the low wavelength end of the band (tuning condenser open) and TC4 is already well unscrewed, the oscillator coil core must be unscrewed a turn or so.



The front of the chassis, with the tuning dial in position.

To complete L.W. adjustments, adjust TC3 for best results at a low wavelength (tuning condenser open) and the position of the L.W. winding on the rod at a high wavelength (condenser closed). If the oscillator coil core has been moved, some re-adjustment, particularly of the M.W. winding on the rod, will be needed, to restore full efficiency on the M.W. band.

The whole aligning procedure can be carried out in a few minutes, but if the constructor has no experience with superhet circuits, a few extra points may be helpful.

Band Coverage

If low wavelengths cannot be reached on the M.W. band, the capacity of TC1 and TC2 is too high. They should thus be unscrewed. If they are fully unscrewed, and the set still fails to have a minimum tunable wavelength of around 200 to 205 metres, the plates on the trimmers should be *carefully* separated with a knife. The thin insulation between the plates must not be broken. Some trimmers which have been left tightly screwed down have such a high minimum capacity that it is impossible to reach the low wavelength end of the M.W. band until this has been corrected.

On the M.W. band, a maximum wavelength in the region of 550m should be reached. If this is not so, the oscillator coil core probably needs screwing in slightly. When this core is screwed in, the M.W. part of the aerial has to be moved a little further on to the rod, to match.

Should the set tune much higher on the M.W. band than is required, with the condenser fully closed, unscrew the oscillator coil core, and withdraw the M.W. winding a little, to suit. The oscillator core position depends on the exact capacity of C4, and this is why individual adjustment is needed.

On the L.W. band, C3 and TC4, in conjunction with the oscillator coil core, govern the highest wavelength tuned (condenser closed). The L.W. winding is then adjusted on the rod, for best results. Finally, TC3 is adjusted at a low wavelength on this band (condenser nearly open).

It is best to leave final, careful adjustments until the set is installed in its case. All adjustments (except TC4) can be made from behind.

Cabinet Fitting

The cabinet mentioned is available in black and cream, red and cream, and blue and cream. The loudspeaker is bolted securely to it, as described, all fixing holes being provided.

Three 6B.A. countersunk-headed bolts are inserted through the holes in the front of the cabinet. A sleeve about ½in. long, or spare nuts, will be needed on the bolt near the loudspeaker. The two other bolts need sleeves about ¼in. long, or spare nuts adjusted to suit.

The receiver can then be inserted, the volume control fitting in the provided slot. Nuts are placed on the bolts, and tightened. The slide switch should project, without binding.

The gold metal loudspeaker grille can be fitted as soon as the loudspeaker has been bolted in, and it is held by four lugs, which are turned over inside the cabinet.

The tuning dial does not need removing to install the set, as it passes through a large opening in the cabinet. The slide switch extension is then placed on the switch, and the shaped cover, which goes over switch and dial, may be fitted in position. Studs on this engage with holes in the cabinet.

Finally, the handle is fitted with two special pins, which are opened inside the cabinet. The back is a simple push-on clip fitting. ■

Short-wave Listeners' Log

MANY S.W. receivers, including those of simple type, can perform well with inefficient aerials. For this reason poor aerials are often used and probably give reception of stations over a distance of thousands of miles. Despite this, when really good S.W. results are wanted, an efficient type of aerial is worth while. For real Dx working, such as reception of Australian and New Zealand stations, such an aerial can make all the difference. Remote Dx may be inaudible with a poor aerial but come in well with a good aerial.

The requirements of a good aerial can be put under a number of headings. Very often *all* these points cannot be met, but adhering to even only one or two will greatly improve results if the present aerial is poor.

Signal Pick-Up

This should naturally be as large as possible. Height above ground and the distance from earthed objects is important. Other things being equal, a doubling of effective height will increase signal strength approximately *four* times. For short aerials pick-up is roughly proportional to length, so time spent in getting a reasonable length of wire as high as possible will be more than justified.

Lack of Noise

Local noise may blanket out weak signals and so the aerial should be remote from mains wiring, etc., and the downlead should also be clear of such wiring or be of the anti-noise type. The simplest anti-noise down lead is 75Ω coaxial cable, taken to the centre of a dipole cut for a chosen band. An open wire transposed feeder is also helpful and allows the aerial to be used on several bands. An aerial, a ½-wave long, may be connected to a 75Ω coaxial downlead, the outer braiding of which is earthed.

Multi-band use

One aerial for all bands is often the aim of S.W.L.'s and an end-connected wire, taken to the receiver, will work on all bands. An excellent all-band aerial is the tuned doublet, which is an aerial, cut in the centre, with two leads, held roughly 4in. apart with insulated spreaders, descending from this point.

The Zepp feeder will also work well on all bands and is fundamentally the same as the doublet feeder, but one feeder wire goes to the *end* of the horizontal aerial, the other ending at an insulator.

Single Band Use

Listening on one particular band allows the aerial to be chosen to suit and dipoles, with a coaxial feeder as described, are largely used. The lengths for the popular Dx bands are 22ft. for 21Mc/s and 33ft. for 14Mc/s (the feeder length is unimportant).

Receiver Matching

Best results are obtained when the aerial feeder impedance matches the receiver input impedance. With a Zepp or doublet feeder an aerial tuner will tune the feeder and allow matching to the receiver. Such a tuner is any air-spaced variable capacitor and parallel coil, tunable to the operating frequency. Each feeder has a clip and is tapped on to the coil equal distances from the centre tap, which is earthed. The receiver aerial lead also has a clip which can be taken to any turn on the coil. Aerial tuning and clips are adjusted for best volume.

Directivity

Aerials of the kind mentioned are not very directive, so there is no need to orient the wire any particular way and good reception can be expected from all directions. There is also usually no great loss of results if the aerial is sloping.

Materials

Stranded wire (about 7/26) or solid wire (about 14s.w.g.) will do well. The aerial should be one uncut length or any joints must be soldered. A good ribbed glass or similar insulator should be fitted at each suspension point. If the down-lead is not screened it should be well clear of walls, etc.

Earth

Finally a reasonably stout, short lead to a good earth will always help. A copper or plated earth spike or other non-corrosive metal object actually buried in the ground will do well for this purpose.

Servicing Tape Recorders

(Continued from page 209)

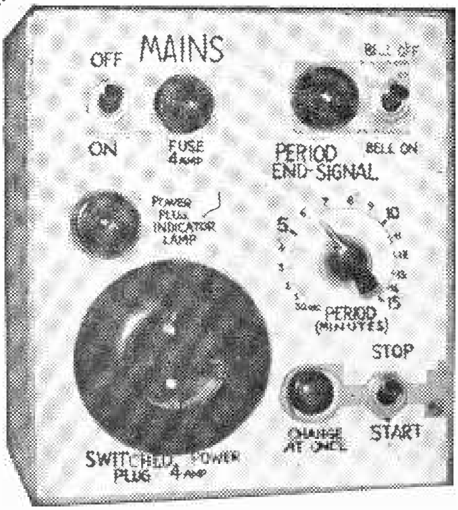
The smaller current required for bias is fed to the recording head through C2 and R1, while the larger erase current is fed through C3 direct to the erase head.

Prevention of Surges

Resistor R2 and capacitor C4 give a fairly long time-constant which ensures that the bias and erase signal amplitude rises slowly on switching on and falls slowly on switching off, and in this way transient surges of signals are avoided.

To conclude this article, Fig. 15 shows the Meissner oscillator which is also frequently employed in domestic machines. This uses two coils—one for feedback—instead of the tapped coil of Fig. 14. Otherwise the operation is similar to that already described.

(To be continued)



ELECTRONIC

By E. McLoughlin

A USEFUL AND ACCURATE REPETITIVE TIMING UNIT

THIS unit performs timing functions of any duration from 30 seconds to 15 minutes. By simple alteration of component values it is easy to extend the range of times available from fractions of a second up to several hours. At the end of a run of time of the selected value a red neon signal lamp glows for approximately five seconds, and, if switched to operate too, a bell rings simultaneously for approximately five seconds. Thereafter a new period of the same set length begins automatically, without the need for an operator to restart it, and when this period has expired, lamp and bell operate again and another equal period starts and so on, until the unit is switched off.

The apparatus described has further features too. Not only does it give the above-described audible signals at regular intervals, but it also performs a mains-switching function of up to 4A power at mains voltage, at the termination of each timed period. A mains output power plug is mounted on the panel, and the switching is such that the power at the plug is switched on for one run, off during the whole of the next run, on again during the whole of the third, and so on. A second neon lamp is mounted on the panel near the power plug, to show whether power is on or off during the run in progress at any moment. Finally, the apparatus is fitted with a bell-push labelled "change at once." When this is momentarily pushed, it causes the run in progress, whatever its stage of progress may be, to be terminated immediately, the lamp to light and the bell to ring for the normal five seconds, the power-plug condition to change over, and a new run of the set length to start.

When the reader has read the circuit and building instructions below, it will be apparent to him that the combination of features and operations incorporated into the apparatus here described is only one of a large number of possible variations. Simple circuit alterations, such as different dispositions of relay contacts, will easily give a host of other functions.

Circuit Principles

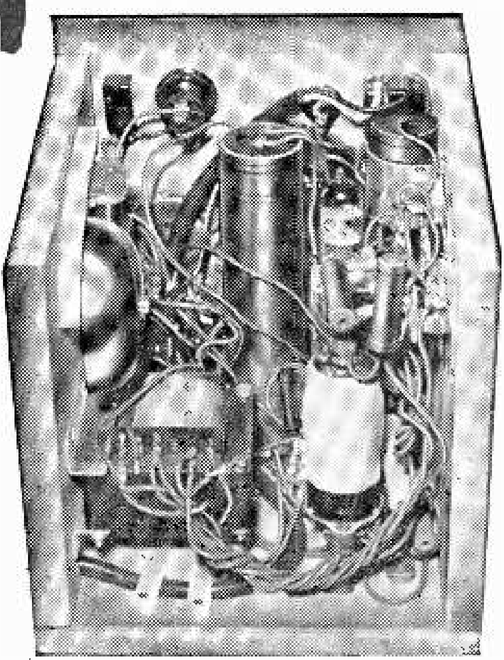
A good-quality condenser is used as the basic timing element, in conjunction with a variable resistor. These are Ct and Rch respectively in Fig. 1a, which shows the basic circuit. The cathode resistor Rk, by virtue of the voltage drop across it due to the anode current of V1, supplies the charging voltage which charges Ct through Rch. At first the anode current is small, only about 1mA or so, to give a voltage about equal to the grid-base of V1 (about 5V) across Rk. The grid is at chassis potential, because Ct is initially uncharged.

Now imagine the charging to have progressed until Ct has attained a potential of 1V. The grid of V1 will then also be 1V above chassis, and, by cathode-follower action, the voltage across Rk must also have risen by one volt. Thus the difference between the voltage on Rk and the voltage on Ct has not changed. It remains constant at roughly 5V. Thus, for every period equal to the basic time-constant Ct.Rch, the condenser Ct will rise in potential by about 5V, and the anode current of V1 and the voltage across Rk will have risen accordingly. This process will continue until the valve reaches its full anode current, and the voltage across Rk and on Ct has risen to 50 or more.

In this manner the charge of Ct is far slower than it would be if the condenser were charged direct from a constant supply of 50V; in fact about 10 times slower. This slowing-up action of the V1 circuit, which is called a cathode-follower bootstrap-circuit, enables large charging times to be obtained with condensers of reasonable sizes.

In fact, the charge is not as steady as in this idealised explanation, but becomes more sluggish towards the end (Fig. 1c). This would cause great errors in time for slight errors in the exact current required to energise the relay in the anode circuit. To overcome this difficulty, the "avalanche amplifier" V2 is added (see Fig. 1b). When the voltage at V1 cathode is still low, V2 is heavily cut-off by its high negative bias, and is effectively

ROCESS TIMER



not present, but the bias is so proportioned that when the cathode of V1 has risen to about 50V positive, V2 just reaches cut-on at its grid. A small further increase of V1 cathode potential then causes heavy anode current in V2 and this current also passes through the relay. Thus, the total current is rising very rapidly at the point where the relay energises, and small inevitable fluctuations of energising-current value cause little error in the timed periods.

Actual Circuit Details

The basic circuit elements just described will be recognised in the full theoretical circuit, Fig. 2. R6 is added to determine the shortest period which may be selected; R9 is a grid-stopper to prevent parasitic oscillation. The "change at once" button shorts most of the charging resistance (except R7), which reduces the period to a fraction of a second. R7 is necessary to prevent too sudden a rise upon pressing the button. R8 is to discharge C1 again at the end of the period, through the relay contacts 'a'.

When a period is complete, and relay Rly1 energises the signal neon is lit via contacts 'b,' and the bell rings via contact 'c,' if S3 is closed. Current passes to the trip-relay through contacts 'd,' and throws it over. At the same time, C1 discharges through R8 via contacts 'a,' and this takes about 5 seconds. When C1 has thus discharged so far that the anode currents are unable to hold Rly1 closed any longer, this relay de-energises, the lamp extinguishes and the bell ceases to ring, and a new run commences. R2 is present to give a permanent current through the relay Rly1, almost equal to that at which it would de-energise after being energised. This is to ensure that the circuits of V1 and V2 and C1 really do return virtually to zero each time before the relay de-energises, and thus the true starting conditions are reproduced each time. The exact value for R2 will depend entirely on the relay used, and will normally be such that about one third of the energising current flows through it.

(To be continued)

Note: Fig. 2. and the Components List appear overleaf on page 230.

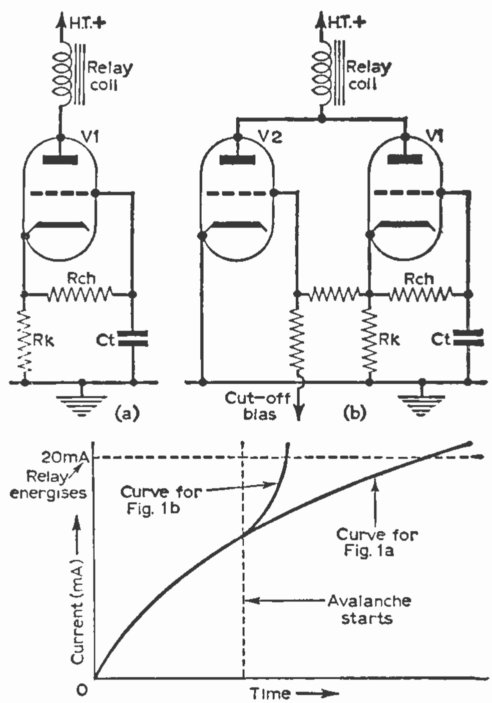


Fig. 1a—Basic 'bootstrap' cathode follower circuit.
Fig. 1b—Addition of an 'avalanche' amplifier (V2) to the basic circuit of Fig. 1a.
Fig. 1c—Charging curves for Ct in Figs. 1a and 1b.

ELECTRONIC PROCESS TIMER—CONTINUED

COMPONENTS LIST

Resistors:
(All carbon types, 10% except where stated)
R1 100k 1W
R2 See text (about 75k 2W)
R3 2·2M 2W (see text next month)
R4 330k 1W
R5 5k 2W (wire-wound or ±5% carbon)
R6 100k 1W
R7 180Ω 1W
R8 56k 1W
R9 100k 1W
VR1 2M linear variable
(high power ratings are specified for high stability)

Capacitors:
C1 32μF 150V to 250V; high insulation; NOT electrolytic
C2 8μF 350V electrolytic
C3 1μF 500V paper

Switches and Relays:
S1, S2, S3 — SPST toggle switches for 250V A.C. S1 4A rating; S2, S3 1A rating
S4 Small insulated panel-mounting bell-push
Rly1 Normal relay—300ohm 20mA—see text for alternatives (a, b, c, d are four independent 'make' contacts on Rly1—rating: 350V D.C., 50-100mA.
Rly2 Trip relay—6·3V magnet; mains 4A contacts (see text)

Valves and Lamps:
V1 EC92 with B7G ceramic, high insulation valveholder
V2 SP61 with M.O. valveholder, preferably ceramic
LP1, LP2 — Mains voltage signal neons in panel-mounting indicator lamp Sockets, with photographically safe red glass

Miscellaneous:
Mains transformer—primary to suit local mains; Secondaries—250V 40mA, 6·3V 1A, 6·3V 1A.
3V to 8V electric bell
Panel-mounting 5A three-pin mains socket
Panel-mounting mains fuse holder and 4A fuse
MR1, MR2 — Metal rectifiers—250V 50mA (E250C50)
Connecting wire with substantial insulation (see text)
Tag-strips with faultless insulation
Wood for cabinet

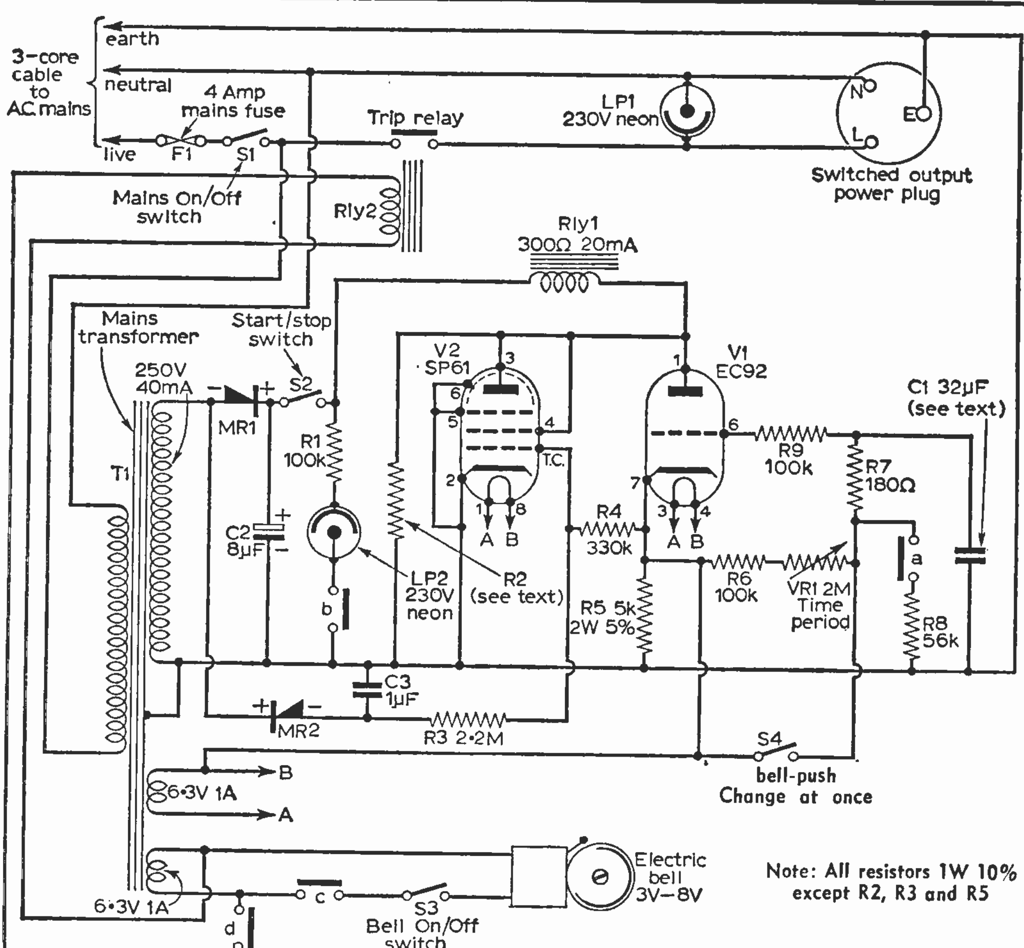


Fig. 2—The circuit of the process timer.

NEONS in the Experimenter's Power Pack

A discussion of some factors of fundamental practical importance in the design of circuits using neon-tubes, leading to some simple but worthwhile further improvement to the "Experimenter's Power Pack" published in PRACTICAL WIRELESS, January 1962, etc.

By M. L. Michaelis

(Continued from page 170 of the June issue)

THE conventional valve oscillator was the last topic dealt with by the author last month.

A completely different class of oscillators is formed by those circuit elements which are *inherently* of negative resistance, without any external power-feedback influences being necessary. The simplest example probably familiar to most experimenters is the basic tetrode valve, with its "anode kink" in the region where the anode voltage has fallen just below the screen voltage. Here there is a small range of anode voltages where the anode current rises with decreasing anode voltage, representing negative anode resistance, caused in this instance by effects due to the higher voltage screen-grid capturing secondary electrons proceeding from the anode due to the impact of the main anode current. The constructor may be familiar with various oscillator circuits of the "transitron" or "dynatron" class utilising this negative resistance of the tetrode-kink; he will also doubtless have heard that the introduction of the suppressor grid, connected to the cathode, close to the anode, was made to remove the tetrode-kink, thus producing the stable pentode valve.

Amplitudes

An important feature of the "tetrode-kink" must be pointed out at this stage, as it is common to *all* cases of *inherent* negative resistance. The "tetrode-kink" is confined to a *small region* of voltages and currents; for all other voltages and currents through the circuit element in question the resistance is positive, i.e. voltage increase is needed to increase current (see Fig. 3). This fact limits the amplitude of oscillation of all oscillators using circuit elements with inherent negative resistance, the amplitude being such that voltage and current excursions are basically limited to the region showing negative resistance. This region may under certain circumstances be very small, so that oscillation at very low amplitudes can occur, possibly little greater than normal hum-levels in a circuit. This effect was obviously present in the author's prototype of the "Experimenter's Power Pack", and it is thus clear that a discussion of the voltage/current characteristics of neon-tubes is now required, seeking regions of inherent negative resistance in such characteristics. Once this is understood, the main question is answered. If we desire the neon-tube circuit to run as an oscillator, we must place the would-be operating point within the region of negative resistance. If we desire a stabiliser-function, we must choose an operating point safely removed from the negative-resistance region of the characteristic.

The important conclusion of this discussion on negative resistance, as far as practical issues are concerned, is to realise that common neon tubes form a second example of inherent negative resistance, in addition to the familiar basic tetrode valve.

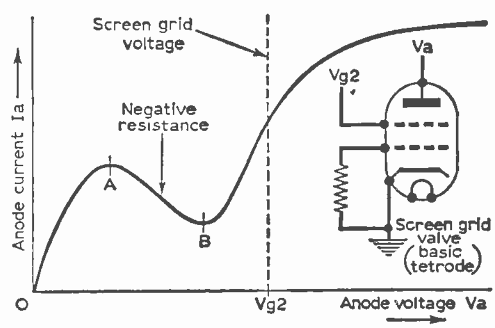


Fig. 3—The anode characteristic of a screen grid tetrode. The region A to B represents negative anode resistance; in this region DECREASE of voltage causes an INCREASE of anode current. All other parts of the curve represent normal positive resistance.

Anode Characteristic of Neons

Fig. 4 shows the general features of the anode voltage/current characteristic of a neon tube. Starting with zero voltage and current at O, let us gradually increase the voltage. The line O to B is thereby followed, i.e. only an extremely low current flows (far too small to be registered with anything except the most sensitive specialised amplifiers). This low current is due to ionisation in the neon resulting from cosmic and other atomic radiation present in the surroundings, and may be ignored for our present purposes.

The striking-voltage, Vs, is reached at B, and the real discharge commences in the neon, accompanied by the first visible appearance of light in the tube. As long as the limiting resistor in the anode circuit does not allow more current to flow than is represented by the point C, the voltage remains constant at the value Vs for any current value between B and C. Thus, in principle we have here a voltage-stabilisation range, but in practice this range is not useful, as it is very small (only a fraction of a milliamp for most neons), somewhat unstable, and subject to considerable changes according to the age of the neon.

Effects

If the limiting resistor is, however, of such a value as to cause a current lying between the values for points C and D to flow, in theory, once the neon has struck, then the circuit necessarily goes into the familiar sawtooth oscillation, because the would-be operating point lies on a region of the characteristic having negative resistance. Thus no operating point lying between C and D can be

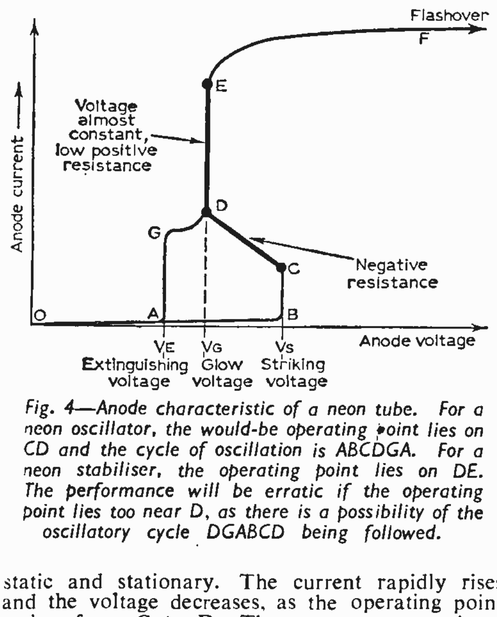


Fig. 4—Anode characteristic of a neon tube. For a neon oscillator, the would-be operating point lies on CD and the cycle of oscillation is ABCDGA. For a neon stabiliser, the operating point lies on DE. The performance will be erratic if the operating point lies too near D, as there is a possibility of the oscillatory cycle DGABCD being followed.

static and stationary. The current rapidly rises and the voltage decreases, as the operating point rushes from C to D. The excess current above that capable of arriving through R in Fig. 2 (last month), required to reach point D, is supplied from the charge on the condenser C. When point D is reached, the voltage would have to increase again slightly for any progress up DE. This it cannot do, as R could not even supply enough current to reach point D, and thus the condenser had to supply this current, and certainly cannot increase its voltage again under these circumstances. The condenser cannot even continue to supply the current represented by point D without further drop in its voltage and thus voltage and current must fall as the portion D to G is traced out on the characteristic. At point G, representing the extinction voltage of the neon, the discharge cannot maintain itself any longer, and stops abruptly, so that the current ceases without immediate change of voltage, i.e. conditions drop from point G to point A. The condenser then begins to recharge, then, along a portion A to B of the same line O to B as traced out at the initial start. At C the neon strikes again, to start another similar cycle. And so on, until switched off.

It is clear that, to secure oscillation, i.e. to obtain a would-be operating point between C and D, there is a *definite lower limit* imposed on the value for the resistor R in Fig. 2, such that the current supplied does not exceed the value for point D in Fig. 4. There is also in theory an upper limit for R, though this is considerably less definite and certainly so high that it can normally be ignored, as the point C in Fig. 4 represents a very small current, and is not well-defined. Thus, there being a lower limit for the value of R in a given neon circuit if oscillation is to take place, there is an upper limit to the frequency of oscillation achievable. The frequency is determined by the time constant C times R in Fig. 2, being inversely proportional to this. Thus the highest frequency of oscillation is obtained with the smallest possible values for C and R in Fig. 2. The smallest C is obtained by omitting a physical condenser altogether, so that the remaining stray capacities of the circuit are operative. The smallest tolerable R is dictated by the condition for maintaining oscillation, discussed above, which thus, together with the stray capacities determines the maximum frequency possible. This lies between 10kc/s and 50kc/s in most cases. No limit is imposed on the lowest possible frequency, as the condenser C in Fig. 2 can be made as large as one pleases. The condenser does not affect the decision as to whether oscillation takes place or not. This decision is fixed solely by the H.T. voltage used, the value of R and the anode characteristic of the neon, in the manner discussed above.

Neon tubes particularly suitable as oscillators should have large differences between voltages and currents represented by the points C and D in Fig. 4, i.e. the range CD should be a major part of the whole characteristic of the tube. This is a function of the geometric design of the electrodes within the tube, and their surfaces, as well as the gas pressure.

Drift of DC with age

A point of great practical importance is that the range CD in Fig. 4 often undergoes considerable change within the first 10 to 100 operating hours of an initially new neon tube. This effect was observed experimentally by the author, and is probably to be explained in terms of changes in the electrode surfaces inside the tube during the initial operating hours. The current-value corresponding to point D in Fig. 4 can be very much less in a brand new tube than in the same tube after some 100 or so operating hours. Thus, an operating point initially within the range D to E, and thus stable, can drift into the range C to D later, so that an initially stable circuit goes into oscillation after some 100 hours of operation. This appears to be the ultimate explanation of the effects noticed with the author's "Experimenter's Power Pack", and accounts for the presence of the low-amplitude oscillations after about 2,000 operating hours, these oscillations having been initially absent.

Neon Stabiliser Circuits

If the circuit is to perform as a voltage stabiliser, then an operating point within the range D to E is required, i.e. the tube must be run with amply sufficient anode current under all circumstances. The value of R (in Fig. 1 last month), has a definite upper limit which must not be exceeded if oscillation is to be prevented with certainty. This upper value for R permissible in the stabiliser circuit is such that the tube current in the neon still lies safely above the value corresponding to point D in Fig. 4, measured when the output load current drawn has its maximum value, i.e. neon current its minimum. If R has a value small enough to guarantee sufficient current in the neon when no current is drawn from the stabilised output, yet not small enough to leave sufficient neon current when the output is loaded up to the intended maximum, then as the output load current is gradually increased the circuit may burst into oscillation as the operating point of the neon passes point D in Fig. 4. This effect was clearly also present in the author's "Experimenter's Power Pack" after some 2,000 hours of use, due to a drift of the location of point D in Fig. 4. It explains the observed apparently haphazard presence or absence of oscillations, according to the precise loadings of the outputs.

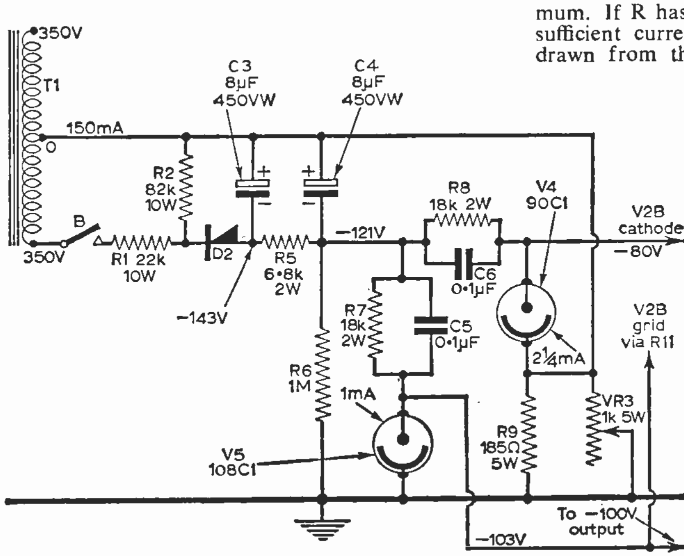
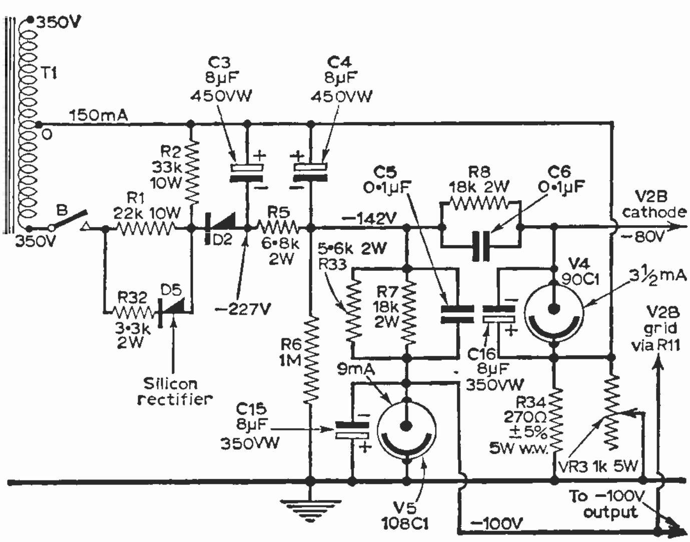


Fig. 5 (above)—Part of the original circuit of the "Experimenter's Power Pack" to show the circuits of the neons V4 and V5. Voltages and currents shown are with respect to earth and as measured after 2,000 hours of operation.

Fig. 6 (below)—Modified version of the circuit in Fig. 5 for greatly improved stability. (Note: Point D in Fig. 4 is quoted as "5mA maximum" for the 108C1. The new operating point in this circuit is at 9mA, and the (—100)V output may be loaded up to 4mA (f.s.d. on the meter) in this version of the circuit without the start of oscillation).



Manufacturer's Ratings for Neon Tubes

The simple conclusion is that neon tubes intended for voltage stabilisation must not be starved of anode current. A glance at data tables for neon tubes, supplied by the manufacturers, reveals that, apart from statements of the stabilised voltage possible with tube, also minimum and maximum tube currents are specified. The maximum current is simply dictated by the need to avoid danger of destruction of the tube (see Fig. 4), but the ***minimum*** current is far more important than one would think. It represents the highest current value that point D in Fig. 4 is likely to reach at any time during the lifetime of the tube. and thus represents the minimum tube current that must be guaranteed under all circumstances of operation if oscillation is to be permanently prevented with complete certainty. The author must frankly admit his own insufficient awareness of this subtle practical point at the time of design of the "Experimenter's Power Pack", particularly as most textbooks and essays he has read to date—in fact. all of them, including a small handbook devoted *entirely* to

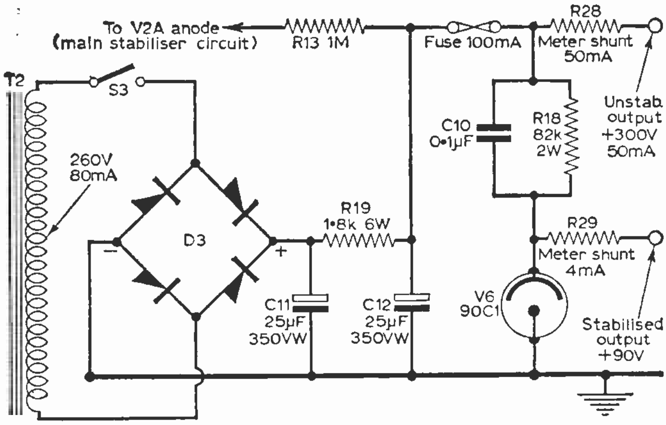


Fig. 7—The unstabilised H.T. circuit of the "Experimenter's Power Pack."

neon tubes — completely omitted to make any mention of it whatsoever. Thus the operating points of the neons in the original design of the Power Pack, whilst sufficiently high in current for most samples of new neon tubes of the specified types, are too low to guarantee stability as the tubes age.

Modifications made to "Experimenter's Power Pack"

Figs. 5 and 7 show the *original* form of relevant portions of the circuit of the "Experimenter's Power Pack", with measured values of important voltages and currents after 2,000 hours of operation. Figs. 6 and 8 show the new modified versions of the same portions of the circuit, showing changes of resistor-values made to ensure that the neons all receive ample current to ensure complete stability under all conditions.

It should be emphasised that, contrary to common belief, condensers connected in parallel with the neon tube or in parallel with R in Fig. 1 do not affect the decision as to whether the circuit is stable or oscillates, and could probably be omitted in a stabiliser circuit. Yet they do no harm, and certainly shunt any noise-effects from other causes that might be present. Thus they have been maintained, and indeed augmented, in the new modified design of Fig. 6

Other Modifications

Only one other modification was found desirable to the "Experimenter's Power Pack", and this has nothing to do with the neons. It was found that the maximum achievable voltage on the main stabilised H.T. output dropped to a mere 250V (instead of the normal 350V) as soon as the unstabilised "300V" output was simultaneously loaded up to its full capacity of 50mA.

This undesirable effect was not present if only a mere 10mA to 15mA, as required by a valve voltmeter, oscillator, etc. for which this output was primarily intended, was drawn simultaneously from the unstabilised output, which accounts for the fact that this deficiency in the original design was not noticed much earlier. Full-capacity simultaneous loading of both H.T. outputs is rarely required, and thus this shortcoming escaped notice for so long. For this very reason, too, it does not represent a serious fault, yet it is nevertheless desirable to remove it, especially as the cure was found to be extremely cheap and simple.

The cause was that the feed to V2A anode (see Fig. 7, which gives the relevant portion of the original circuit) came through R19, and thus suffered the same voltage drop as occurred across R19 due to current drawn from the unstabilised output. Thus this voltage drop was passed on to the stabilised output with the result that the stabilised output voltage could not exceed the unstabilised output

(Continued on page 241)

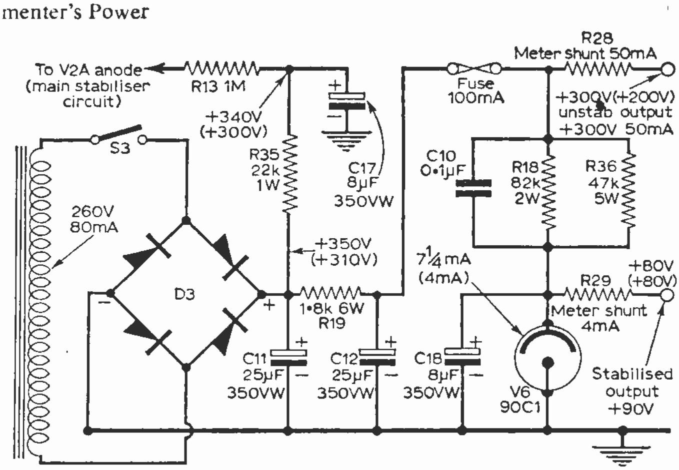


Fig. 8—Modified version of Fig. 7 with improved capacity for simultaneous high loading of the H.T. outputs.

Simultaneous loading now possible:

Main stabilised H.T. output—150-300V, 100mA (f.s.d. on the meter).

Unstabilised H.T. output—50mA (f.s.d. on the meter).

Loading of +90V stabilised output:

4mA (f.s.d. on the meter) if the unstabilised H.T. is not loaded; 1.5mA if the unstabilised H.T. is loaded to the rated 50mA.

(The loading of the main stabilised H.T. has no effect on the +90V output).

In the diagram, the figures in brackets were taken when the unstabilised output was loaded to the rated 50mA; others refer to the unloaded condition of this output.

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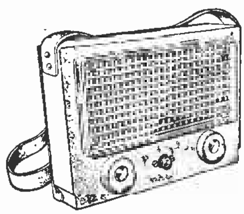

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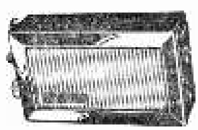

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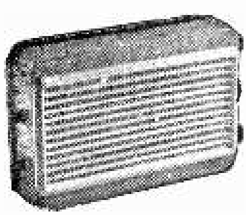

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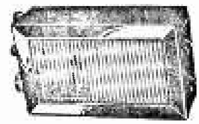

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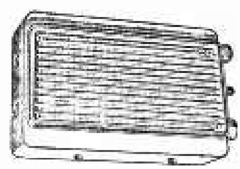

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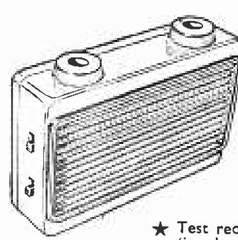

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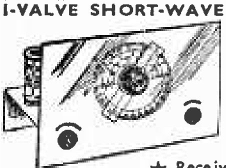

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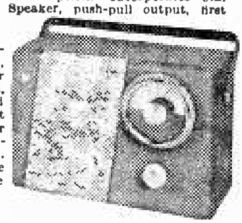

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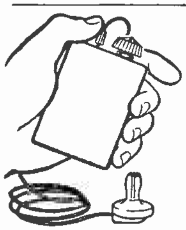

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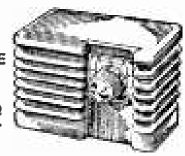

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USING AN OUTPUT PENTODE AS GRID-CONTROLLED H.T. RECTIFIER, A WIDE RANGE OF VOLTAGE CONTROL CAN BE ACHIEVED IN A VERY SIMPLE CIRCUIT.

(Continued from page 165 of the June issue)

By D. A. Brandon

ALTHOUGH, in last month's article, the author recommends an 807 valve for an r.m.s. A.C. voltage up to 250 at the transformer, a valve of even higher voltage rating, but which is unfortunately more expensive, as it seldom appears on valve bargain lists, is the EL34, and this is considered to be the most suitable valve of all for the circuit of Fig. 1 (last month). It should, at any rate, be easily obtainable. It has a peak anode rating of 800V, which is certainly sufficient for a 250V transformer, and the peak screen rating is 425V. This figure for the screen is still a little low theoretically, but considering that it applies for a positive voltage, for which sense about 350V can never be exceeded in Fig. 1, and that the negative peak voltage is likely to be permissibly much higher, an EL34 can be relied upon in the circuit of Fig. 1. Accordingly, the writer made all further experiments using an EL34, and performance results are given later in this article.

Using an 807, results will be very similar, but the *lowest* voltages attainable in the circuit of Fig. 3 will be higher than those obtained using an EL34, because of the lower mutual conductance of the 807.

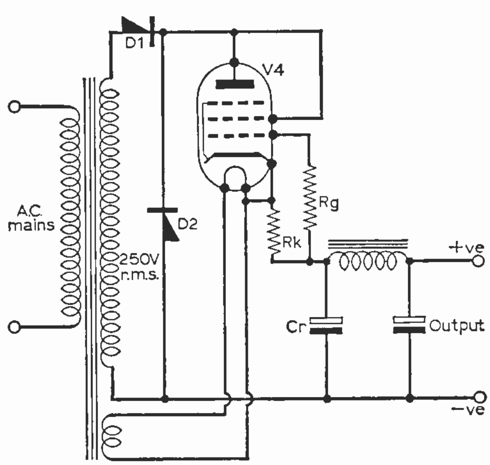

Fig. 4—The circuit of Fig. 1 (page 161, last month) modified to include two selenium metal rectifiers to remove the inverse voltages.

Addition of Metal Rectifiers

If the expense of an EL34 is felt to be too great, or the heat generation too high, it is possible to use an ordinary 6V6 or EL84 output valve with *perfect reliability* if a couple of selenium metal rectifiers are used to remove the inverse voltages. Fig. 4 shows this modification made to Fig. 1, and Fig. 5 shows the modification made to the ultimate variable-output-voltage circuit of Fig. 3. These rectifiers should be of 250V A.C. input rating, and about 25 to 50mA current rating. The first, D1, takes up the inverse voltage itself, whilst the second, D2, shorts out any portion of the inverse voltage that may still be reaching the valve. The need for D2 results because we have, on the negative half cycles, effectively two rectifiers in series — the metal rectifier D1 and the output valve. The valve certainly has the higher inverse resistance, thus D1 alone cannot be fully effective in removing all inverse voltage from the valve; hence the need for D2.

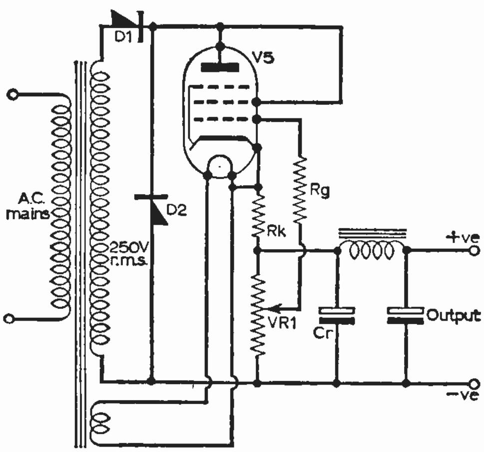

Fig. 5—The circuit of Fig. 3 (page 162 last month) modified to remove the inverse voltages.

Grid-control to Achieve Variable Output Voltage

An inspection of Figs. 1 and 3 (last month) will make it clear how the output valve itself is used as "variable resistance" by means of controlling its grid-bias voltage, which is obtained on VR1 from the output voltage itself.

It is clear that the maximum voltage obtainable across any load connected across the output is given when the slider of VR1 is at the top, A, and the circuit (Fig. 3) is virtually identical to Fig. 1.

The minimum output voltage is given when the slider of VR1 is at the bottom, at B. In this state the whole output voltage is applied as grid bias to the valve, and if this voltage is to be small the valve must be virtually cut off, to have sufficiently high resistance to cause the necessary voltage drop. Consequently the minimum voltage down to which one can regulate with VR1 is given approximately by the grid-base of the valve. It will be the lower, therefore, the higher the slope of the valve used.

Final Circuits

From the results of the above discussion, two final circuits have established themselves as ultimately the most reliable and suitable—namely, Fig. 3 with an EL34, and Fig. 5 with a 6V6 or EL84.

Fig. 6 gives component specifications for the EL34 circuit, and Fig. 7 a graph of performance results measured by the writer after building this circuit.

Fig. 8 gives component specifications for the circuit using a 6V6, and Fig. 9 performance results of the prototype.

The Performance Graph

The graphs are drawn in the form of a number of "load lines" for various effective resistances of the consumer-load connected to the output of the H.T. supply. These load lines are obviously determined *solely* by Ohm's Law applied to the

(Continued on page 241)

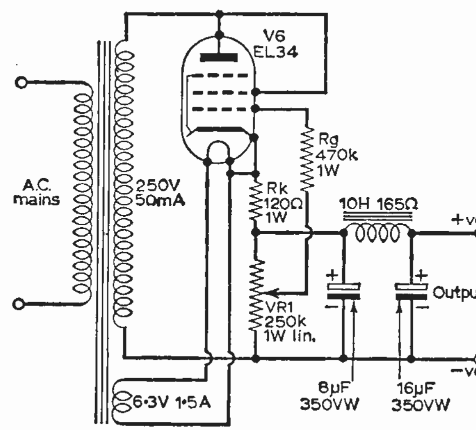

Fig. 6 (above)—The circuit of Fig. 3 with the component values indicated.

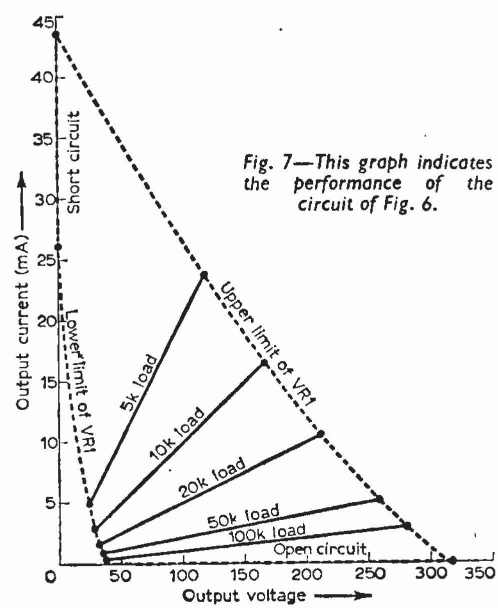

Fig. 7—This graph indicates the performance of the circuit of Fig. 6.

(Continued from page 238)

resistance-value of the consumer load, and have nothing whatsoever to do with the H.T. supply, as far as location on the graph is concerned. Thus all load lines must necessarily go through the origin O, as at 0 volts the current through any resistance whatsoever is 0 amps. The slope of the load-line, which is Volts needed for Amps caused to flow, is clearly the Ohm's Law definition of the resistance of the load to which the load-line is intended to apply. We can thus draw in all load lines as a fan of lines spreading out from O, without even building the H.T. supply, let alone measuring anything with it. But it is seen that there is one difference in the graphs of Figs. 7 and 9. The load lines are not complete, they start and stop abruptly. The load lines drawn thus represent only those portions realisable—i.e., those of all possible combinations of voltage and current which are actually realisable, using the circuit specified as H.T. supply, and a consumer-

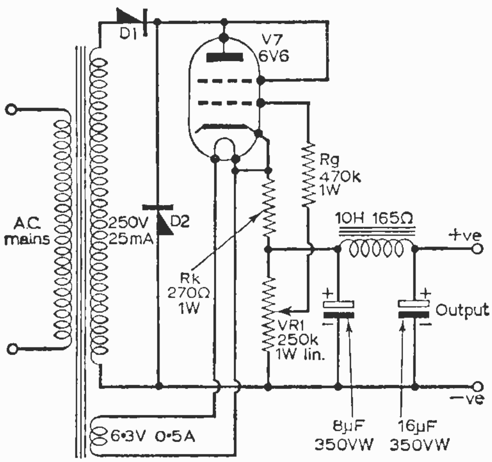

Fig. 8—The circuit of Fig. 5 with the component values indicated.

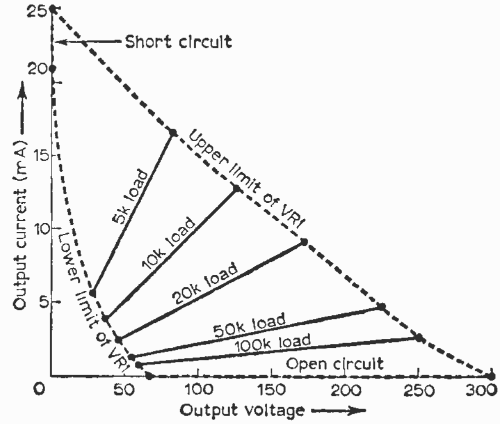

Fig. 9—The performance results of the circuit of Fig. 8.

load of resistance marked on the load-line, connected to the output. The portion of each load-line drawn is passed through from one end to the other as VR1 is turned through from one end to the other.

After joining up all ends of all load lines in the manner shown by the dotted line on Figs. 7 and 9, to form an area on the graph, we have at a glance on paper all possible combinations of output voltage and current whatsoever which the H.T. supply in question is capable of giving. If any desired combination of H.T. voltage and current for a certain consumer circuit lies within the area enclosed by the dotted line, then it is obtainable from the supply, simply by connecting the consumer circuit and adjusting VR1 until the desired condition is reached. If the desired voltage/current combination lies outside the enclosed area, then it cannot be supplied, though a suitable modification of circuit and component values might enable it to be included in the resulting new "operational area". ■

Neons in the Experimenter's Power Pack

(Continued from page 234)

voltage. Having realised this, the cure was simple, as shown in Fig. 8. Here the feed for V2A was transferred to the rectifier side of R19, and given its own independent new smoothing resistor and condenser. After this modification, full simultaneous loading of the unstabilised output up to 50mA had no effect upon the stabilised output voltage and its stabilisation for any voltage within the design range of 150 to 300, so that the defect was successfully removed.

Final Design

These simple modifications discussed in this article further improved the quality of the "Experimenter's Power Pack", which is now a really valuable piece of equipment. The general reliability and freedom from overheating has proved itself, in that the appearance of the internal construction was still "new", and bright and clean, at the time of the inspection after some 2,000 operating hours which gave rise to the writing of this article.

This period of operation represented some months of virtually non-stop operation day and night, the power-pack being switched off only for short periods of an hour or two at intervals of a week or more, for changes to apparatus in the long-term experiments which were being fed.

It is hoped that this article forestalls any difficulties or disappointments which constructors might experience with their power units, and that it also provides some interesting and useful tips in general for the use of neon circuits. ■

BOOKS REVIEWED

RADAR POCKET BOOK—by R. S. Boulding. 248 pages. Published by George Newnes Limited. Price 21s.

LIKE many of today's books bearing the term "pocket" in the title, this publication is too large truthfully to substantiate the use of that qualification; but as the word "pocket" is nowadays recognised as descriptive of the contents of a book being of the 'handy', reference class (rather than of its dimensions), the foregoing information must be regarded only as a warning for those who, on first reading the title, visualise the whole history of radar published in miniature form.

The author assumes, understandably, that anyone reading this book is already familiar with much of the fundamental knowledge necessary to command an understanding of ordinary radio. But this is not merely a reference manual for experts engaged in work on radar equipment—the first few chapters are devoted to a concise presentation of the electronic principles and formulae which are the basis of radar.

Subsequent chapters deal with the individual units which comprise a modern radar installation, and an informative section on testing and test gear is included.

It appears that the student of radar operation must keep a large store of formulae and equations readily at hand, for several "comprehensive" chapters seem to deal with little else; but comprehensive they no doubt are and for the radar operator, engineer or just the technically minded enthusiast, this book will find a natural home on the workbench along with all the other essential volumes.

BASIC RADIO COURSE—by J. T. Frye. 224 pages. Published by Gernsback Library, Inc., 154 West 14th Street, New York 11, N.Y., U.S.A. English agents: The Modern Book Co., 19-21 Praed Street, Londn W2. Price 32s.

THIS is a revised addition of one of the most popular technical books ever published by this company. Much new data has been added and in some cases up-to-date material has replaced earlier information.

The author begins with the basic elements of electricity—the electron theory, which leads to an understanding of Ohm's law, resistance, capacitance and induction. In these opening chapters the reader will gain knowledge slowly but surely through the precise and clear explanations of the author. However, it seems as though the number of illustrations, usually so large in Gernsback Publications, has been kept to a minimum which proves detrimental to the understanding of the more technical points.

As the book proceeds, terms common to radio are explained and the reader is shown how the component or components, associated with any of the terms operate in accordance with the laws involved. Each chapter in the book ends with a dozen questions on the subjects dealt with in the chapter for the student to answer and so test the knowledge he has gained.

Different stages of common circuitry are dealt with in following chapters—the power supply, the converter stage, some oscillator circuits, etc.

The last three chapters, which are concerned with transistor radios, instruments and tools and servicing techniques, only give elementary instruction on these subjects but this will prove valuable for the student as an introduction to different fields of radio.

The complete beginner to wireless will be a little confused by the discrepancies between American and English terminology when he compares the knowledge he has gained from this book to English radio circuits and literature, but these will soon become obvious.

RADIO AND ELECTRONIC LABORATORY HANDBOOK—by M. G. Scroggie, B.Sc., M.I.E.E. 537 pages, including over 300 diagrams and photographs in the text. Published by Iliffe Books Ltd. Price 55s. net; by post 57s. 3d.

IN previous editions the title of this volume was "Radio Laboratory Handbook" and, as the new title indicates, this new edition has been broadened in scope to include the field of electronics. Much of the book deals with the measurements involved in testing and assessing the performance of electronic equipment and the explanations given are lucid and in a style which makes for easy reading.

Not only are the means of making measurements discussed in great detail but also the reasons for making them in the first place. The interpretation of results also receives the attention it deserves; all too often the technician is capable of making tests on apparatus but unable to display the results of the tests in as clear a manner as possible so that he may interpret them easily, and so that his report will be clearly understood by those who eventually receive it.

Another valuable section deals with the standards required for very accurate tests and gives valuable information on the use of broadcast signals as frequency standards. Among rewritten sections are those on stabilised power units; indicators, including valve voltmeters and oscilloscopes; crystal attenuators; the construction of experimental apparatus; and those on manufactured equipment. There are new sections on the testing of transistors, diodes and F.M. receivers, on clip-around and digital meters, and on wow and flutter. The large reference chapter at the end of the book contains a concise summary of all the relevant information which may be required.

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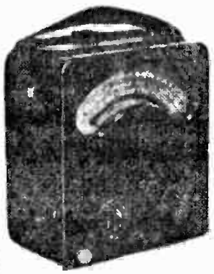

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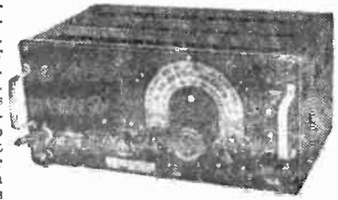

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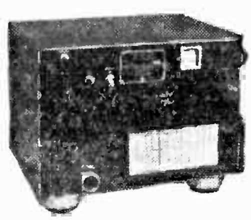

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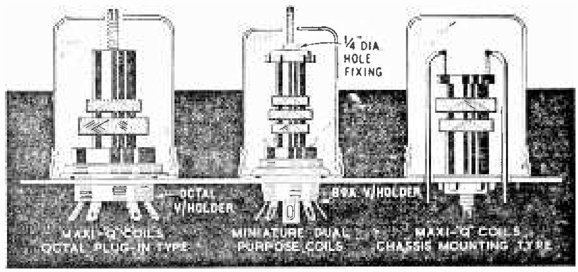

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A SURVEY OF PRINCIPLES OF PRACTICAL IMPORTANCE, AND USES OF THESE CIRCUITS

By L. N. Nash

(Continued from page 131 of the June issue)

In last month's article, the conventional half-wave rectifier circuit was dealt with.

The Conventional Voltage Doubler

It is perfectly feasible to feed a positive and a negative half-wave rectifier circuit of the types discussed in last month's article *simultaneously* from the *same* transformer winding, in the arrangement of Fig. 7a. This is, in a sense, a full-wave circuit because use is made of *all* half cycles, i.e., one of the rectifiers is always drawing current,

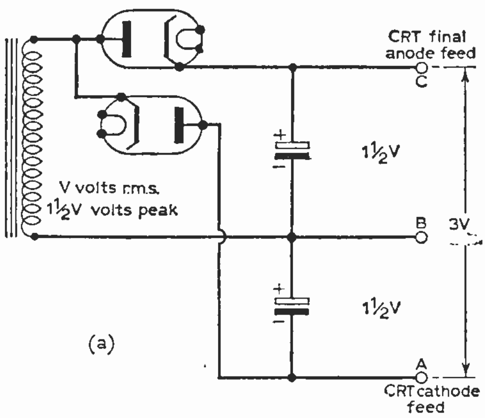


Fig. 7a—The conventional voltage-doubler circuit. (The voltages marked are ratios.)

whatever the polarity of the voltage from the transformer winding may be at any instant. But it is not usually classed as "full-wave", because the total output voltage is in essentially two parts, each of which is of half-wave nature. The circuit is normally known as the "conventional voltage doubler".

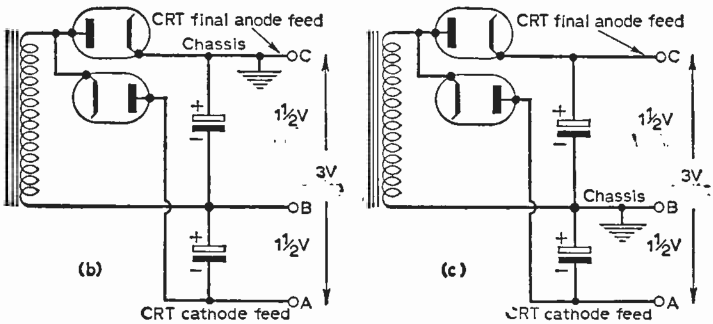
Three possibilities exist for practical forms. A voltage equal to about twice the peak A.C. value of the transformer winding is present between points A and C in Fig. 7a, whereas point B is at the half-way voltage-point.

Earthing

Now the three basic practical possibilities amount to the choice of whether we connect A, B or C to chassis. If we connect A or C to chassis, we have a true voltage doubler giving the doubled D.C. output of positive or negative polarity with respect to chassis, respectively. Such circuits are very conveniently used in small EHT circuits for small oscilloscopes. An ordinary 350V transformer winding will then deliver EHT voltages up to 1,000 with the circuits of Fig. 7b or 7d. The circuit of Fig. 7b delivers a D.C. voltage negative to chassis, and would be fed to the cathode of the cathode-ray tube, as indicated. This enables the final anode of the tube to be earthed, and thus the deflector plates to be approximately earthed. In consequence, coupling condensers from the timebase circuits and Y-amplifier need only be of normal H.T. rating.

The circuit has the disadvantage of needing a separate insulated heater winding for the cathode-ray tube, as otherwise the full EHT voltage would appear between heater and cathode, which would cause breakdown!

The circuit of Fig. 7d gives a positive voltage to chassis which would be applied to the final anode of the CRT, the cathode being approximately earthed. This circuit allows the CRT heater to be run off the same heater supply as other valves in the oscilloscope, but requires coupling-condensers of EHT-rating from the timebase and Y-amplifiers. It is very often more convenient to use this latter circuit, and Fig. 8 shows the power-supply section of a miniature test-oscilloscope which the author has designed and built. This instrument has already given two years of trouble-free service, and uses a practical form of the circuit of Fig. 7d. It is at once evident from this circuit, that the same rectifier circuit supplies H.T. for the timebases and amplifiers as well as EHT for the CRT. The positive EHT voltage is tapped at the mid-point B to give the H.T. voltage. This arrangement of supplying the single and the double voltage output simultaneously is in principle possible with any of these voltage doubler circuits, a possibility seldom realised by the average constructor. It is not even necessary to have equal loading of the two possible outputs, or to have even anything approaching equal loading. In such cases of unequal loading, as



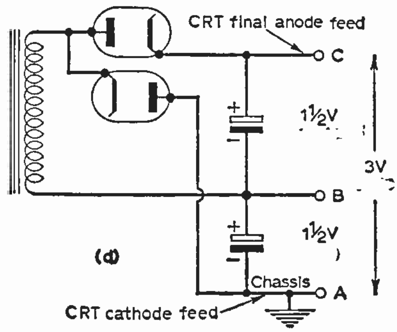


Fig. 7b, c and d—The three possible forms of a practical voltage-doubler circuit. (The voltages shown are ratios.)

typified by Fig. 8, where the EHT load is only about 1mA and the H.T. load is some 20mA, it is merely necessary to choose rectifiers of suitable current ratings, and to choose the size of the reservoir condensers appropriately. The section with the higher loading will receive the rectifier of higher current rating and the reservoir condenser of higher capacity. Values are generally by no means critical.

Two Supplies

It is an advantage of the "positive" circuit of Fig. 7d, used in the practical example of Fig. 8, that the "mid-way H.T." point is of the correct polarity for use as valve-H.T. supply. With the "negative" circuit of Fig. 7b the mid-way H.T. is negative to chassis, and is thus unsuitable for application in a circuit such as Fig. 8. But the pioneering experimenter must remember that the polarity is then just right for feeding the transistors in a transistorised oscilloscope, so that the circuit of Fig. 7b would be useful for such cases. A voltage bleeder will easily give the desired negative supply voltage level actually required by the transistors to be used, and thus again the object of running all circuits from a single rectifier assembly is achieved.

Two final points are to be remembered in connection with this conventional voltage doubler and its more unconventional applications. Firstly, great care is required in connecting the electrolytics with correct polarity, as on account of the more unusual nature of these circuits, and consequent less familiarity, the constructor is more liable to make mistakes if he hurries his work. An incorrectly wired electrolytic invariably leads to a drastic short-circuit in part or all of such a circuit. The second point is, that the circuits are not by any means limited to uses for oscilloscope EHT supplies; they may be used for any circuits whatsoever needing just the outputs available, and it is always possible to connect any number of voltage-bleeder chains of resistors across the outputs to obtain any number of intermediate voltages. The intermediate voltages may be stabilised with neon-tubes in the usual manner, if desired. It is merely necessary to ensure that the total sum current of the bleeders and loadings of the various outputs does not exceed the rectifier-circuit output current rating, and that components of appropriate voltage and current ratings are used throughout. In this manner, a vast variety of rectifier circuits is seen to be possible, all based on this simple fundamental voltage doubler.

Rectifiers of Differing Ratings

In Fig. 7c, where the mid-point is connected to chassis, the section positive to chassis can receive a high-current rectifier and large reservoir condenser, and be used as valve-H.T. supply, whereas the negative section can be fitted with a low-rating rectifier and smaller reservoir condenser, and supply negative grid-bias. Fig. 9 shows a typical circuit. If the negative circuit is used to supply grid-bias to sensitive amplifiers, it may, however, be better to use a reservoir condenser even larger than for the H.T. section, in spite of the lower loading, to avoid hum being introduced and amplified at the grids being biased. It is probably most economical not to make C2 too large in Fig. 9, but to use a really large capacity electrolytic for C3, where the voltage is lower—a large-capacity electrolytic of such a voltage rating will be of reasonable price.

If the transformer winding has a tapping, another useful circuit modification is possible, giving

(Continued on page 249)

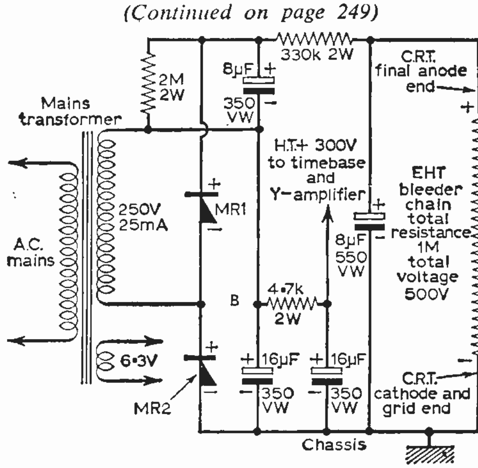


Fig. 8—The power supply used by the author in his miniature cathode-ray oscilloscope.

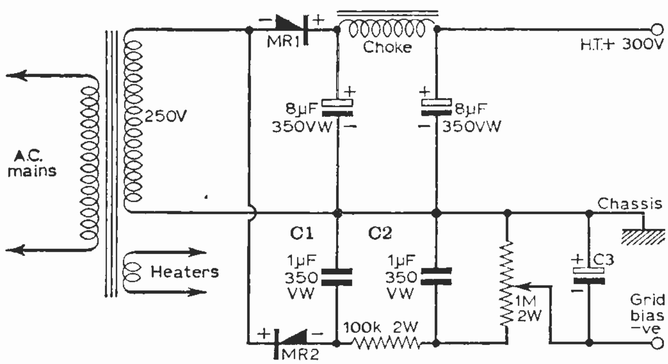
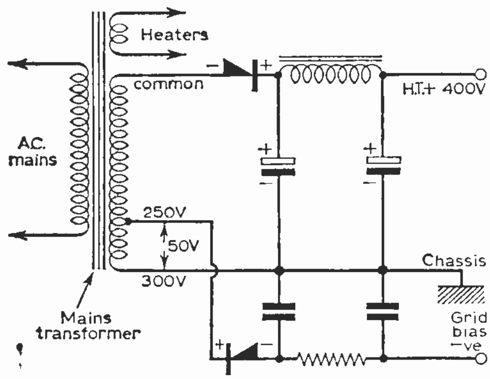


Fig. 9 (above)—A use of the voltage-doubler circuit for generating independent H.T. and bias supplies. (The component values in this diagram are approximate.)

Fig. 10 (below)—A variation of the circuit of Fig. 9 to achieve lower grid bias voltage.



(Continued from page 246)

deliberately unequal voltage outputs for the two halves of the "voltage doubler" right from the start. The smaller output would be polarised negative, to give the grid bias, which is normally required at lower voltage than H.T. This could avoid the need for bleeders altogther, and gives a bias-supply of far better stability. Fig. 10 shows a typical example of a circuit possibility for a 300V transformer winding tapped at 250V which is very common. Using it connected in the opposite sense to usual, so that the 250V tapping represents only 50V (this will be clear from Fig. 10), a 300V A.C. input results for the H.T. section, and a 50V A.C. input for the bias section.

The Conventional Full-wave Rectifier Circuit

Fig. 11 shows the conventional full-wave rectifier circuit, extremely common in the H.T. supplies of domestic receivers. It is at once seen that the development from the simple half-wave circuit to the full-wave circuit of Fig. 12 is closely analogous to the development from the simple half-wave circuit to the voltage doubler, with one *important* difference. Whereas the voltage doubler used two rectifiers of *opposite* polarity on a *single* transformer winding, the full-wave circuit uses two rectifiers of *the same* polarity fed from *a pair* of transformer windings of *opposite* polarity. The two half-wave rectifiers of equal polarity feed the same single common D.C. output, alternately from alternate transformer windings on alternate half cycles of the A.C. inputs. The interconnection of the two basic half-wave circuits here involved is required to be such that a pair of ends of respectively opposite polarity of the two transformer windings must be connected together. The pair of transformer windings thus degenerate to a centre-tapped winding of twice the voltage, as is familiar in radio mains transformers.

But, to emphasise the principle of the circuit, it is perfectly possible to use two separate windings, even on separate transformers, for the same full-wave rectifier circuit. Thus the circuit of Fig. 12

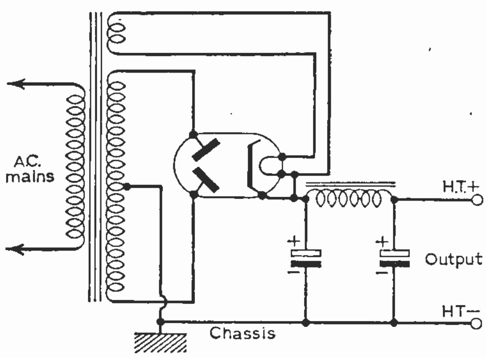


Fig. 11—A conventional full-wave H.T. rectifier circuit (fundamental positive full-wave circuit).

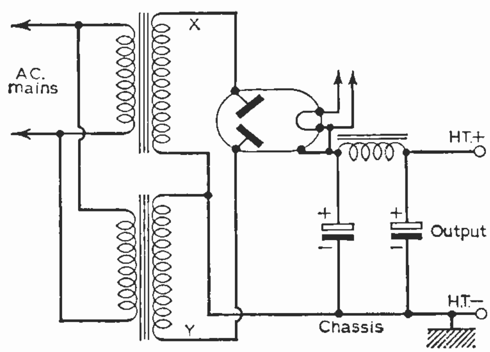


Fig. 12—This circuit gives a performance identical to that of Fig. 11 but uses two separate windings (on two separate transformers even) instead of a single, centre-tapped transformer.

is identical in performance to that of Fig. 11, and may be used by a constructor having a pair of transformers with untapped windings in his junk-box, and not wishing to purchase an extra conventional transformer.

Windings

It must be stressed that the two transformer windings in the conventional full-wave rectifier circuits *must be of identical voltage.* If the voltages differ, the loading of the two rectifiers will be unequal to an extent proportional to the voltage inequality, in particular at the higher output currents. A voltage difference of only some 10% to 20% could suffice in many cases for the rectifier connected to the higher voltage to take virtually all of the load, and the other rectifier to idle. This could lead to severe overload of the one rectifier and transformer. Thus it is important in Fig. 11 that the tap be a true centre-tap (which is normally ensured by the transformer manufacturer), and that the windings of the transformers in Fig. 12 have identical voltages.

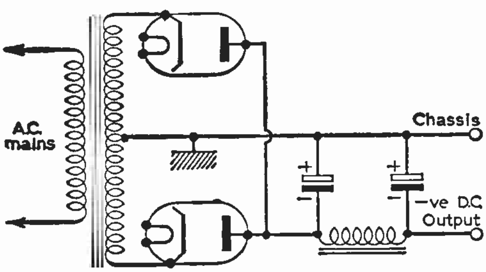
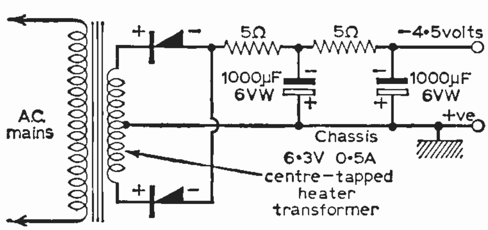


Fig. 13 (above)—A fundamental negative full-wave rectifier circuit.

Fig. 14 (below)—A collector voltage power supply for a pocket transistor radio (a mains adaptor) using a negative full-wave rectifier circuit.



Phasing

Furthermore, it is important to observe proper relative polarities for the transformer windings in the circuit of Fig. 12. Proper polarity exists when an A.C. voltmeter connected between points X and Y in Fig. 12 reads twice the voltage of a single winding. Incorrect polarity exists when the voltmeter reads zero or almost zero under these circumstances; *one* of the transformer windings should then be reversed.

A circuit running with incorrect polarity functions here simply as a pair of simple half-wave circuits in parallel, and is thus equivalent to a single half-wave circuit of twice the current rating without giving the benefits of the better smoothing and regulation of the full-wave circuit. No damage is likely from incorrect relative polarity, merely a loss of efficiency, as both rectifiers then conduct on the same half-cycles, and both block on the others, instead of conducting alternately. Incorrect relative polarity is also manifest by the output voltage rest-ripple being at mains frequency instead of at twice the mains frequency characteristic of a properly-operating full-wave circuit. This is the main reason for the poorer relative smoothing and regulation of the half-wave

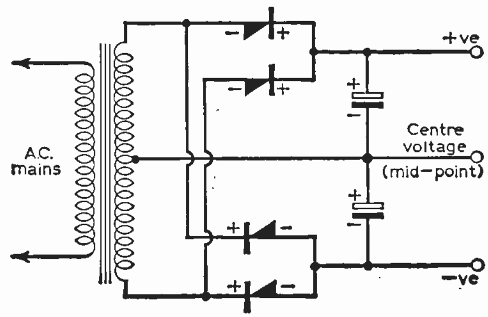


Fig. 15—A full-wave voltage-doubler circuit.

circuit compared with the full-wave circuit, as in the latter the smoothing condensers receive reinforcement current from the rectifiers at twice the frequency of the half-wave circuit, i.e., once each half cycle of A.C. input instead of once each full cycle. Thus, for the same size of smoothing components, the full-wave circuit has at least twice as good smoothing as the half-wave circuit, or, accordingly, smaller components may be used for achieving the same degree of smoothing.

The Inverse Full-wave Circuit

Most constructors are possibly not aware of the fact that the c o n v e n t i o n a l full-wave rectifier circuit of Fig. 11 represents only one of several possibilities, namely the *fundamental positive circuit.* Fig. 13 shows the corresponding fundamental negative circuit, obtained by simple reversal of both rectifiers and appropriate reversal of the polarity of the smoothing electrolytics. This circuit is so very unfamiliar because it has little practical use for valve circuits, yet it is likely to receive increasing favour for mains-adaptors for running transistor sets. For such purposes it forms the natural counterpart of the positive valve circuit, transistors of *pnp*-type requiring negative collector voltages. Fig 14 shows a typical collector-voltage power-supply unit as built by the author for operating his pocket transistor superhet from the mains at home. Use is made of a normal 6.3V heater transformer with centre-tap, and two small germanium diodes in the fundamental negative full-wave rectifier circuit. The fact that this circuit is at the low voltage level required by transistors is a mere matter of detail; using components of appropriate voltage and current ratings, the same circuit functions with valve or metal rectifiers at any desired voltage.

(Continued on page 258)

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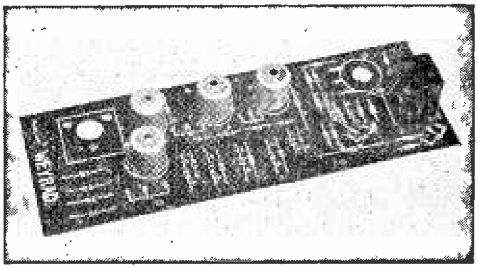

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OC73	16/-	OC75	8/-	OCP71	25/-	OA79	3/9	Red	
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1962 CATALOGUE
Our 1962 Catalogue is now available. Please send 1/- in stamps for your copy. Trade Catalogue also available for which, please attach your business letter heading.

PRACTICAL WIRELESS POCKET TRANSISTOR SUPERHET. The New Version in a re-designed Cabinet with Carrying Strap. *Components Price List:* Coil Set (Osc. and 3 I.F.'s), 22/-; Driver Transformer, Type PW/DT, 8/3; Output Transformer, Type PW/OT, 8/-; Ferrite Rod Aerial, Type PW/FR, 8/6; Printed Circuit Board, 7/6; 2 Gang Capacitor, Type "00", 12/6; Volume Control, Type V.C. 1545, 8/-; Switch, 3/6; Hardware (Screws, nuts, washers, spacers, battery clips, cable cradles, cable studs, cable strapping), 4/-; Transistors Type YC (Set of 6). Xtal Diode Type GD9, 43/-; *Speaker:* Case, 12/6; Capacitors, 15/-; Resistors, 5/-; Trimmers, Type MT31/4A (3 required), 3/9. Constructional Leaflet and "Blown-up" Circuit Diagram. PRICE FOR THE COMPLETE KIT £7.19.6.

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CH1, 2.5 millihenry choke, wound on Ferrite Core with wire ends, 2/6.
REPANCO MINIATURE DOUBLE TUNED I.F. TRANSFORMERS. 455 to 475 kc/s, boxed with circuit 6/9 each.
REPANCO NEW RANGE OF MINIATURE TRANSISTOR TRANSFORMERS, $\frac{3}{4}$in. x $\frac{5}{8}$in. x $\frac{7}{8}$in. **TT45 Driver Transformer 5/- each.**

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Baseboard cut suitable for a BSR UA14, available in red, turquoise, grey, and black/yellow, 63/- each. Amplifier and Loudspeaker to suit above, 75/-.

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Trade News

NEW OSCILLOSCOPE

A NEW oscilloscope has recently been put on the market by Dartronic Limited, and is selling at £67. It operates from a mains supply of 110-120/200-250V.

The bandwidth of the main Y-amplifier covers D.C. to 10Mc/s and is adjusted for optimum pulse response with no overshoot. Interpolation between the timebase sweep speeds is provided by an uncalibrated continuously variable control.

The display is a 3in. helical PDA cathode-ray tube operated at 3·5kV, which provides a very bright and sharply defined trace at all sweep speeds.

An efficient convection cooling system ensures that the instrument does not run hot even under continuous operating conditions.

The panel controls include brilliance, focus astigmatism, Y-shift, X-shift, input sensitivity selector, A.C. or D.C. Y input selector, mains on/off, etc.

Dartronic Limited, 3-7 Windmill Lane, London, E.15, are the makers of this oscilloscope.

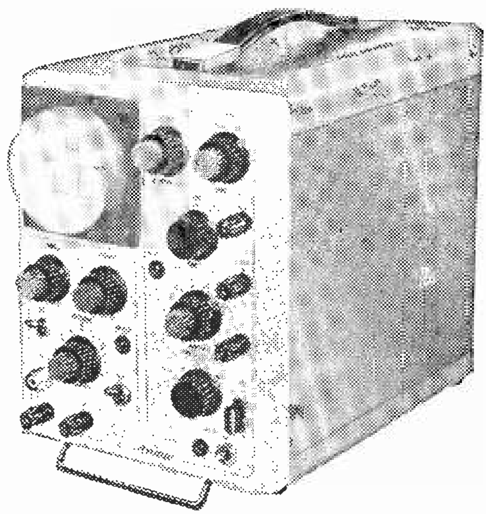
NEW 15W SOLDERING IRON

A 15W mains-operated soldering iron, only $8\frac{1}{2}$in. long and weighing 3ozs has been added to the AEI range. It is available for operation from 200/220V and 220/240V, and costs 23s. 4d.

The chromium copper bit is only $\frac{1}{8}$in. in diameter and the stem only $\frac{5}{16}$in. in diameter. The iron is, therefore, particularly suitable for use in confined spaces and for soldering to miniature components liable to be damaged by the application of too much heat. The iron heats to working temperature in $1\frac{1}{2}$ minutes.

It is fitted with a removable hook so that it can be hung in a convenient place when not in use and a 6ft length of three-core flex is supplied with each iron.

The new 15W Solon iron is on sale at all general electrical and hardware stockists, and is marketed by *Distribution Equipment Sales Department, AEI Cable Division, 145 Charing Cross Road, London, W.C.2.*



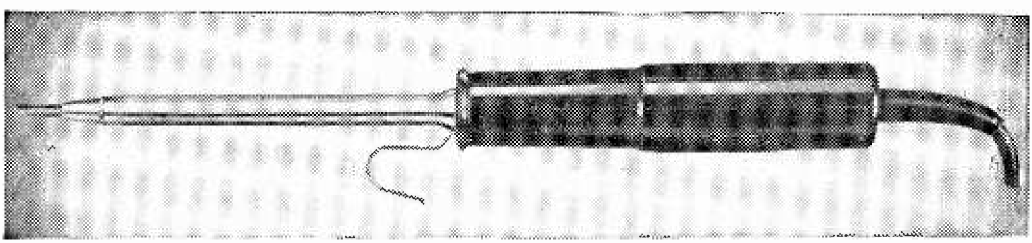
The Dartronic oscilloscope.

LOW-PRICE DIAMOND STYLUS

A NEW system of manufacturing and handling diamond styli now permits Dansette Products Ltd. to market a diamond stylus for record players for 12s. 6d.

The new manufacturing process reduces the number of operations because new automatic grinding and polishing methods have superseded hand polishing. This allows manufacture to closer tolerances.

J. & A. Margolin Ltd., Plus-a-Gram House, 112-116 Old Street, London, E.C.1.



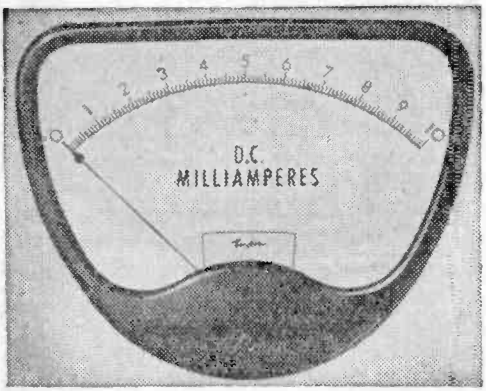
AEI's new 15W soldering iron.

NEW STYLED METER

TO meet the demand for a large scale meter with a modern appearance, the Taylor Model 70 has been introduced. The meter has a nominal scale length of 6½in. and the dial is designed to provide maximum viewing distance. The open styling of the moulding provides "shadowless" readings and enables several combinations of arcs and scale calibrations to be incorporated. Despite the long scale length, the meter movement "housing" has a diameter of only 3¼in.

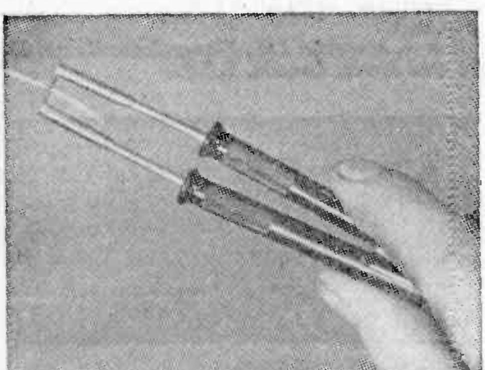
The Model 70 is fitted with a centre pole moving coil movement but moving iron meters can also be supplied.

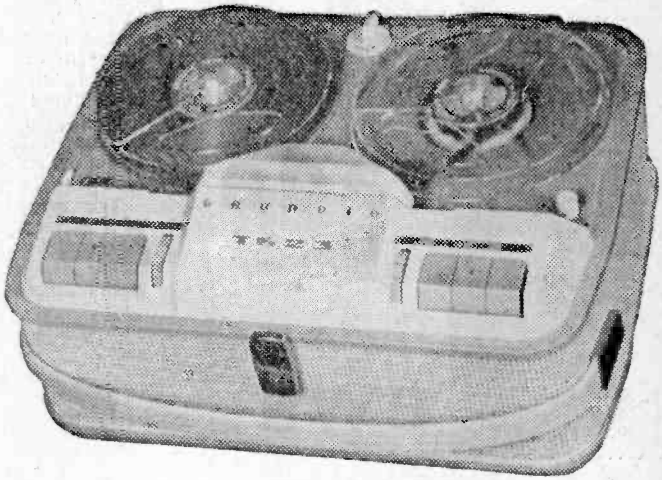
Taylor Electrical Instruments Ltd., Montrose Avenue, Slough, Buckinghamshire.



Above—A new-styled meter from Taylor Electrical Instruments Ltd.

Below—These Oryx wire stripper tweezers are marketed by W. Greenwood Electronics Ltd.





The Grundig TK.23 4-track tape recorder.

NEW 4-TRACK TAPE RECORDER

A NEW four-track tape recorder—the TK.23—has recently been announced by Grundig (Great Britain) Limited. Although basically following the design of its twin-track counterpart, the TK.14, several new features have been incorporated. The TK.23 is a single speed machine operating at 3¾in./sec. There is a temporary stop that can be locked in the stop position and quickly released in a single operation, and an automatic stop, the metal foils on the end of the tape causing a solenoid to be energised, releasing the start or fast wind buttons.

There are facilities for superimposition, synchronised superimposition and mixing. A digital position indicator and a magic eye recording level control are fitted.

The valve line up of the recorder is EF86, ECC81, EL95, EM84. An additional valve, reduces the hum and noise figures to a low level and provides the extra gain required by the input mixing controls. The frequency response is level from 60c/s to 12kc/s and the signal to noise ratio is 47dB.

The price of the TK.23 complete is 45 guineas, which includes a Grundig moving coil microphone. The recorder is made by *Grundig (Great Britain) Limited, 40 Newlands Park, Sydenham, London, S.E.26.*

WIRE STRIPPER TWEEZERS

LOW voltage wire stripper tweezers have been developed by Oryx to meet the need for speedy and efficient stripping of wire insulation such as PVC, nylon, rubber and thermoplastics.

The instrument accommodates wires of up to ⅛in. (3mm) diameter and operates at a temperature of 250°C. Each limb of the tweezer has a miniature heating element with a total consumption of 12W at 6V.

The instrument is manufactured by Oryx Electrical Laboratories Ltd., and is being marketed by *W. Greenwood Electronic Ltd., 677 Finchley Road, London, N.W.2.*

Letters to the Editor

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

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

THE "38" SET

SIR,—By now, many readers will have purchased the "38" set walkie-talkie. Use of this unit entails the wearing of headphones, which can, in certain conditions be inconvenient. No doubt, conversion to a speaker could be attempted, but there is little room in the case for a volume control anyway. However, the receiver uses a very unconventional I.F. of 285kc/s (1,050m) which can be tuned in by many broadcast receivers. There is no need to remove the set from its case, the broadcast receiver simply being placed near it and tuned in to the I.F. The signals received can then be heard at good loudspeaker strength without noticeable distortion. — G. J. POWELL (Marden, Herefordshire).

AMERICAN STATION

SIR,—I am a keen S.W. listener. On Sunday, April 29th I received an American station on approximately 32m. The transmission consisted of a message in English and another language which I could not recognise. The message was as follows:

"This is a test transmission by single telegraph system, operated by the overseas telephone service of the ———. Please give identification signal on channel A for receiver adjustment".

I wonder if any readers could complete this message and give some facts about this station.—T. GERRARD (Bolton).

ECHO EFFECT FOR TAPE RECORDERS

SIR,—I feel that a good many of your readers who own tape recorders will be interested in the method I use to produce an echo effect on my machine. Using this idea an echo can be produced which is variable in the time between echos from 0·25sec to 2sec. The only extra components necessary are a variable attenuator (T type for keeping the impedance correct) and an extra record/replay head. The normal head is fed with an A.F. signal (speech, music, etc.) which is recorded on the tape. The extra head is situated $3\frac{3}{4}$in. from the first head, therefore giving the tape a time lapse of 1sec at $3\frac{3}{4}$in./sec tape speed. The second head picks up the signal and feeds it back via the attenuator, to the amplifier input which feeds it straight back to the first head at approximately half the output (due to the effect of the attenuator). This signal is again recorded on to the tape. When it is picked up for the second time on the extra head it is again reduced by half, and so as this process continues the signal smoothly fades away. With the extra head set at $3\frac{3}{4}$in. from the original, the normal tape speeds will give the following time lapses approximately:

$1\frac{7}{8}$in./sec=2sec echo
$3\frac{3}{4}$in./sec=1sec echo
7in./sec=$\frac{1}{2}$sec echo.

Of course the second head may be set at any convenient distance from the first, giving different time lapses.—R. T. SUMMERS (Worcester).

COMPONENT STANDARDISATION

SIR,—I know there have been comments previously on the lack of standardisation in certain components, but there is one other point which I feel should be given special consideration. I refer to controls of all kinds which have a standard $\frac{1}{4}$in. spindle, but which are, in some cases, supplied with a plain spindle and in others, have a flat on one side. The majority of control knobs which I have obtained have a securing grub screw well sunk into the knob for safety reasons. When placed over the spindle I find, with the pointer type of knob, that it is difficult to position it on the control so that any adjustments made permit the pointer to travel over the desired scale. The same remarks apply to the type of knob having an engraved arrow on the top. Couldn't the spindle be made adjustable, or would a further grub screw prove an additional objection? Alternatively, why couldn't the components be supplied with knob complete, or must these remain in the same category as normal electrical apparatus which is always supplied without a mains plug? — G. BETTERSON (Hastings).

TAPE TROUBLE

SIR,—I had read previously about people being troubled with radio break-through on their recorders, but never had the trouble myself. Then one day I switched on to take a microphone recording, and made my usual two or three feet test run, to be surprised with a background of radio signal. I made several tests but could not trace the cause. After two or three days I found the trouble, which was not in the recorder at all. The signal was mains fed, either from a neighbouring house or picked up direct on the mains wiring. Reversal of the mains plug feeding the recorder stopped the trouble, and this was confirmed on two or three days subsequently, by reversing the plug when the trouble reappeared. Perhaps one of your readers may like to try this effect to cure a similar fault.—G. PLEASANCE (Northholt).

Club News

REPORTS OF CURRENT ACTIVITIES

AMATEUR RADIO SOCIETY OF CHESHAM AND DISTRICT
Hon. Sec.: Capt. C. G. Stephenson, G3CLJ, 21 Lynton Road, Chesham, Buckinghamshire.

The society's aim to train and assist all to obtain licences has drawn a large number of requests for membership recently.

A communications, radio, and amateur radio demonstration has been planned to be held in late June.

BARNSLEY AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: P. Carbutt, G2AFV, 19 Warner Road, Barnsley, Yorkshire.

On May 11th J. Ward gave a lecture on 'Transistors in a Station' and the meeting for May 25th was reserved for a debate.

Future Event:
June 8th—Relays in a station, by D. W. Heath.

BRADFORD RADIO SOCIETY
Hon. Sec.: M. T. G. Powell, G3NNO, 28 Gledhow Avenue, Roundhay, Leeds 8.

On May 8th members visited the automatic telephone exchange, as planned. On the 22nd May, amateur television was the subject of L. A. F. Stockley's talk.

Future Event:
June 12th—Treasure Hunt.

EXETER AMATEUR RADIO SOCIETY
Hon. Sec.: S. Line, 46 Roseland Crescent, Heavitree, Exeter, Devon.

At the meeting on 3rd April, members attended an interesting talk and demonstration given by J. Forward on television interference and harmonic detection.

At this meeting also, questions from SWL's concerning the forthcoming RAE, were numerous.

HALIFAX AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: G. Sunter, 24 Booth Fold, Luddendenfoot, Halifax, Yorkshire.

On June 5th members visited the Ferranti works in Manchester.

Future Event:
July 3rd—Single sideband debate.

LICHFIELD AMATEUR RADIO SOCIETY
Hon. Sec.: G. Seward, 51 Long Bridge Road, Lichfield, Staffordshire.

The society meets on the first Monday of each month. At a recent meeting, T. Wood gave a talk on suitable aerials for field day use.

LUTON AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: D. Bavister, 70 Crawley Green Road, Luton, Bedfordshire.

The most important event for the society in May was the Mobile Rally held at Stockwood Park, Luton on May 27th.

NORTHERN HEIGHTS AMATEUR RADIO SOCIETY
Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax, Yorkshire.

At a recent meeting, H. Brooke, G3GJV, gave an interesting lecture on mobile equipment. Convertors for 2 and 4 was the title of the talk given by D. Millard, on May 16th. On May 30th members visited the Holme Moss television station.

J. Davidson gave a lecture on June 6th about printed circuitry.

PETERBOROUGH RADIO SOCIETY
Hon. Sec.: D. Byrne, G3KPO/G3PTC, Jersey House, Eye, Peterborough, Northamptonshire.

At an April meeting, members heard all about the latest techniques in radio direction finding from Mr. J. W. Hewlett, an Air Ministry electronics engineer.

On May 20th, the Mobile Rally and D.F. contest at Hunstanton, was attended by members of the society.

A 40-valve receiver was discussed by G3FUR at the meeting on June 1st.

PLYMOUTH RADIO CLUB
Hon. Sec.: R. Hooper, 2 Chestnut Road, Peverell, Plymouth, Devon.

The club has now been allocated its own callsign by the G.P.O. —G3PRC—and may be heard on the air any Tuesday evening on 160 and 80m.

The judging for the G5ZT trophy took place on April 4th, the winner being G3LWJ, with C. Cummings and E. Fallon coming second and third.

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

Power transformers was the title of the talk given by N. B. Simmonds on May 4th. On May 11th a number of members visited the Edgbaston Observatory. On May 18th, in the second part of his series on radio fundamentals, J. E. Smith talked about electromagnetic inductance and capacitance. A. T. Spencer and a number of colleagues gave a talk on June 1st on radio controlled models.

Future Events:
June 15th—Sound and TV magnetic recording, by P. J. Guy.
June 29th—Sound reproduction.

SPEN VALLEY AMATEUR RADIO SOCIETY
Hon. Sec.: N. Pride, 100 Ralkes Lane, Birstall, near Leeds.

Dr. N. H. Chamberlain gave a talk called "More about counting" on May 9th and the subject of the meeting on May 23rd was the Radio Amateur Emergency Network.

Future Event:
July 4th—Annual general meeting.

YORK AMATEUR RADIO SOCIETY
Hon. Sec.: N. Spivey, G3GWI, 80 Melton Avenue, Clifton, York.

The society's transmitter, under the callsign G3HWW, has been on the air on 14 Mc/s and several good Dx contacts have been made in spite of the poor location of the headquarters.

The programme for the future includes several tape recorded lectures, which have proved very popular with members in the past. A recent talk on the class D wavemeter was given by G3GJY.

Power Rectifier Circuits

(Continued from page 250)

The Full-wave Voltage-Doubler Circuit

It is possible in all cases to advance from the conventional full-wave circuit in the same fashion as from the half-wave to the simple voltage doubler circuit. In other words, it is possible to feed a fundamental positive and a fundamental negative full-wave circuit simultaneously from the same centre-tapped transformer winding, giving two outputs of opposite polarity additively in series (Fig. 15). This is completely analogous to the simple half-wave voltage doubler circuits of Fig. 7, and exactly parallel remarks apply as in the discussion there. Thus, the two outputs may be unequally loaded, making appropriate choices for the rectifiers and smoothing condensers. A pair of identical rectifiers must be used for each full-wave part of the circuit, though the pair for the one half may be different from that for the other.

Fig. 15 shows the basic full-wave voltage-doubler with its two outputs, which may again be subdivided and stabilised with bleeder chains of resistors and neons if desired.

The Conventional Full-wave Bridge Rectifier Circuit

It is apparent from Fig. 15 that the centre-tap of the full-wave voltage-doubler circuit serves merely to feed the mid-point voltage D.C. output. If this is not required, when only the full output voltage is desired to be used, the centre-tap of the transformer may be omitted altogether, and the circuit has degenerated to the familiar *full-wave bridge* rectifier circuit, which needs little further comment, as almost all constructors will have seen this circuit in accumulator charging apparatus etc. *(To be continued)*

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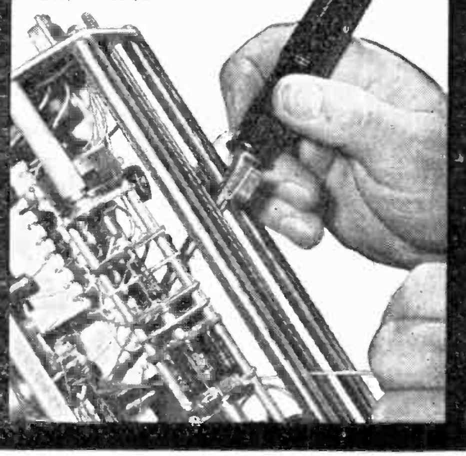

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TRANSISTORS. OC44, OC45 7/6 each. A.F. Pack OC81D, 2 OC81, 18/6, set. G.E.C. 874, 4/6, S6, S7, good output transistors, 2/6 each. Red spots, 2/3, White spots, 2/6, OC76 3/6, OCP71 12/6, OA81 Diodes 2/6, GEX 00 9d. Terms C.W.O. or C.O.D.

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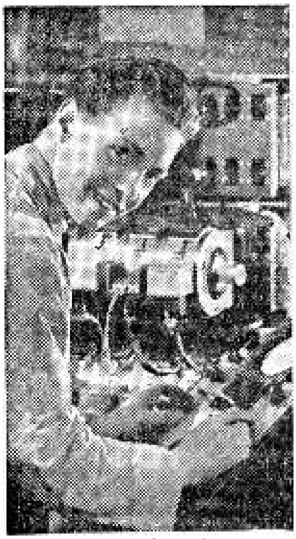

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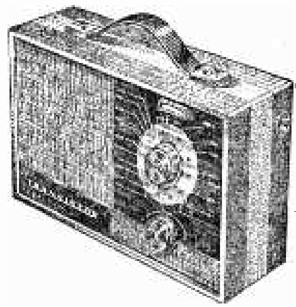

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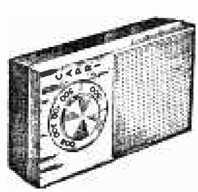

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- High Q frame aerials.
- High sensitivity on both wavebands.
- Medium and long wave superhet circuit.
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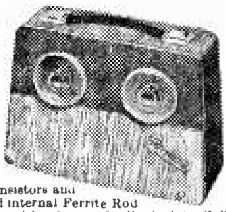

Using six Transistors and one Diode and internal Ferrite Rod Aerial, with provision for Car Radio Aerial. Full medium and long waveband coverage and 6 x 4 High Flux Speaker. When constructed the receiver is housed in an attractive two tone case, size 10½ x 7¾ x 3½in.

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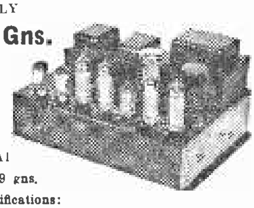

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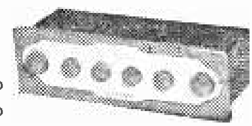

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Practical Wireless

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

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

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

SPECIAL NOTE

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

Title	*Number*	*Price*
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Junior Crystal Set	PW94	2/-
Dual-wave Crystal Diode	PW95	2/6
STRAIGHT SETS		
Battery Operated		
Modern One-valver	PW96	2/6
All-dry Three	PW97	3/6
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SUPERHETS		
A.C. Band-pass Three	PW99	4/-
A.C. Coronet-4	PW100	4/-
A.C. D.C. Coronet	PW101	4/-
The PW Pocket Superhet	—	5/-
MISCELLANEOUS		
The PW 3-speed Autogram	—	8/-
The PW Monophonic Electronic Organ *(No constructional details are available with this blueprint)*	—	8/-
The PW Roadfarer *(No constructional details are available with this blueprint)*	—	5/-
TELEVISION		
The PT Band III converter	—	1/6

Title	*Number*	*Price*
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Experimenter's Short Wave	PW30a	2/6
Midget Short Wave Two	PW38a	2/6
Band-Spread Three (Battery)	PW68	2/6
Crystal Receiver	PW71	2/-
Signet Two (Battery)	PW76	2/6
Simple S.W. One-valver	PW88	2/6
Pyramid One-valver	PW93	2/6
BBC Special One-valver	AW387	2/6
A One-Valver for America	AW429	2/6
Short-Wave World Beater	AW436	3/6
Standard Four Valve S.W.	WM383	3/6
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PRACTICAL WIRELESS, JULY, 1962

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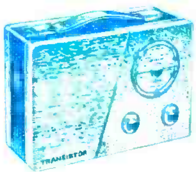

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3 ranges resistance 0/10K/100K/1 Meg
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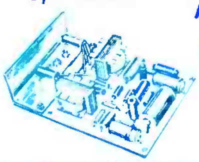
3/4 WATT 4 TRANSISTOR AMPLIFIER



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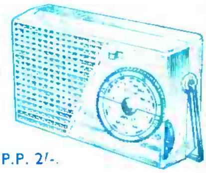

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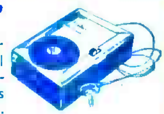

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