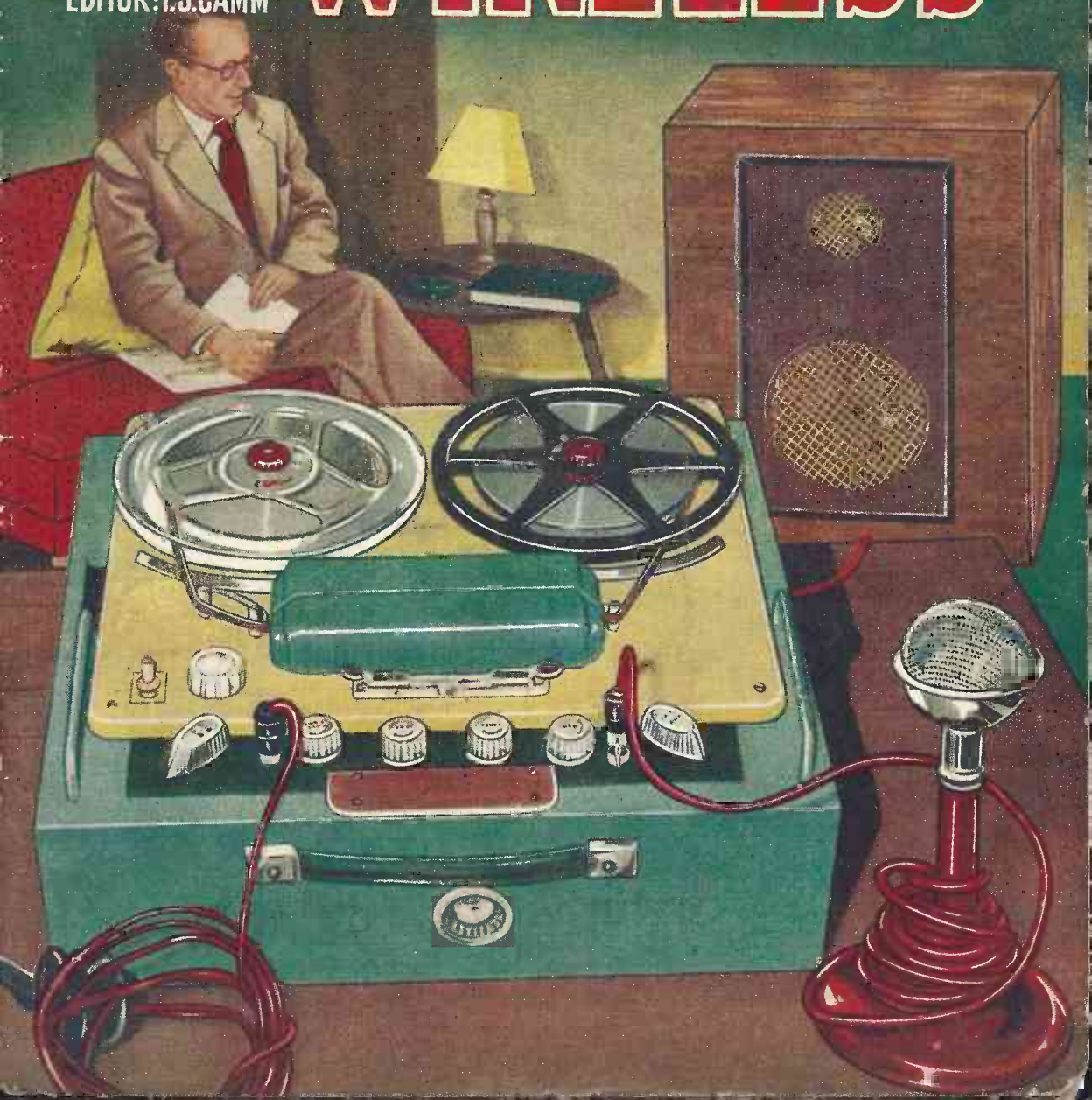
MAKING THE P.W. HI-FI TAPE RECORDER

PRACTICAL WIRELESS

1/3

MAY
1957
EDITOR: F.J.CAMM



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	each
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TWO HIGHLY INFORMATIVE PUBLICATIONS

The G.E.C. nine-one-two Plus, 4/-. The F.M. plus Tuner for the nine-one-two, 2/6.

COMMERCIAL ALPHA CONVERTOR

Price, £6.15.0.

★ Tuneable over Band III Range.
★ Single Knob Channel Changing.
★ 4-Valve Circuit.
★ Hammer-Tone Bronze Finish.

NOTE THE PRICE, £6.15.0.

Fully Guaranteed against Faulty Workmanship or Materials (other than valves) for 12 Months. The Unit uses B.V.A. Valves. Guaranteed for 90 Days.

Wearite "P" coils, full range available, 3/- each.

T&L Lorenz LPH 65 Treble Speaker, 39/6 each.

Solon Instrument irons, all voltages, 24/- each.

Brayhead Convertor now available from stock. Detailed List by return. Price £7.7.0. Converts most sets to I.T.A. at I.F. frequency.

All these and many other interesting radio and TV components are listed in our current catalogue which is available to you now. Send 1/- in stamps for your copy.

HEATER TRANSFORMERS

230v. INPUT

2 v. 2 a., 8/3 each. 4 v. 1.5 a., 5/6 each. 4 v. 3 a., 10/- each. 5 v. 2 a., 10/- each. 6.3 v. 1.5 a., 6/9 each. 6.3 v. 2 a., 10/- each. 12 v. .75 a., 5/9 each.

OUTPUT TRANSFORMERS

Universal Type. 18 ratios available, 6/6 each.

Standard: 5,000 ohms to 3 ohms, 40 m/a. 4/6 each.

Standard: 10,000 ohms to 3 ohms, 40 m/a. 4/6 each.

Super: 5,000 ohms to 3 ohms, 60 m/a. 4/9 each.

Midget: 5,000 ohms to 3 ohms, 30 m/a, 3/9 each.

CONTACT COOLED RECTIFIERS

Half Wave:
125 v. 80 m/a, 5/-.
250 v. 50 m/a, 9/-.
250 v. 85 m/a, 10/-.
Full wave:
250 v. 75 m/a, 9/-.
250 v. 125 m/a, 11/6.

STC RECTIFIERS

RM1, 4/6; RM2, 5/6; RM3, 7/6; RM4, 16/6; RM5, 20/-.

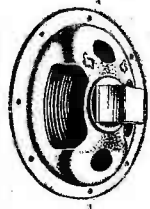
PENCIL RECTIFIERS

K3/25	4/9	K3/40/3/-	K3/45 6/3
K3/50	6/9	K3/60/7.6	K3/100 11/-

CYLDON TURRET TUNER Conversion to I.F. (no patterning) Nine versions covering three major I.F. Bands. 10 mc/s, 16 mc/s, 38 mc/s, and 3 valve heater supplies (6.3 v., 100 m/a. and 300 m/a). Send for full descriptive leaflet. £7.7.0 each.

LOUD SPEAKERS

All PM Types less Transformers



	each
WATERHOUSE 5in. Unit	17/6
PLESSEY 6½in. Unit	18/6
R. & A. 5in. Unit	19/6
PLESSEY 12in. Unit	35/-
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Elliptical Speaker 10in. x 6in.	25/-
BAKER SELHURST 12in. heavy duty unit, 15 ohms speech coil 20 watts	£5.5.0
5" Mains Energised Speaker	20/- each

VIBRATORS

4 Pin UX Base 12 v. and 6 v., 8/6 each.

HEADPHONES

Type CLR 120 ohms, 7/6 pair.
Type DHR 4,000 ohms, 16/- pair.
High Resistance type 13/6 pair.
Aerialite Aerascial semi air spaced co-axial cable. Centre core stranded. Suitable for Band III, 9d. yard.
A large selection of miniature type "A" volume controls now available. Values 5k, 10k, 20k, 50k, 100k, ¼ meg., ½ meg., 1 meg., 2 meg. Less switch, 2/6 each; single pole, 3/9; double pole, 4/9.

Large stocks of aerials (send for lists). Band III Aerialite 3 element Model 700 xu, 30/-.

Composite Aerialite Band I/III (2 & 10 channels). Model 820 ct., complete with chimney lashings, etc., £5.5.0.

MAINS TRANSFORMERS

3-way Mounting Type

MT1
Primary: 200-220-240 v.
Secondarys: 250-0-250 v., 80 m/a. 0-6.3 v. 4 amp. 0-4 v. 2 amp. both tapped at 4 v., each 19/6

MT2
Primary: 200-220-240 v.
Secondarys: 350-0-350 v. 80 m/a. 0-6.3 v. 4 amp. 0-5 v. 2 amp. both tapped at 4 v. each 19/6

MT3
Primary: 200-220-240 v.
Secondary: 30 v. 2 amp. taps at 3v., 4v., 6v., 8v., 9v., 10v., 15v., 18v., 20 v., 24 v., each 19/6

2/- Packing and Post on above Transformers.

HUGE MINISTRY PURCHASE

R.1155—yours for £2 down

Frequency 75 kc/s to 18 Mc/s—10 valves—metal case—robust receiver—cost over £60 to make—will give years of service, very little used. Price £10 or 5 payments of £2.

Carr. & transit case 15/- extra.

FLUORESCENT LIGHTS

These are a complete fluorescent lighting fitting. Built-in ballast and starters—stove enamelled white and ready to work. Ideal for the kitchen, over the workbench and in similar locations.

Single 40. 4ft. 3in. long, uses a 40 watt tube. Price **39/6** complete with tube. Carriage and ins. 5/6.

Twin 20. Uses 2 20-watt standard tubes. Price **39/6** with tubes. Carriage and ins. 5/6.

YOURS FOR 30/- DOWN

MULLARD AMPLIFIER '510"

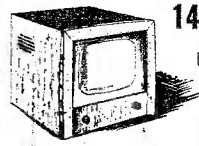
A Quality Amplifier designed by Mullard. Power output exceeds 10 watts. Frequency response almost flat from 10 to 20,000 C.P.S. For use with the Acos "Hi G" and other good pick-ups. Made up and ready to work is £12.10.0 or £1.10.0 down and 8 payments of £1.10.0, plus 10/- carriage and insurance.

MULLARD PRE-AMP

In order to obtain the full output of the Mullard Amplifier a reasonably large input voltage is required. This voltage is available from crystal pick-ups but not from magnetic types nor is it available from most types of microphones. To overcome this, Mullard engineers have designed a Pre-Amplifier and this we are pleased to offer as a ready-made unit. It uses the low hum/noise high gain pentode type EF86. It takes its power supply from the amplifier and incorporated 2 switches to provide immediate compensation, for radio, microphone, L.P. and 78 records. The price of this unit is £4 or 15/- deposit and 8 monthly payments of 10/-. Post and insurance 3/6 extra.

SOMWEAVE

This really lovely loudspeaker fabric we offer at approximately a third of to-day's cost. It is 42 in. wide and our price is 12/- per yard, or panels 12in. x 12in., 1/9 each. This is also very suitable for covering plain wooden case, for portable radio amplifiers, etc.



14" T.V. CABINET

14in. T.V. cabinet of the latest styling made for one of our most famous firms—beautifully veneered and polished—limited quantity—19/6 each. Carriage and packing 3/6 extra.

POCKET TRANSISTOR RECEIVER

Fits into the pocket.
Size only 4½ x 3 x 1½ in.
Weight only 10 ozs.
Works anywhere.
Uses deaf aid or ordinary earpiece.
Ferrite rod aerial.
No external aerial required.
Uses 2 transistors.
Self contained batteries.
1/- battery lasts months.
All parts including data but not battery, case or earpiece. £2.17.6. Case now available, price 2/6.

BABY ALARM

Unlike most baby alarms, this not only enables you to hear baby but also to talk to him. Price complete with one microphone and 100ft. twin flex, £6.19.6. carriage 3/6. additional microphone. 19/6.

T.V. Commercialising Outfit

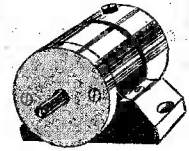
Do it yourself—it's really quite easy. You will manage it in an evening and we guarantee

SUCCESSFUL RESULTS OR MONEY BACK

Our parcel contains :—*I.T.A. Aerial. 36ft. I.T.A. Down Lead. I.T.A. Converter. I.T.A., BBC - Interference Eliminator.*

A special bargain price for all the above items if bought together is £8.10.0 (Post and Insurance 4/6). Or £1.10.0 down and 8 payments of £1. Instructions free with parts or available separately.

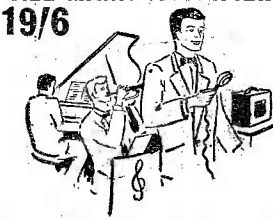
THIS MONTH'S SNIP



Powerful electric motor, size 3in. long by 2½in. diameter with speed varier suitable for operation on/off standard A.C. mains. Ideal for driving fan model, car heater, dryer, etc., etc. Don't miss this snip, 12/6, plus 2/- post and insurance.

Stand not included

ALL MAINS AMPLIFIER 19/6



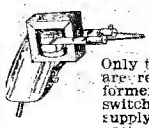
Construct a powerful three-valve mains amplifier. Ideal for dances, parties, etc. Complete less chassis, cabinet and speaker (available if required). Data 1/6 (free with parts).

W.D. CIRCUIT DETAILS

Diagrams and other information extracted from official manuals. All 1/6 per copy, 12 for 15/-.

American Service	
Sheets	R.109
A.1134	78 receiver
BC.348	76 receiver
BC.312	R28/ARC5
R.103A	R1116/A
BC.342	RA-1B
RA-1B	AR88D
R-208	AN/APA-1
R-1155	78
R-1124A	76
R-1132A/R-1481	R.T.18
R-1147	CAY-46-AAM-
R-1224A	RADAR
R-1622	A.S.B.-3
R-1355	Indicator 62A
B.C. 1206-A/B	Indicator A.S.B.3
B-455-A (or -B)	Indicator 62
B-454-A (or-B)	Indicator 6K
B-453-A (or -B)	R.F. unit 24
Transmitter T1154	R.F. unit 26
Fifty-eight walkie talkie	R.F. unit 25
	R.F. unit 27
Frequency meter	Wireless set No. 19
B.C. 221	Demobbed valves

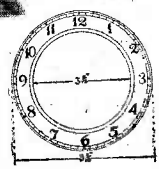
MAKING A SOLDER GUN



A 7-second solder gun of the type costing £3-£4 was described in Prac. Mech. Only two essential parts are required—(a) transformer and (b) push switch. These we can supply at 13/6, plus 2/- post. The rest of the parts you will have in your own "junk" box. Copy of the article concerned given free with the kit.

CLOCK CASE

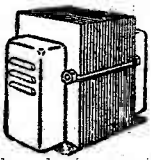
Also suitable for barometer or other instrument. Nicely polished. Price 4/6 post and packing 1/6.



Clock numerals to suit these cases etched on metal, 2/6.

Post 9d. if ordered separately.

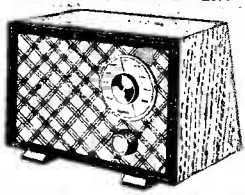
TRANSFORMERS SNIP



Standard tapped mains input. Output 6.3 at 3 amp. 5 v. at 2 amp. and 350-0-350 at 80 milliamps. Exequipment but guaranteed perfect. 8/6 plus 2/6 post. & packing. (Note this transformer is a half shrouded drop-through type not stand up as illustrated.)

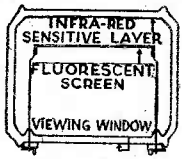
THE SKYSEARCHER

An all mains set for 19/6

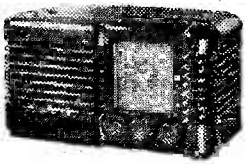


This is a 2-valve plus-metal rectifier set useful as an educational set for beginners, also makes a fine second set for the bedroom, workshop, etc. All parts, less cabinet, chassis and speaker, **19/6**. Post & ins. 2/6. Data free with parts or available separately **1/6. 3-valve battery version also available at the same price.**

"SNIPERSCOPE"



"Cat's eye" used for seeing in the dark. Will work burglar alarms, counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Price 5/- each. Post and ins. 1/-. Data will be supplied with cells if requested.

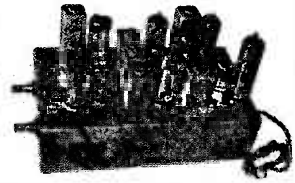


NEW CIRCUIT

OCCASIONAL 56. We have evolved a new T.R.F. circuit and have had really good results, equal in fact to many superhets. You really should try this circuit. All parts including valves (6K7, 6J7, 6F6 and 6X5) and bakelite case with back cost only **£5/10/-**, plus 2/6 post and insurance. Data included with the parts is also available separately, price 2/-.

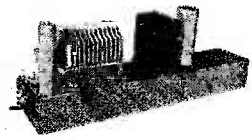
TELEVISION SECTIONS

THE I.F. UNIT



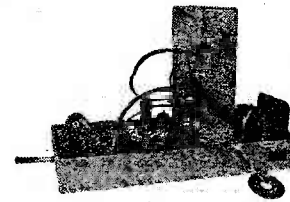
This unit employs 8 miniature all glass valves, the first two of which are common to sound and vision. After separation, sound and vision are amplified separately at 34/36 and 37.5 mc/s respectively. Vision is then detected and passed to two stages of Video amplification, and sound is detected and further amplified by output valve type EL84 to give just over one watt of high fidelity sound. The circuit employs a variable peak white clipper to reduce vision interference and the second section of the audio detector is used to limit sound interference. The unit which can be driven by any standard 34/37 mc/s turret or other tuner, is beautifully made and contained on a chassis size approx. 8in. x 4½in. x 2in. The unit with valves made up, aligned and ready to work is available price **£9.12.6.**

THE POWER UNIT



Intended for A.C./D.C. working with .3 amp. valves, this unit contains all the necessary power components. Rectification is by metal rectifier, smoothing is by a 3 Henry choke, and large electrolytic condensers ensure freedom from hum and a clean picture. The ballast resistor has ample tappings to compensate for H.T. voltage as well as heater current and a thermistor protects the circuit against initial current surges, fuses are fitted in the mains input lead. There is a front control comprising a double pole on/off switch, this is attached to the sound volume control which, although not part of the power unit, is included for the sake of convenience and symmetry. The size of the unit is 15½in. x 3in. x 2in. It is all wired up and ready to work, price **£3.5.0.**

THE TIME BASE CHASSIS



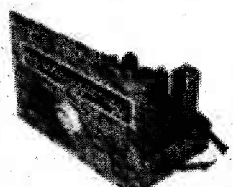
This uses 8 valves and includes the sync separator, the focus magnet, scanning coils and ion trap. The line time base is of the self-oscillating type employing an auto wound O.P.T. and efficiency diode to provide boost voltage for the line flyback E.H.T. transformer which gives about 12.5 kV., the frame time base is multivibrator type, using an ECL80. The whole unit measures 15½in. x 6½in. x 2in., and the metal work includes tube support for chassis mounting a 14in. tube, but up to 21in. tube can be scanned but will require separate mounting. Price for the unit with valves ready made up and tested is **£13.15.0.**

NOTE.—These three units, although quite separate and usable separately, may also be joined together and then comprise a complete T.V. less only tuner unit and speaker (available if required). Demonstrations at all branches. circuit diagrams, etc., 3/6.

THE "CRISPIAN" PORTABLE RADIO

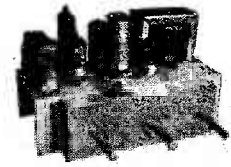
A 4-valve truly portable battery set with very many good features as follows: Ferrite rod aerials, low consumption valves, superhet circuit with A.V.C., ready-built and aligned chassis if required, beautiful two-tone cabinet covered with I.C.I. Rexine and Tygan. Guaranteed results on long and medium waves anywhere. All parts, including speaker and cabinet, are available separately or if all ordered together the price is **£7.15.0** complete or **£1.15.0** deposit and 7 monthly payments of **£1**, post and ins. **3/6**, ready-built chassis **30/-** extra. Instruction booklet free with parts or available separately price **1/6.**

F.M. TUNER



This is a high fidelity unit which although moderately priced has a performance equal to the highest priced. Its stability is very good and extremely good results have been received with the simplest of aerials as far away as Eastbourne. The unit is made up ready to work and has its own power supply for A.C. mains. Demonstration at all our branches. Price **12 gns.** or **£1.12.0** down and 6 payments of **£2.** Post plus insurance 5/-.

THE OCTAVIAN HIGH FIDELITY AMPLIFIER



3 valve 4 watt with frequency response better than 40-15,000 C.P.S. Control panel size 8 x 2½in. comes fixed to chassis but is intended for independent mounting. Separate bass and treble controls giving fullest variation of cut and lift. Separate switch, absolutely no mains hum. Remarkable value at **7 gns.** or **£1** deposit and 7 payments of **£1**, plus 3/6 post & packing.

ELECTRONIC PRECISION EQUIPMENT, LTD.

Post orders should be addressed to E.P.E., LTD., Dept. 7, Sutton Road, Eastbourne.

Personal shoppers to one of these addresses please.

268, London Road, Croydon.
Phone: CRO. 6553
Half day, Wednesday.

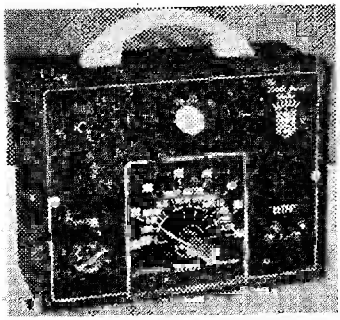
42-46, Windmill Hill, Ruislip, Middx.
Phone: RUISLIP 5780
Half day, Wednesday.

152-3, Fleet Street, E.C.4.
Phone: FLEet 2833
Half day, Saturday.

29 Stroud Green Rd., Finsbury Park, N.4.
Phone: ARChway 1049
Half day, Thursday.

249, Kilburn High Road, Kilburn.
MAIda Vale 4921.

SIMPLE TO MAKE—CHEAP TO BUILD!



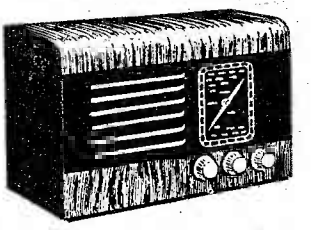
47/6

Build this exceptionally sensitive double triode radio. Uses unique assembly system and can be built by anyone **without any radio knowledge whatever** in 45 minutes. Handsome black-crackle steel case with specially made black and gold dial with stations printed. Size of radio only 6¼in. x 5in. x 3in. Covers all Medium and Long waves—uses only one all-dry battery. H.T. consumption only 1 to 1.5 mA. Uses personal phone. Ideal for Bedroom, Garden, Holiday, etc. **Many unsolicited testimonials. Mr. Norton of Oxted writes:** *Yesterday evening on the Medium waveband, I counted 32 separate stations: I am very pleased with the set, which is well worth the money.* **BUILD THE "SKYROMA" NOW! Total building cost—everything down to last nut and bolt—47/6** (Postage, etc., 2/-)—**with full set of clear, easy-to-follow plans.** (Parts sold separately. Priced Parts Lists, etc., 1/6.)

LOOK!

BUILD THIS POCKET RADIO FOR ONLY 37/6

AT LAST! In response to many requests we now present the **DOUBLE TRIODE "SKYPOCKET,"** a beautifully designed precision **POCKET RADIO.** No radio knowledge needed!—EVERY SINGLE PART TESTED BEFORE DESPATCH; **our simple, pictorial plans take you step-by-step.** This set has a remarkable sensitivity due to painstaking design. Covers all medium waves 200 to 550 Metres. Size only 5¼in. x 3in. x 2in. in Strong, Transparent case with panel, cover and ivorine dial. A really personal-phone, pocket-radio **WITH DETACHABLE ROD AERIAL.** Self-contained all-dry battery operation. Average building time 1 hour. **Total Building Cost—including Case, Double Triode Valves, etc., in fact, everything down to the last nut and bolt—ONLY 37/6, with plans.** Postage, etc., 2/-. C.O.D. 1/6 extra. (Parts sold separately. Priced Parts List, etc., 1/6.) **Demand is certain to be heavy—so SEND TODAY!**



107/6

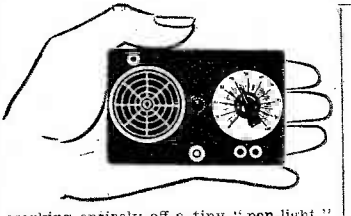
Total building cost including choice of beautiful walnut veneered cabinet or ivory or brown bakelite. **This is the lowest possible price consistent with high quality. No radio knowledge whatever needed . . . can be built by anyone in 2-3 hours,** using our very simple easy-to-follow diagrams. The terrific new circuit of the **"OCEAN-HOPPER"** covers all medium and long waves with optional negative feedback, has razor-edge selectivity, and exceptionally good tone. Price also includes ready drilled and punched chassis, set of simple easy-to-follow plans—in fact, everything! All parts sparkling brand new—no junk! **Every single part tested before despatching.** Uses standard octal-base valves: 6K7G high-frequency pentode feeding into 6J5G anode-bend detector triode, coupled to 6V6G powerful output beam-power tetrode, fed by robust rectifier. For A.C. Mains, 200-250 Volts (low running costs—approximately 18 Watts!). Size 12in. x 6in. x 5in. **Build this long range powerful midget NOW. All parts and set of plans, £5.7.6.** (Post and packing 3/6.) Parts sold separately. Priced Parts List, 1/6.

Build This TRANSISTOR POCKET SET For Only 49/6!

ONLY £8-12-6

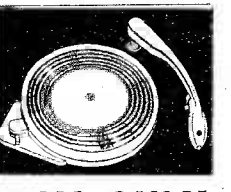
BRAND NEW — NOT SURPLUS! In maker's sealed cartons. Latest UA8 "Monarch" 4-speed record-player complete with High-fidelity "turnover" head. Type HGP 37—1. Capacity of 10 Records, plays 12in., 10in. and 7in. intermixed in any order, 78, 45, 33⅓ and 16 r.p.m. For A.C. mains 100 to 250 volts. Exclusive selector gives quickest and quietest change ever. With full instructions and fixing plans. **Limited Quantity at £8-12-6,** plus 4/6 Post, Packing, etc. **WHY PAY MORE! SEND NOW WHILE STOCKS LAST!** —modernise your radiogram and increase its value.

WE'VE DONE IT AGAIN! . . . our design department in response to a great many requests have designed this **"SKY-PIXIE" Vest-Pocket TRANSISTOR RADIO** which gives a superb performance. It is powerful and highly sensitive. Size only 4¼in. x 3¼in. x ¾in., the weight under 7 ozs.!—yet it is a **TWO-STAGE** receiver covering all medium waves, working entirely off a tiny "pen-light" battery, which costs 6d.—fits inside the case—and lasts many months. Uses personal phone and has push-button **LUMINOUS** On/Off Switch. Every part tested before despatch! **SPECIAL STEP-BY-STEP PLANS for ABSOLUTE BEGINNERS. Total building cost including case, transistors, etc.—everything down to the last nut and bolt—ONLY 49/6 with plans.** Postage, etc., 2/-. C.O.D., 1/6 extra. (Parts sold separately. Priced parts list, etc., 1/6.) As the building cost is absolutely "rock-bottom" (it might increase later) **DEMAND WILL BE VERY HEAVY—RUSH YOUR ORDER TO-DAY!**



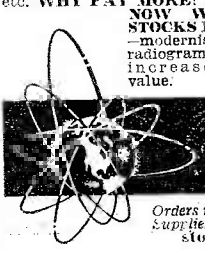
BUILD THIS TRANSISTOR SET FOR ONLY 35/-

VERY SPECIAL OFFER WHILE STOCK OF PARTS LASTS!—The "Sky-Scout" Pocket two-stage transistor set, size only 3¼in. x 3¼in. x 4¼in. Covers all medium-waves and works entirely off tiny "pen-light" battery which costs 6d. and fits inside case. All parts tested before despatch. Can be built for 35/-, plus 2/- post and packing, including Case, Transistor, **STEP-BY-STEP PLANS FOR ABSOLUTE BEGINNERS,** nuts, bolts, etc. (C.O.D. 1/6 extra.) Parts sold separately, priced parts list, etc., 1/6. **VERY SIMPLE TO BUILD.**



FEW ONLY AT 92/6!

NEW in maker's sealed cartons!—limited quantity of the famous 3-speed record player units, exceptionally easy to fix, with lightweight pick-up, incorporating "Acos" crystal turnover head and separate sapphire stylii for Standard and Long-Playing. With full instructions and fixing plans. **Unbeatable price 92/6,** plus 3/6 Post, Packing, etc. C.O.D. 2/- extra. **RUSH YOUR ORDER NOW—BEFORE IT'S TOO LATE!**



CONCORD ELECTRONICS

69, PRESTON STREET, BRIGHTON — **Dept PWI**

Orders receive prompt attention. Cheques accepted. Cash or delivery 1/6 extra. Please print name and address in block letters. Suppliers to Schools, Universities, Government and Research Establishments. **Complete range of components and valves stocked.** *CALLERS WELCOME. Shop Hours: 9 a.m. to 6 p.m. (1 p.m. Thursday). Regret no C.O.D. abroad.*

R.S.C. BATTERY CHARGING EQUIPMENT

All for A.C. Mains 200-250 v., 50 c/cs. Guaranteed 12 months.

ASSEMBLED CHARGERS

6 v. 1 amp..... 19/9
6 v. or 12 v. 1 amp..... 25/9
6 v. 2 amps..... 29/9
6 v. or 12 v. 2 amps..... 38/9
6 v. or 12 v. 4 amps..... 59/9

Above ready for use. Carr. 3/6 With mains and output leads.

HEAVY DUTY KIT

12 v. 30 amp. Suitable for Garage or firm with a number of vehicles. Mains input 200/250 v. 50 c/s. Outputs 12 v. 15 amp. twice. Consists of Mains Trans. 2 Metal Rectifiers. 2 Meters, 4 Fuses, 4 Terminals, 2 Rheostats and circuit. Only **9 gns.**, carr. 15/-.

BATTERY CHARGER KITS

Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case, Fuses, Fuse - holders, Grommets, panels and circuit. Carr. 2/9 extra.

6 v. or 12 v. 1 amp..... 22/9
6 v. 2 amps..... 25/9
6 v. or 12 v. 2 amps..... 31/6
6 v. or 12 v. 4 amps..... 53/9

BATTERY CHARGER KIT

Consisting of F.W. Bridge Rectifier 6/12 v. 5 a. Mains Trans., 0-9-15 v. 6 a. output and ammeter **49/9.** Post 3/-.

ASSEMBLED CHARGER

6 v. or 12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use. With mains and output leads. Double Fused.

Only **47/9**
Carr. 3/9.

Assembled 6 v. or 12 v. 4 amps. Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Louvred steel case with stoved blue hammer finish. **75/-**

Ready for use with mains and output leads. Carr. 3/9.

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

Interleaved and impregnated. Primaries 200-230-250 v. 50 c/cs Screened.

TOP SHROUDED DROP THROUGH

250-0-280 v. 70 mA, 6.3 v. 2 a, 5 v. 2 a ... 16/9
350-0-350 v. 80 mA, 6.3 v. 2 a, 5 v. 2 a. ... 18/9
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a. 22/9
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a. 22/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a. 22/9
350-0-350 v. 100 mA, 6.3 v. 4 a, C.T. 0-4-5 v. 3 a. 23/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a. ... 29/9

FULLY SHROUDED UPRIGHT

250-0-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a, Midget type 2½-3-3in. 17/6
350-0-350 v. 70 mA, 6.3 v. 2 a, 5 v. 2 a. ... 19/9
250-0-250 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a. 26/9
250-0-250 v. 100 mA, 6.3 v. 6 a, 5 v. 3 a, for R1355 conversion 31/-
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a 23/9
300-0-300 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a.... ... ... 26/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a, 23/9
350-0-350 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a. 27/9
300-0-300 v. 130 mA, 6.3 v. 4 a, 6.3 v. 1 a, for Mullard 510 Amplifier 35/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a. 33/9
250-0-350 v. 150 mA, 6.3 v. 2 a, 6.3 v. 2 a, 5 v. 3 a. 35/9
425-0-425 v. 200 mA, 6.3 v. 4 a, C.T. 6.3 v. 4 a, C.T. 5 v. 3 a. Suitable Williamson Amplifier, etc. 49/9
450-0-450 v. 250 mA, 6.3 v. 6 a, 6.3 v. 6 a, 5 v. 3 a. 69/9

FILAMENT TRANSFORMERS

All with 200-250 v. 50 c/s primaries 6.3 v. 1.5 a, 5/9 ; 6.3 v. 2 a, 7/6 ; 0-4-6.3 v. 2 a, 7/9 ; 12 v. 1 a, 7/11 ; 6.3 v. 3 a, **8/11** ; 6.3 v. 6 a, **17/6** ; 12 v. 3 a or 24 v. 1.5 a, 17/6.

SMALL POTTED MAINS TRANSF. Removed from New Ex-Govt. units. Primary 0-200-230-250 v. Secs. 250-0-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a. Size 3½ x 4¼ x 3in. ... **11/9**

ELIMINATOR TRANSFORMERS

Primaries 200-250 v. 50 c/s 14/9
120 v. 40 mA, 5-0-5 v. 1 a. 15/9
90 v. 15 mA, 4-0-4 v. 500 mA. 9/9

CHARGER TRANSFORMERS

All with 200-230-250 v. 50 c/s Primaries : 0-9-15 v. 1½ a, **11/9** ; 0-9-15 v. 3 a, 16/9 ; 0-3.5-9-17 v. 3 a, 17/9 ; 0-3.5-9-17.5 v. 4 a, 18/9 ; 0-9-15 v. 5 a, 19/9 ; 0-9-15 v. 6 a, 23/9.

SMOOTHING CHOKES

250 mA 5 H 100 ohms 12/9
150 mA 7-10-250 ohms 11/9
100 mA 100 H 200 ohms 8/9
80 mA 10 H 350 ohms 5/6
60 mA 10 H 400 ohms 4/11

OUTPUT TRANSFORMERS

Midget Battery Pentode 6/8 : 1 for 3S4, etc. 3/9
Small Pentode, 5,000Ω to 3Ω 3/9
Small Pentode 7/8,000Ω to 3Ω ... 3/9
Standard Pentode, 5,000Ω to 3Ω ... 4/9
Standard Pentode, 7/8,000Ω to 3Ω ... 4/9
Push-Pull 10-12 watts 6V6 to 3Ω or 15Ω 15/9
Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω 16/9
Push-Pull 15-18 watts, 6L6, KT66 ... 22/9
Push-Pull 20 watts, sectionally wound 6L6, KT66, etc., to 3 or 15Ω 47/9
Williamson type exact to spec. ... 85/-

MANUFACTURERS' SURPLUS MAINS TRANSFORMERS. Primaries 250-250 v. 50 c/cs. Fully shrouded upright mounting 425-0-425 v., 150 mA, 6.3 v. 3 a, 5 v. 3 a, **29/11**, post 2/9. Drop Through Chassis type, 250-0-250 v. 70 mA. 6.3 v. 2.5 a, **11/9.**

SPECIAL OFFERS. ELECTROLYTICS. 32-32-32 mfd. 250 v. Dubilier small can **2/9 ea.** 150 mfd. 450 v. **3/9.** Small .0005 mfd. 2-gang. 4/9 ea. Westinghouse Rectifiers 250 v. 250 mA., 7/9.

EX-GOVT. TRANSFS., 230/250 v. 50 c/cs 460 v. 200 mA, 6.3 v. 5 a, 25/9. HEAVY DUTY OIL FILLED suitable for electric welding or soil heating. Output 12 v. 80/100 amps., **£6-19-6.** Carr. 7/6.

EX-GOVT. SMOOTHING CHOKES

250 mA, 5 H 50 ohms 12/9
150 mA, 10 H 100 ohms 11/9
150 mA, 6-10 H 150 ohms Trop. ... 6/9
100 mA, 5 H 100 ohms 3/11

EX-GOVT. E.H.T. SMOOTHING CONDENSERS, .02 mfd. 5,000 v. Cans, 2/9 ; .1 mfd. 2,500 v. Bakelite Tubulars, **3/3.**

EX-GOVT. METAL BLOCK (PAPER) CONDENSERS

4 mfd. 500 v., 2/9 ; 4 mfd. 1,000 v., 4/9 ; 8-8 mfd. 500 v., 6/9 ; 8 mfd. 500 v., 4/9 ; 10 mfd. 500 v., 4/9 ; 4 mfd. 400 v. plus 2 mfd. 250 v., 1/11.

EX-GOVT. ELECTROLYTICS. Removed from unused equipment. 8-16 mfd. 550 v., 1/3 ; 1,500 mfd. 6 v., 1/9 ; 100 mfd. 50 v. with clip, **9d.**

EX-GOVT. DOUBLE WOUND STEP UP/STEP DOWN TRANSFORMER 10-0-100-200-220-240 v. to 5-0-75-115-135 v. or REVERSE. 80/100 watts. Only 11/9, plus 2/9 post.

EX-GOVT. CASES. Size 14-10-8½in. high. Well ventilated black crackle finished, undrilled cover. IDEAL FOR BATTERY, CHARGER OR INSTRUMENT CASE, OR COVER COULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 postage. Size 8½ x 13½ x 6½ ins. with undrilled well ventilated cover, finished in stoved grey enamel. Suitable for charger or instrument case, 7/9, plus 2/9 post.

EX-GOVT. VALVES (NEW)

1T4	7/9	EF39	5/9	EF80	7/9
1S5	7/9	6V6G	7/9	EB91	8/9
3S4	8/9	6X4	8/9	EF36	4/9
5Y3G	8/9	6X5GT	7/9	LL32	3/9
5U4G	8/9	CL6G	11/9	EL91	5/9
5Z4G	8/9	807	7/9	KT44	8/9
6K7G	5/9	12A6	7/9	EZ90	8/9
6SJ7GT	6/9	15D2	4/9	EZ80	9/6
6SL7GT	8/9	25Z4G	9/9	EL84	10/6
6SN7GT	8/9	MH4	4/9	SP61	2/9
6AT6	7/9	ECC83	9/9	35Z4	8/9

EX-GOVT. UNIT RDF1. Brand new, cartoned. Complete with 14 valves, including 5Z4, E.H.T. rectifier. Transformer, Choke, etc. Only 29/9, carr. 7/6.

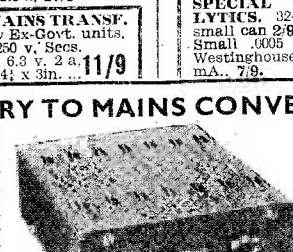
ELECTROLYTICS (current production) NOT EX-GOVT.

Tubular Types		Can Types	
8µF 450 v. ...	1/9	16 mfd. 350 v.	1/11
8 mfd. 500 v.	2/6	16 mfd. 500 v.	2/9
16µF. 350 v. ...	2/3	16µF 450 v. ...	2/9
16µF 450 v. ...	2/9	32µF 350 v. ...	2/11
16µF 500 v. ...	3/9	32 mfd. 450 v.	4/9
32µF 350 v. ...	3/9	100 mfd. 450 v.	4/9
25µF 25 v. ...	1/3	8-8 µF 450 v. ...	2/9
50µF 12 v. ...	1/3	8-16µF 450 v. ...	3/11
50 mfd. 25 v. ...	1/6	16-16µF 450 v.	3/11
50µF 50 v. ...	1/9	32-32µF 350 v.	4/9
100 mfd. 12 v.	1/9	32-32µF 450 v.	5/9
100 mfd. 25 v.	2/3	100-100mfd. 350v.	4/9
3,000 mfd. 6 v.	3/9	64-120 mfd. 350 v.	7/9
6,000 mfd. 6 v.	3/9	200-200 mfd. 275 v.	6/9

Many others in stock.

HUNTS MOLDSEAL CONDENSERS, .005 mfd. 400 v., .01 mfd. 400 v., .04 mfd. 500 v., **5/6 doz.** (one type) ; .1 mfd. 350 v., **8d.** ea ; .5 mfd. 500 v., 1/8 ea.

R.S.C. BATTERY TO MAINS CONVERSION UNITS



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

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

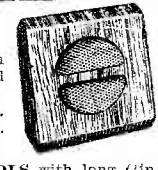
Type BM2. Size 8 x 5½ x 2½in. Supplies 120 v. 90 v., and 60 v., 40 mA and 2 v. 0.4 a to 1 amp. fully smoothed. **Thereby completely replacing both H.T. batteries and L.T. 2 v. accumulators.** When connected to A.C. mains supply 200-250 v. 50 c/cs. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using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

H.T. ELIMINATOR AND TRICKLE CHARGER KIT. Input 200-250 v. A.C. Output 120 v. 40 mA. Fully smoothed and rectified supply to charge 2 v. accumulator. Price with louvred metal case and circuit, **29/6.** Or ready for use, 8/9 extra.

T.V. CABINETS. Leading manufacturers surplus. Attractive designs. Walnut veneered, with doors for 15, 16, or 17in. Tube, **£3-19-6.** Carr. 7/6.

MINIATURE MOTORS. 24/28 v. D.C. or A.C. made by Hoover Ltd., Canada. Size only 2⅜ x 1¾in. Spindle 1¼in. long, ¼in. diam. **Brand New, 9/9.**

EXTENSION SPEAKERS



Ready for use in walnut veneered cabinet.

8in. 2-3 ohms. 35/9. Very limited number.

VOLUME CONTROLS with long (1in. diam.) spindle all values less switch, 2/9 ; with S.P. switch, 3/9 ; with D.P. switch, 4/6.

PRACTICAL WIRELESS

EVERY MONTH EDITOR : F. J. CAMM 25th YEAR OF ISSUE

VOL. XXXIII, No. 605, MAY, 1957

COMMENTS OF THE MONTH

BY THE EDITOR

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CONTENTS :

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

THREE-D SOUND

ELSEWHERE in this issue we describe the latest developments in sound reproduction—stereophonic or 3-D sound. Stereophonic tapes can now be purchased by Hi-Fi enthusiasts, but the new process which we describe bids fair to offer a further and improved solution to the problem of high fidelity reproduction of sound. Coincident with this new development is 3-D vision, and our companion paper, PRACTICAL TELEVISION, will in its May issue deal with the latest 3-D vision system, which has been designed primarily for use at the atomic centre at Harwell.

AN ELECTRONIC TIMER AND CAR RADIO

OUR next issue will contain detailed instructions for building an electronic timer, for which many readers have asked. It can be used for many different switching operations, such as switching a door light on and off, timing various processes, such as photographic developing and printing. It is not costly and it is simple to build.

We have also received a large number of requests for constructional details of a car radio receiver, and this will appear in the July issue on sale June 7th.

OUR QUERY SERVICE

WE are receiving so many letters from those who do not comply with our query rules that we would remind our readers that we cannot undertake to answer queries unless they are accompanied by the coupon cut from the current issue and a stamped and addressed envelope. Our query service is only available to regular readers. We regret we cannot answer questions sent in by those who do not provide evidence of it. The coupon will be found on page iii of the cover of this issue.

THE P.W. FILM SHOW

THE recent PRACTICAL WIRELESS film show at Caxton Hall was attended by over 500 readers—the limit of capacity. Many readers who, for one reason or another, could not come have asked whether we propose to repeat it. I should be very glad indeed to arrange another show towards the end of the year, if sufficient readers are interested. Perhaps, if you did not attend, you will write and let me know.

VIEWMASTER CONVERTER

READERS of this journal who built the View-Master TV will be interested to know that we have reprinted our series of articles on building a converter for commercial TV in the form of a booklet and copies are available for 2s. 9d. by post. Send crossed postal orders to the editor, address as on this page.—F. J. C.

Our next issue, dated June, will be published on May 7th.

Round the World of Wireless

By "QUESTOR"

Broadcast Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of January, 1957, in respect of receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland. The numbers include Licences issued to blind persons without payment.

Region	Total
London Postal	1,203,459
Home Counties	1,192,700
Midland	925,251
North Eastern	1,203,261
North Western	907,512
South Western	749,330
Wales and Border Counties ...	476,842
Total England and Wales ...	6,658,355
Scotland	854,250
Northern Ireland	195,986
Grand Total	7,708,591

Philips Recording Studio

THE new recording studio of Philips Electrical Ltd., which is claimed to be one of the most up to date in the country, is now in operation at the headquarters of the company's Gramophone Records Division at Stanhope House, Stanhope Place, London, W.2. It will be used by Philips for recording titles in their "popular" range and is also available for booking by other organisations and private individuals for all types of recording purposes.

Specially designed as a "popular" studio, it is situated on the lower ground floor of the building and has a separate entrance and reception room. Sound-proofing is of the latest type, the floor being set in rubber. Both studio and control room are air-conditioned.

Impressive Demonstration of Telecoms Equipment

A HIGHLY successful demonstration and display of wide-band radio communications systems and techniques was recently given by Marconi's Wireless Telegraph Company Ltd. at their Development Laboratories at Writtle. In addition to the Marconi equipment other stands were occupied by manufacturers of such specialist apparatus as multi-channel telephone equipment, diesel alternators, aerials, aerial-supporting towers, electronic test gear, travelling-wave tubes and other thermionic devices, thereby collectively providing for every possible requirement on wideband telecommunications systems.

Much of the equipment shown was working under operational conditions, one of the highlights being the transmission and reception of colour television pictures by Marconi radio link (which included a repeater station). The signal path was approximately 30 miles.

The demonstration and display served not only to emphasise the ability of the Company to provide and install every category of equipment from simple point-to-point links to the most complex trunk systems, but also to indicate the astonishing progress which has been made in radio telecommunications during the post-war period.

Six Hundred Marconi Radio Compasses for Viscounts

AIR travel today is such a matter of routine that few passengers give a thought as to the means by which aircraft find their way to a given destination.

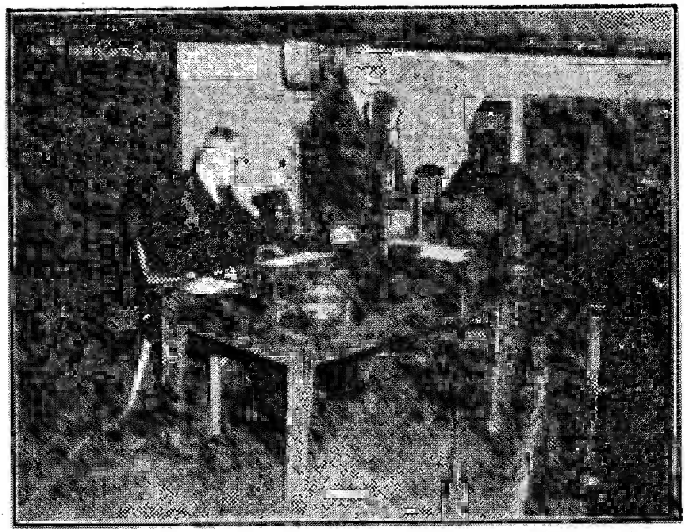
One of the simplest but most important of the devices used is the automatic direction finder, or radio compass, which adds to the safety of air travel by providing the pilot with bearings of selected medium-frequency ground radio stations or beacons.

Marconi's, as pioneers of air radio, have supplied such equipment to airlines all over the world. A recent order for 20 brings the total number of automatic direction finders ordered to date by Messrs. Vickers Armstrongs Ltd. for use in their Viscount aircraft to over 600. These equipments, of the type AD.7092 series, are most frequently employed as dual installations.

British V.H.F. Equipment for Netherlands Liners

THE Holland-America line's fleet of transatlantic luxury liners is being equipped with the latest type of frequency modulated V.H.F. radio-telephones, supplied by Automatic Telephone & Electric Company Limited, for use in harbour control and short distance communications.

Equipment has already been installed on three of the company's



Mr. C. Gardner, of Mullards, opening the PRACTICAL WIRELESS *Film Show.*

crack liners at present in service, including the 21,000-ton S.S. *Statendam*, which has just completed her maiden voyage to New York. The two other vessels on which equipment has been installed are the 15,000-ton S.S. *Massdam* and the 36,000-ton S.S. *Nieuw Amsterdam*. The 15,000-ton S.S. *Ryndam*, and a fifth liner, S.S. *Rotterdam*, which is at present under construction, will soon be equipped.

A section of the audience at the PRACTICAL WIRELESS *Film Show at Caxton Hall.*

New Marconi Staff Appointments

BECAUSE of the ever-increasing amount of the company's business in the field of aviation electronics, Marconi's Wireless Telegraph Company Ltd. has created two new posts on the aeronautical engineering staff.

Mr. G. P. Parker, A.M.I.E.E., has been appointed Deputy Chief Air Radio Engineer (Development): he will undertake the responsibility for the Airborne and Ground Development Group of the Aeronautical Division.

Mr. J. H. Gill has been appointed Deputy Chief Air Radio Engineer (Projects) and will be responsible for airborne and ground installation projects.

Both Mr. Parker and Mr. Gill will be responsible to Dr. B. J. O'Kane, Ph.D., B.Eng., A.M.I.E.E., Chief Air Radio Engineer.

Bright Start for Radio Exports

AFTER breaking records in 1956 with exports worth more than £40 million, representing a 20 per cent. increase on the previous year, exports of British radio equipment in January, over £3.2 million, were nearly 10 per cent. more than in January last year, according to the Radio Industry Council.

Death of Wireless Pioneer

THE Marchese Solari, an early associate and lifelong friend of Marconi, has died in Rome at the age of 83 after a long illness.

As an officer of the Italian Navy, the Marchese Solari was associated with Marconi's early demonstrations of wireless telegraphy on board Italian warships in 1897, and the two men became close friends.

When the Italian Government put the warship *Carlo Alberto* at Marconi's disposal in 1902 for the furtherance of his investigations into the propagation of wireless waves, the Marchese Solari accompanied Marconi as the officer in charge of the vessel's wireless telegraph station.

Shortly after his retirement from the navy he became manager of the Italian branch of Marconi's Wireless Telegraph Co. Ltd.; in 1927 he was appointed managing director and general manager of the Societa Italiana Radio Marittima, the posts which he held until his retirement.

Mr. J. H. Gill.

He leaves a widow, the Marchesa Solari, and one son, the Marchese Loranzo Solari.

Weather Charts by Radio

A MUFAX chart recorder, for displaying facsimile picture transmissions of weather charts, is now on exhibition in the Science Museum.

The recorder, which has been lent by the makers, Muirhead & Co., Ltd., reproduces a whole chart in 35 minutes or less depending on the speed setting, and throughout the recording the progressively growing chart is visible on a flat platen.

The exhibit can be shown in operation and will normally be used to record the transmissions broadcast from Dunstable meteorological station at 1210 hours and 1650 hours.

The recorder will remain on exhibition for a period of about six months.

Hours of opening: Weekdays, 10 a.m. to 6 p.m.; Sundays, 2.30 p.m. to 6 p.m. Admission free. (The museum will be closed on Good Friday.)

Marconi Transmitters for Aden Broadcasting Service

THE Aden Government has ordered two radio transmitters from Marconi's for the Aden Broadcasting Service. The transmitters, a 7½ kilowatt, Type BD.260, to serve the protectorate, and a 5 kilowatt, Type TBM.672, to serve the colony, are due to come on the air in the early summer of 1957.

Mr. G. P. Parker, A.M.I.E.E.

Both these transmitters are compact equipments designed for high fidelity performance.

An F.M. Tuner

MAKING AN AUDIO END FOR THE TUNER—SOME DETAILS OF WHICH WERE GIVEN LAST MONTH

By "Mark Time"

(*Continued from page 110, April issue*)

AS stated last month, the 8μF condenser and R18 and R19 are marked over the hole which the gain control originally occupied. The centre earth tapping between the two resistors is taken to the top of the screening can which originally held IC21. The resistor R14, which is connected to one end of the tertiary winding, is placed inside the screen originally holding IC26. The de-emphasis network C23, C24 and R17 is also mounted above the chassis, the audio output being taken across R17.

There should be little difficulty in wiring the first two stages. The capacitors C4, C6 and C7 should all be mounted below the chassis and wires about 2in. long should be brought from them through the holes where IT2 originally stood to where the tuning capacitor will eventually be placed. The resistance R1 should be connected as close to the aerial coil as possible, otherwise feedback may occur.

Finally, the front panel is bolted in position complete with the tuning capacitor. The tuning and oscillator coil is soldered across it and the wiring described earlier which comes from below the chassis connected in the correct manner. The tuner is now ready for simple tests prior to alignment.

Aligning the Tuner

Before the valves are inserted the heater voltage and 200-volt H.T. should be applied and the tuner inspected to ensure that no short circuits have occurred. The power being switched off the valves should be inserted and their screening cans placed in position. The heaters should then be switched on, and all the valves checked to see that the heaters are glowing. Finally, the H.T. should be switched on and the total current measured. A reading of about 20 mA is correct.

The signal generator being tuned to 10.7 Mc/s its output should be connected across the grid of V4 and earth. The multimeter, set on a 10-volt range,

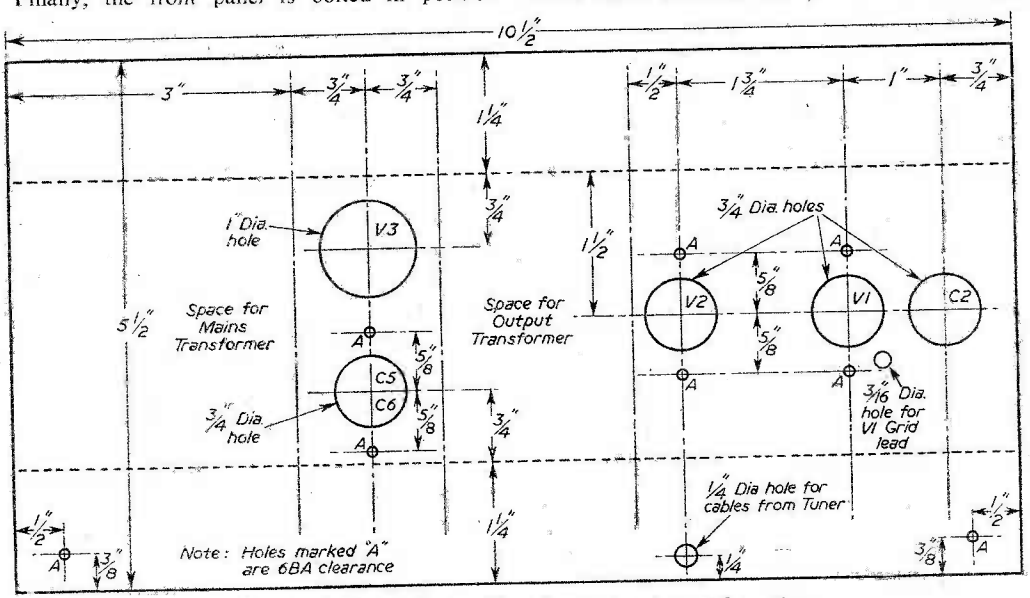


Fig. 1.—Details of amplifier chassis bending and cutting.

should be connected across C27. The top (primary) dust core of T3 should be adjusted to give a maximum reading. Do not touch the bottom dust core at this stage. The signal generator output should now be transferred to the grid of V3, and both cores of T2 set to give a maximum output. This should then be repeated for T1, the generator output being connected across C8.

Finally, the generator being left connected across C8, the voltmeter should be connected across C21. The bottom (secondary) dust core of T3 should then be set to a depth approximately equal to the depth of the other core in the primary, and then finally tuned to a zero reading. Moving the core in one direction should give a negative reading, in the other direction a positive voltage should occur. When the core has finally been adjusted to zero all the transformers are correctly aligned: the signal generator and meter may be removed.

The aerial, which consists of a dipole with arms of length 2ft. 5in., should now be connected across the aerial input socket. The audio output should be connected by means of a piece of screened cable to the amplifier input. On rotating the dial stations will be heard: the tuning is quite critical and the stations may be weak. When the stations are not tuned a faint "shushing" noise will be heard.

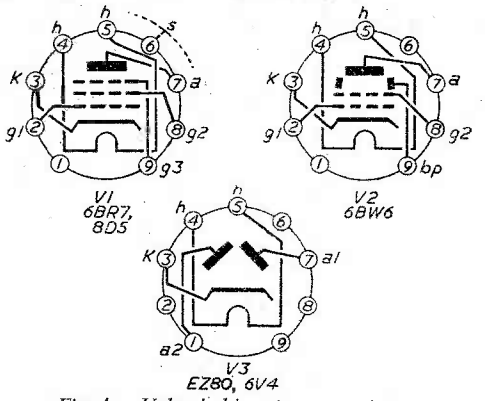


Fig. 4.—Valve holder pin connections.

To improve reception tune to a station and vary the spacing between turns of either L2 or L3. With patience very good reception will result: the tuner is as sensitive as any average commercial receiver. The author's gives moderate reception on a simple indoor dipole over 50 miles from Wrotham; the Midland Home Service has also been heard at reasonable entertainment value.

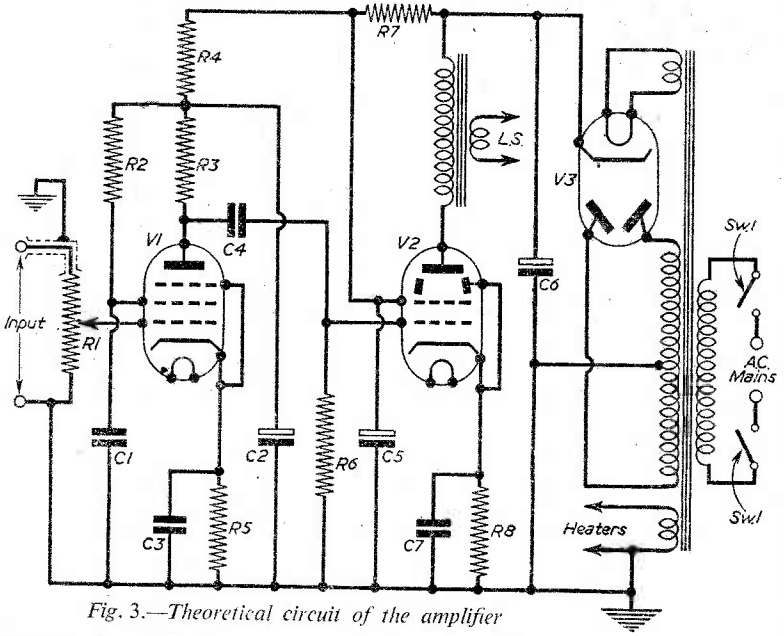


Fig. 3.—Theoretical circuit of the amplifier

Audio Amplifier

The output from the amplifier may be plugged into a standard radio, radiogram, or an amplifier. An alternative is to include the tuner with a normal standard broadcast tuner and to provide switching so that either F.M. or normal transmissions may be received.

In order to make the F.M. tuner completely self-contained, it was decided to add an audio stage and power pack. The only stipulations made concerning the additions were:

COMPONENTS LIST

C1—0.1 μF 350 v. wkg.
C2—8 μF 350 v. wkg.
C3—25 μF 25 v. wkg.
C4—.05 μF 350 v. wkg.
C5, C6—8-8 μF 500 v. wkg.
C7—50 μF 50 v. wkg.

V1—6BR7.
V2—6BW6.
V3—EZ80.

R1, Sw 1—100 KΩ variable with D.P.S.T. switch.
R2—1 MΩ 0.25 watt.
R3—.25 MΩ 0.25 watt.
R4—1.5 KΩ 0.25 watt.
R5—1.5 KΩ 0.25 watt.
R6—0.25 MΩ 0.25 watt.
R7—4.7 KΩ 5 watt.
R8—270Ω 1 watt.

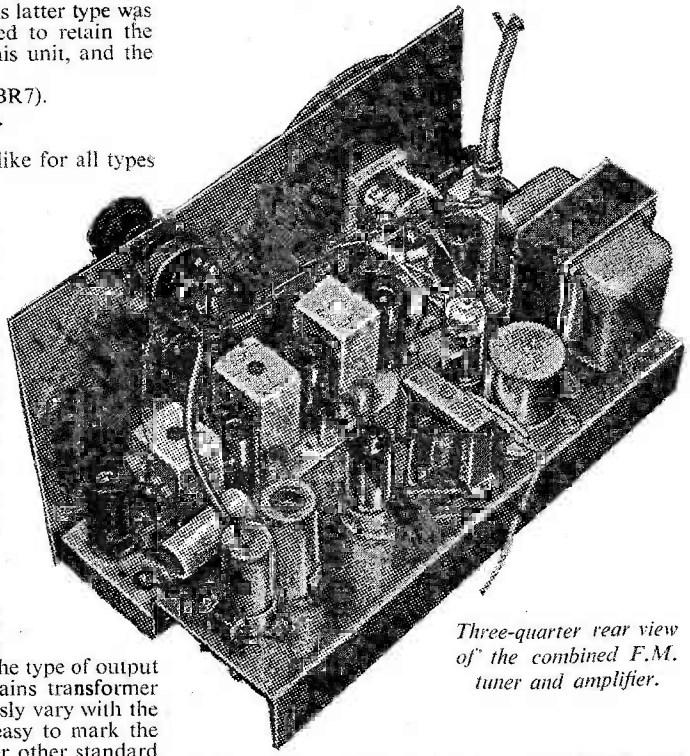
Output transformer: Primary 5,000 ohms. Secondary to suit L.S. Any described as suitable for 6V6 will be correct.
Mains transformer: Input to suit locality. Output 250-0-250 70 mA, 6.3 volts 0.6 amp, 6.3 volts 2.0 amp.
3 B9A valve bases.
1 valve screening can.
1 six-way tagstrip TS1.
1 two-way tagstrip TS2.
Aluminium 18 s.w.g. 10.5in. by 5.5in.

(i) The front panel should not be moved.
(ii) No part of the tuner itself should be altered.
(iii) The increase in size should be only in depth, not in width or height.

It was originally decided to use a 6V6GT beam tetrode as the output valve, but the miniature version of this, the 6BW6, being available, this latter type was used. Because of this it was decided to retain the Noval base for all three valves of this unit, and the following line-up was adopted.

V1—Audio frequency amplifier (6BR7).
V2—Output beam tetrode (6BW6).
V3—Full-wave rectifier (EZ80).

As the author has a particular dislike for all types of set which have one side of the mains connected to the chassis, an A.C.-only power supply was used and the expense of a mains transformer had to be incurred. The width of the mains transformer dictates the required width of chassis ; the length of the chassis is, of course, the same as that of the tuner, whilst the chassis depth is dictated by the diameter of the cathode decoupling condensers. Suggested chassis dimensions are included in Fig. 1 ; if a larger transformer has to be used, or if it is decided to use a 6V6GT instead of the 6BW6, these dimensions will have to be altered slightly.



Three-quarter rear view of the combined F.M. tuner and amplifier.

Construction

The first thing to be done is the marking out of the chassis. The only holes shown in Fig. 1 are those which will be the same regardless of the type of output transformer, condenser clips and mains transformer used. These three items will obviously vary with the individual constructor : it is quite easy to mark the positions for these once the holes for other standard components have been drilled. It is much easier to complete all drilling before any bending is attempted, so decide what space your transformers will need before putting drill to aluminium.

Bending is best done by cutting two pieces of scrap wood the length of the chassis and placing them either side of what will form a side. The whole can then be placed in a vice and the bend started by applying hand pressure to the remainder of the aluminium. Once the bend has been taken three-quarters of the way in this manner it will have to be finished by light, evenly distributed, tapping with a mallet. The other side is then formed in a similar manner.

Next, all the components except the mains transformer are fixed to the top of the chassis. They are all fitted using 6 B.A. nuts and bolts. Note that the tag strip TS1 is fitted under the mains transformer, using the same nuts and bolts as are used to fix the output transformer. The other tag strip associated with V1 is also fitted now, and all is ready for soldering.

First, an earth rail should be fitted between the two tag strips. It runs under C3 and C7, as shown in Fig. 2, and should be of about 18 s.w.g. tinned copper wire. This wire should also be used to fix one end each of C1, C3 and C7 to the main earth rail: these large components will then be securely fixed, and their other ends can be soldered to the respective tags on valveholders V1 and V2. Before soldering C7 in position, however, R6, the grid-leak resistor of the output valve, should be soldered in place : it lies under C7. Having soldered these large capacitors in position, resistors R5 and R8 can be connected across C3 and C7. All bias circuits are then completed. Before any more components are added the H.T. line from TS1 to TS2 should be wired.

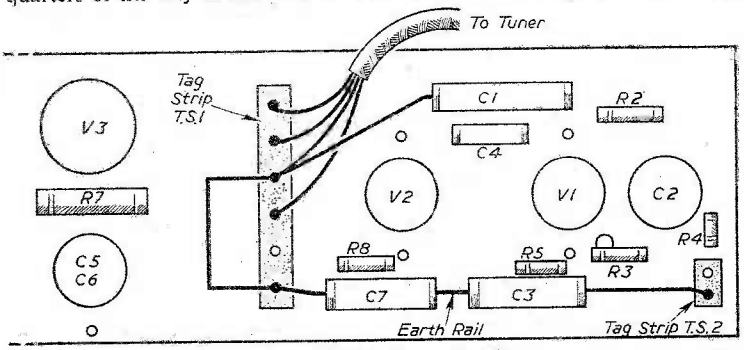


Fig. 2.—Main layout details.

(*Continued on page 178*)

Modifying Meters

HOW TO EXTEND THE RANGE OF EX-SERVICE INSTRUMENTS

By F. G. Rayer

EXCELLENT ex-Service meters are available at very low cost indeed, but many are not suitable for normal use as they stand. An example of this is the R.F. or thermo-couple meter, which is designed to read radio-frequency current. Such meters mostly have a full-scale reading of from .3 amp. to 1 amp., but they cannot be used in D.C. circuits, such as battery chargers—the reading for a given current will depend upon the way round the meter terminals are connected, and neither reading will be correct. Nevertheless, the fact that such meters really consist of a thermo-couple and sensitive moving coil meter make them suitable for very many applications, such as voltmeters, mA meters, and D.C. ammeters, after modification.

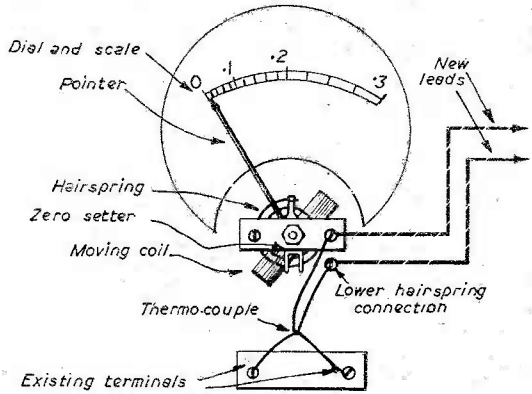


Fig. 1.—Changing a thermo-couple to milliammeter.

The internal connections of such thermo-couple meters are shown in Fig. 1. Two or three very small screws, possibly covered with sealing compound, will have to be removed before the meter case can be opened. It will then be possible to see the thermo-couple and movement. The thermo-couple is removed, and two new leads soldered to the hairspring tags. These new leads are taken to the two terminals on the meter case.

A new scale will need to be drawn up before replacing the meter, as the R.F. scale, crowded towards zero, no longer applies. The new scale will have equal divisions throughout, and this fact greatly simplifies modification and calibration. Many dials can be reversed by taking out two small screws. If so, the new scale can be drawn on the reverse side of the dial. Failing this, a new scale can be drawn on thin card and fitted over the old dial.

If an ammeter is required, for charging or plating circuits, the scale should be drawn to suit, as the meter can afterwards be shunted to read correctly. Zero and maximum marks should occupy the same positions as on the old scale. The intervals between are then marked off in equal divisions by compasses. An 0-1 amp. meter scale could be marked at $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1 amp. positions, or in .1 amp. divisions.

The unshunted movement will usually have a full-scale deflection of 2 mA to 5 mA. The actual range is of no importance, unless a mA meter or voltmeter is to be made. When it is desired to know the deflection, the meter may be wired in series with a calibrated mA meter with a small dry battery and variable resistance of about 10,000 ohms. The resistance is adjusted from maximum value (to avoid a heavy current) until the modified thermo-couple meter reads full scale, when the deflection can be seen on the calibrated instrument. It is also possible to find out the deflection with fair accuracy by using a known battery voltage and series resistor, and applying Ohm's Law. For example, a 1,000-ohm resistor, with 9 volts grid bias battery will give currents of approximately $1\frac{1}{2}$ mA from the $1\frac{1}{2}$-volt tapping, 3 mA from the 3-volt tapping, and so on, up to 9 mA with the full 9 volts.

For use as a mA meter, the scale is divided into equal parts to correspond with the deflection. For example, five equal divisions will show 1 mA, 2 mA, and so on, up to 5 mA, with a 5 mA meter.

Shunting

A meter can be made to read higher currents by wiring a resistor in parallel as in Fig. 2. For heavy currents, such as 1 amp., a very short piece of resistance wire will be sufficient and it may be fitted in a loop directly between the meter terminals Good contact is essential. The meter may be damaged if the leads to the external circuit are taken directly to its terminals and the shunt disconnected. When experimenting with the shunt, it is thus best to wire as in Fig. 2, as disconnecting the shunt from the meter can then cause no damage.

The length of resistance wire in the shunt can be adjusted by wiring up a calibrated ammeter as shown in Fig. 3 at "A." An accumulator or large dry battery will supply current, the resistance being of the wire-wound type.

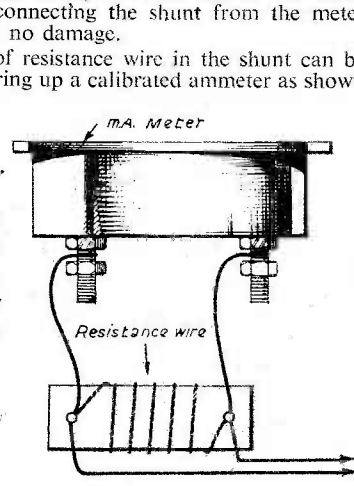


Fig. 2.—This diagram shows how the meter may be shunted to give higher readings.

If it is found that the shunted meter is too sensitive, the pointer rapidly going across the scale, then the length of wire in the shunt must be reduced. On the

other hand, if the modified meter does not give a sufficient reading, the shunt is of too low resistance. When the correct shunt has been found, it is fixed permanently in position. Readings throughout will then correspond to the scale that was drawn up.

" B " in Fig. 3 shows another method of calibrating the ammeter, and quite accurate enough for charging circuits. A 6-volt 6-watt bulb, with 6-volt accumulator, will pass 1 amp. A 6-volt 3-watt bulb would pass ½ amp., as would a 12-volt, 6-watt bulb. If the meter is to read 0-1 amp., it is only necessary to modify

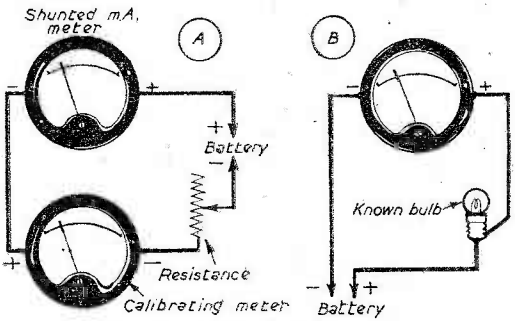


Fig. 3.—Calibrating the meter.

the length of shunt wire until the pointer shows ½ amp or 1 amp., according to bulb. Other readings, above or below as the case may be, will then also be satisfactory.

Voltmeters

For battery testing and similar purposes a voltmeter with one or two D.C. ranges is extremely useful and very easily made. If a mA type meter of known deflection has been obtained, any required voltage range can be provided by using a suitable resistor. With a modified thermo-couple instrument the current necessary to give a full-scale reading must be found by one of the methods described. When the current is known, and expressed in mA, simple division will give the resistance value required in thousands of ohms. The full-scale voltage reading wanted is divided by the full-scale current of the meter. E.g., a 15-volt range is wanted with a 1 mA meter ; 15,000 ohms required. A 150-volt range is required with a 5 mA meter ; 30,000 ohms required.

Two ranges can be provided by using two resistors, as in Fig. 4, the positive test lead being taken to the appropriate socket or terminal. As accuracy depends largely upon the resistances, it is best to obtain the type accurate in value to one per cent.

Round values (e.g., the 15,000 ohms and 30,000 ohms mentioned) are satisfactory for any volts range of 0-10 volts or more. With very low ranges, such as 0-2 volts, the resistance of the moving-coil becomes significant. If high accuracy is required with such a low range, the resistance of the coil should thus be taken from the value of the series resistor. For example, an average 1 mA meter would have a resistance of 100 ohms. For 0-2 volts the total resistance needs to be 2,000 ohms. As 100 ohms are already present in the meter, the series resistor should be 1,900 ohms (2,000—100), not 2,000 ohms. But with high ranges the effect of the internal resistance of the meter is so insignificant that it is disregarded.

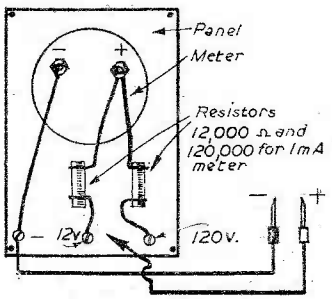


Fig. 4.—A voltmeter circuit.

The actual ranges can be selected to suit the meter scale and purpose in view. A 1 mA meter with marked scale would not really require new scales if used for 0-10 volts and 0-100 volts, though new markings could be provided if desired.

With the modified thermo-couple instrument, or a meter with unsuitable markings, a new scale can be drawn and the series resistances (or shunt) chosen to suit. Fig. 5 shows a 0-5 volt scale added to a 1 mA meter, and 0-10 and 0-150 volt scales on a 5 mA meter. It will be seen that equal divisions always arise throughout and this greatly simplifies marking. These particular ranges would be obtained with a 5,000-ohm resistor for 0-5 volts with the 1 mA meter, and 2,000 and 30,000 ohms with the 5 mA meter for 10 and 150 volts.

When only one range is necessary the resistor may often be included in the meter case. If not, a simple arrangement such as that in Fig. 4 can be adopted, the panel being fitted to a shallow box.

Applications

For testing the batteries used with the average small battery portable radio, ranges of 0-10 and 0-100 volts will do well. If a 7½-volt L.T. battery is not used, the lower range may be 0-5 volts instead. The larger types of battery set will require ranges of about 0-150 volts for H.T. testing, and a low range for accumulator testing. The voltage measurements should always be made with the receiver switched on and working, so that the batteries are delivering their usual current.

A range of 0-10 volts will be suitable for 6-volt charging, this being extended to 0-15 volts or so if 12-volt accumulators are dealt with. Many ready-made voltmeters of cheap type have ranges of 0-12 and 0-120 volts and this is quite useful for general purposes. With the home-constructed meter it is, of cou e, quite simple to provide as many different voltage ranges as necessary by fitting a suitable resistor for each.

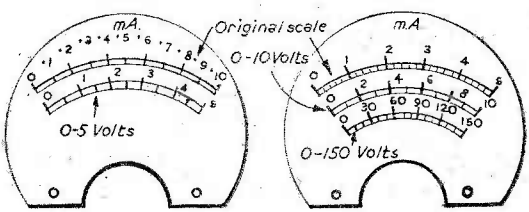


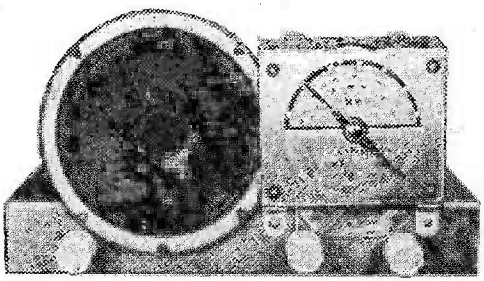
Fig. 5.—Two voltmeter scales.

The "Modern" Battery Receiver

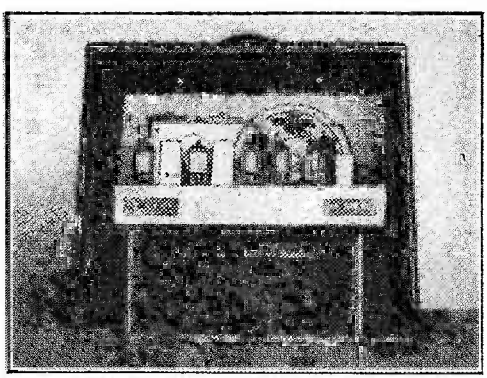
A SIMPLE 5-VALVE SUPERHET FOR GENERAL USE

By R. Hindle

(*Continued from page* 102, *April issue*)



THE order of mounting components is of little importance in view of the open layout, except for the corner where the coils are fitted. Here it will be found as well to mount the tuning capacitor before the coils or wavechange switch. Now fit drum drive and thread the drive cord. This is quite simple, as it goes to the front and not through the top of the chassis. Then the dial plate should be mounted, followed by the wave-



The receiver ready for use.

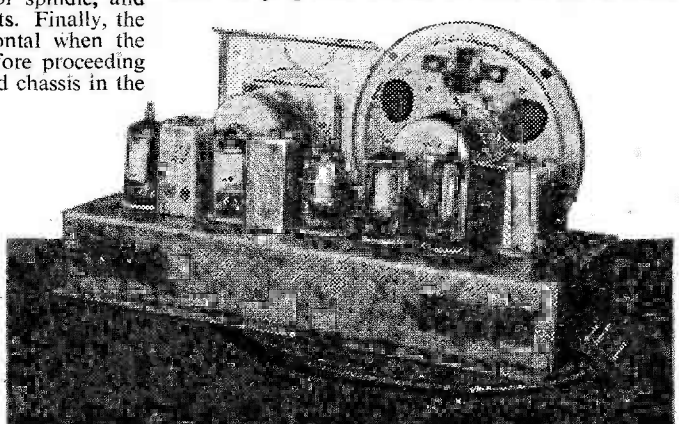
change switch and then the coils. When mounting the speaker insert a layer of rubber between the speaker and the chassis to reduce the risk of audio ringing.

The dial is placed on the dial plate, carefully centring the hole round the capacitor spindle, and holes pierced to take the holding bolts. Finally, the pointer is fitted so that it is horizontal when the plates are fully enmeshed. Now, before proceeding with the wiring, try out the assembled chassis in the cabinet. Mark the length of control shaft required to allow the knobs to sit snugly against the front of the cabinet and on removing the chassis cut off the surplus with a hacksaw while holding the spindle firmly in a vice or a pair of large pliers. The chassis remains in position quite well when the cabinet is assembled and the knobs firmly screwed on but, if preferred, small aluminium angle brackets can be made and bolted to the side of the chassis by which, in due course, it can be screwed to the shelf of the cabinet.

Wiring

The wiring of the chassis is carried out with tinned copper wire, about 24 s.w.g., in sleeving. All points are accessible with the possible exception of the wavechange switch and unless one of the miniature modern soldering irons is to be used it will be as well if lengths of wires are soldered to the lower tags of this switch before mounting it in place. A wiring diagram is given (Fig. 4) which is complete except for the wavechange switch wiring which is given in Fig. 5. Fig. 5 will also serve to identify the wavechange switch contacts. It will be noticed that the switch in the illustration is divided into four sections corresponding to the four poles of the switch and the associated contacts. Identify the four switch sections of the component to be used in this way to ensure correct connection and then use Fig. 5 while wiring. It will be seen from the wiring diagram that two tag strips are used, one with four tags (one of which is earthed by the mounting bolt) used to anchor the battery leads and one with three tags (one earthed) to support the I.F. filter between the detector and the volume control. The positions of these will be clear from the wiring diagram and these should be mounted before wiring.

Below is a wire-by-wire description of the work which, if carried out in the order indicated, is not likely to give any trouble even to the beginner. The best way to work is to put on the leads in the order indicated and to refer to the wiring diagrams to identify the points and to see the run of the wires. It is often necessary, however, when drawing a wiring diagram to deviate from the exact path for the sake of clarity. Generally speaking, all leads carrying signals go by the shortest and most direct path; leads carrying D.C. can be allowed to go by more



A view of the receiver removed from its cabinet.

devious routes and should be run close to the chassis. If the constructor can follow a circuit diagram it is a good plan, also, to mark off on Fig. 1 as the leads are put on. It will be seen that one lead is carried out in screened cable, i.e., the gramophone input lead to the volume control wiring. This is ordinary single core screened wire or alternatively could be screened sleeving over the ordinary tinned copper connecting wire. Care must be taken also to identify the contact soldering tags for the switch on the volume control. A meter or a battery and flash-lamp bulb should be used to find out which tags are shorted together when the switch is on. One pair that is connected together are identified as tags 1 and 2 (it does not matter which way round they are connected) and the other pair is identified as tags 3 and 4; the former pair is used to switch L.T. negative and the latter pair is used to switch H.T. negative.

Components		Connections
		V1 centre ring to V1 pin 7 to earth.
		V2 centre ring to V2 pin 7 to earth.
		V3 centre ring to V3 pin 7 to earth.
		V4 centre ring to V4 pin 7 to earth.
		V5 centre ring to V5 pin 7 to V5 pin 1 to earth.
		H.T. negative to tag 2 of switch on volume control.
		L.T. negative to tag 4 of switch on volume control.
		Strip back the braid of a single core screened lead 5in. long and connect screen to tag 1 of gram. input; inner to tag 2 of gram. input. Connect the inner at the other end to outside tag on 3 tagboard nearest volume control.
		Lead from section of tuning capacitor farthest from dial to V1, pin 6 to aerial socket pin 2.
		Lead from section of tuning capacitor nearest dial to wave-change switch tag A.
C1	300 pF	From wavechange switch tag A to V1 pin 4.
R1	100 KΩ	From V1 pin 4 to earth.
		Wavechange switch tag 8 to tag 9 to V1 pin 1 to V2 pin 1 to V3 pin 1.
		V1 pin 2 to IFT 1 pin 4.
		Wavechange switch tag 6 to L1 tag 1 to aerial socket pin 1.
		Wavechange switch tag B to L1 tag 2 to earth by V1.
		Wavechange switch tag C to L.T.— switch on volume control (tag 3).
		Wavechange switch tag D to pin 3 V1.
		Wavechange switch tag 11 to L2 tag 1.
		Wavechange switch tag 12 to L3 tag 1.
		Wavechange switch tag 3 to L3 tag 4.
		Wavechange switch tag 2 to L2 tag 4.
C3	470 pF	From L3 tag 3 to earth (centre ring of V1 valveholder).
C2	150 pF	From L2 tag 3 to earth (centre ring of V1 valveholder).
		I.F.T. 1 pin 6 to I.F.T. 2 pin 6 to H.T. positive input tag.
		I.F.T. 1 pin 1 to V2 pin 7.
		I.F.T. 1 pin 3 to V2 pin 6.
		V2 pin 2 to I.F.T. 2 pin 4.
		V2 pin 3 to L3 pin 2 to L2 pin 2.

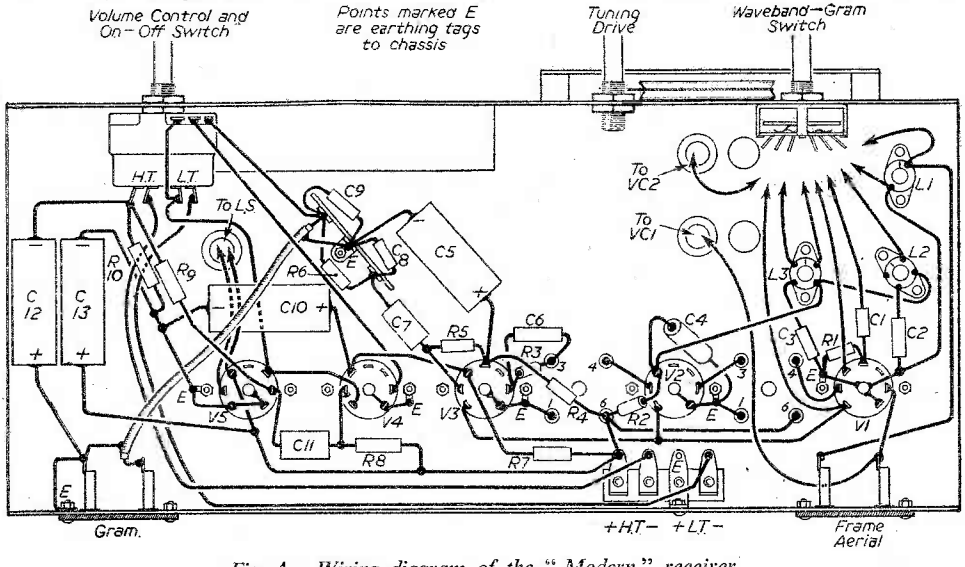


Fig. 4.—Wiring diagram of the "Modern" receiver

Components		Connections
R2	33 KΩ	From V2 pin 3 to H.T. positive tag.
C4	.05 μF	From V2 pin 3 to earth.
		I.F.T. 2 pin 1 to earth at pin 7 V3.
R3	1 MΩ	Both from I.F.T. 2 pin 3 to V3 pin 6.
C6	100pF	V4 pin 3 to V3 pin 3.
R7	2.2 MΩ	From V3 pin 3 to H.T. positive tag.
R5	1 MΩ	From V3 pin 2 to V3 pin 4.
C7	.05 μF	From V3 pin 2 to nearest tag on 3 tag board.
R4	47 KΩ	From V3 pin 4 to H.T. positive tag.
C5	30 μF	From V3 pin 4 (positive lead) to earth.
		V4 pin 1 to V5 pin 5 to L.T.— on volume control switch (tag 3).
C11	.05 μF	From V4 pin 2 to V5 pin 6.
R8	1 MΩ	From V4 pin 2 to H.T. positive tag.
C10	4 μF	From V4 pin 3 to earth.
R6	47 KΩ	Across outside tags of 3 tag board.
C8	100 pF	From one outside tag on 3 tag board to centre tag (earth).
C9	100 pF	From other outside tag on 3 tag board to centre tag.
		Tag on 3 tag board nearest volume control to tag 7 on volume control.
		Tag 6 on volume control to V4 pin 6.
		Tag 5 on volume control to L.T. negative (tag 3 on volume control).
		One outside tag on output transformer (i.e., primary winding) through grommet to V5 pin 2.
		Other outside tag on output transformer to V5 pin 3.
		V5 pin 3 to H.T. positive tag.
C13	8 μF	From V5 tag 3 to earth.
R9	2.2 MΩ	V5 pin 6 to H.T. negative on volume control (tag 1).
C12	100 μF	From H.T. negative on volume control (tag 1) to earth.
R10	680 Ω	From H.T. negative on volume control to earth on 3-way tagboard.
		Two secondary leads from output transformer to two tags on speaker (may be connected any way round).
		Connect one end of a length of four-core cable (about 12in.) with colour coded inners, one core to each of the four power input points on the chassis. At the other end fix a four-pin battery connector or four separate plugs (according to the battery to be used) taking care that the right colour of lead goes to each battery pole.

Winding the Frame

The frame aerial should now be wound if this type of aerial is to be used. This is on a loose frame of wood that fits snugly into the back of the cabinet. In order to space the windings from the wood pieces of matchstick were glued at the corners. Fifteen turns using 26 gauge double cotton covered wire were required on a frame measuring 11½in. x 9½in., the turns being close wound. If a frame of different size is to be used

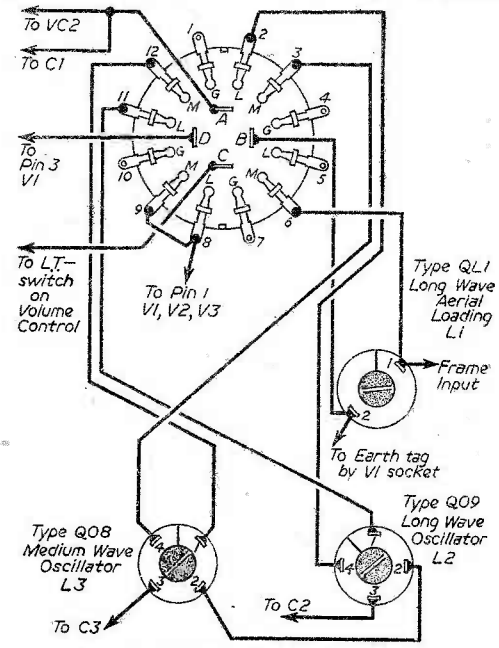


Fig. 5.—Details of the coil switching.

the number of turns should be calculated to use about the same length of wire, i.e., 17½ yds. The constructor will no doubt find it advantageous to experiment himself with the exact number of turns for his own case, starting with a winding a little larger than that indicated. If subsequently he wishes to reduce the inductance he can remove a turn at a time and final adjustment is made by separating the windings a little on the frame. Leave about 4in. of wire at each end, starting and finishing the winding at a point on the frame that will be adjacent to the aerial input sockets of the chassis when both are in position in the cabinet; slide a piece of sleeving on each end and terminate with a plug suitable for the aerial input socket. It does not matter, of course, which way round these plugs are connected to the socket.

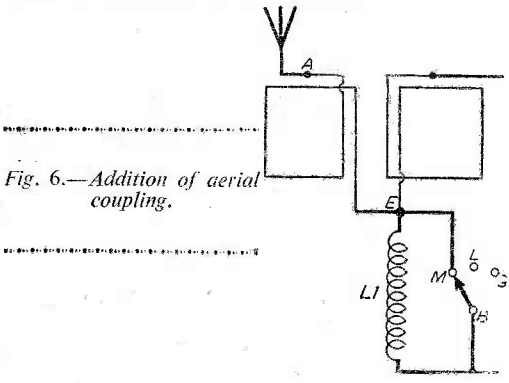
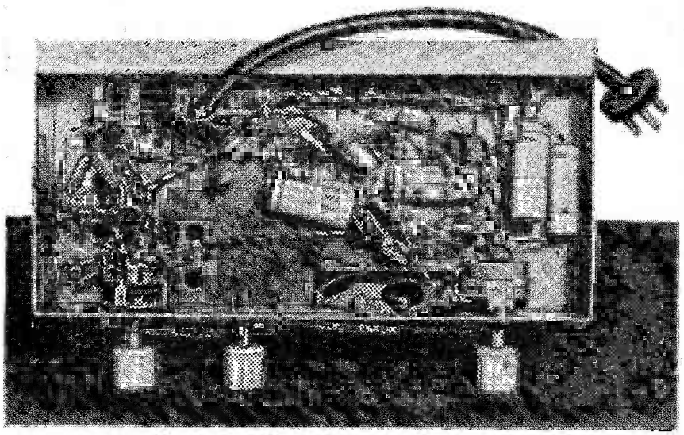


Fig. 6.—Addition of aerial coupling.

Ferrite Rod Aerial

If this alternative form of aerial is chosen, or if maybe the constructor wishes to try both to see which he prefers, a medium-wave winding is placed on one end of the rod in accordance with the instructions supplied with the rod, or the Osmor version already wound for medium waves may be chosen. There is no change to the receiver chassis itself; the end connections of the rod aerial plug into the same sockets of the receiver and the long wave loading coil already fitted on the chassis comes into play for the long waves just as before. The rod is mounted on two brackets made of Perspex, drilled to take the rod reasonably tightly so that it will not drop out when the receiver is moved, and these brackets are screwed to the inside top of the cabinet by means of aluminium angle brackets.



An underside view of the receiver.

The rod aerial will be found very efficient and is particularly suitable in the cases where a rather small cabinet is used or where the fitting of a suitable frame is difficult. In the case of the prototype, where the frame was first fitted and then subsequently the Ferrite rod aerial was substituted the rod has been retained for permanent use, but it is always interesting to try such experiments for oneself.

Setting-up

Carefully check the wiring of the chassis and then plug in the five valves in the correct sockets and plug in the frame or rod aerial. The battery can now be connected. Switch the waverange switch to gram. and touch the gram. input sockets with the finger, the volume control meanwhile being at maximum. In the case of one of the input plugs hum or noise pick-up will be heard in the speaker and if this is not so there must be a fault in the last two valve stages.

Now switch to medium waves. If a signal generator is available tune the I.F. circuits to 465 Kc/s, if such is not available leave the I.F. transformer cores untouched for the time being. Now search the dial for the local medium-wave transmission, remembering that the orientation of the aerial will vary the signal pick-up so set this pointing towards the station being sought. The direction is not very critical and a 30 deg. error is not likely to matter at this stage. When the station is detected the I.F. transformer cores should be adjusted for the maximum signal unless, of course, they were previously correctly aligned with the signal generator, in which case they will now be left alone. Now bring the station on to the correct position of the dial, shifting gradually in that direction whilst following up by adjustment of the core of L3. If there is a choice of stations select the one with the higher wavelength for this adjustment. Now find a station towards the bottom of the tuning range (the medium-wave Light programme is suitable) and tune this to maximum using the two trimmers on the tuning capacitor. Now return to the station higher up the dial and again bring this on to the correct tuning point with the oscillator core and continue to alternate on the higher wavelength, adjusting the core, and the lower wavelength, adjusting the trimmer, until no further improvement can be effected and the tuning points concide with the dial calibration. Now switch to long waves, set the dial to the tuning point for the long-wave Light programme and tune in the station with the cores of L1 and L2, leaving the trimmers alone.

If, now, there is any doubt about the matching of the aerial frame the inductance can be reduced, as previously mentioned, by removing a turn at a time; finally, whilst listening to the signal, opening out the windings slightly with a knitting needle of the plastic variety. If this increases the signal strength of a medium-wave signal at the upper end of the range, return to the lower end of the range and adjust the aerial trimmer here, alternating as before. If separation of the turns does not improve signal strength return to the close-wound position and test to see if the inductance is actually too low. This is easily done by connecting a variable capacitor across the aerial winding and seeing if an increase in capacitance improves signal strength. If it does the number of turns should be increased and it will be better to strip off the winding and rewind with more turns, then proceeding as above.

Aerial Coupling

The reader might desire to couple an aerial to the receiver. It was found that six turns of the 26 gauge wire, spaced ¼in. away from the main winding, were satisfactory. One end of this winding could be taken to another aerial socket fixed to the frame and accessible through a hole in the back of the cabinet. The other end is connected to the end of the main frame that is connected to the wavechange switch inside the chassis and the resulting input circuit is given in Fig. 6. It will be noticed that the bottom end of the coupling winding is not connected to earth as might have been expected. This is because a closer coupling on long waves was preferred.

In the case of the rod aerial, probably a tidier way to couple in an aerial would be by means of a small capacitor, say 20 pF, to the grid end of the winding; the capacitor goes in series with the aerial lead, of course.

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WHITELEY T10 TWEETER UNIT.—Response 2,000-14,000 cycles. Handles 5 watts. Impedance 15 ohms. Suitable for any speaker, but particularly recommended by the makers for the HF1012. Price **£4.4.0.**

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SIZE : 8in. x 4in. x 4½in. high.
INPUT VOLTAGE : For A.C. Mains of 200 to 250 v. Chassis fully isolated from the mains.
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It's Now Brumley

THE bearded boys of the BBC with long necks, loose collars, baggy corduroy trousers and, of course, suede shoes with yellow socks, have not been slow to catch up with the latest piece of snobbery—the pronunciation of *o* as *u*. They now pronounce Bromley as Brumley. I know that district extremely well, and there is not one resident there that I know who so pronounces it. The Director-General should really put some period to these snobbish Chelsea types who wish to give a Kensington drawing-room type of pronunciation to words and place-names. Incidentally, isn't it about time that the BBC insisted upon a reasonable standard of dress for its employees? Many of them have adopted the cult of dressing like tramps in the belief that they will be taken as geniuses. Many of them wear horn-rimmed glasses with plain glass "lenses," to lend a professorial veneer to otherwise vapid and vacuous countenances. No wonder Sir Thomas Beecham said that if they were all placed end to end they would reach from Sodom to Gomorrah! They swashbuckle about the BBC like retired country gentlemen, one hand in trouser pocket, fag-end drooping from the corner of the lips, as if they were obliging the BBC.

BBC Plays

SOME of the plays selected by the BBC for broadcasting are quite unsuited for the purpose. No matter how skilfully adapted, expurgated, amended or revised, they still fall flat. A good example was "The Good Companions." This is not one of Priestley's best works; the plot is corny, the narrative lacks cohesion, there is practically no plot, the dialogue is weak. The story of an impecunious and itinerant theatrical company is as old as the proverbial hills, and as a broadcast it interested me far less than the book. This criticism applies also to TV plays which, by the limitations which TV studio technique imposes, cannot really be adapted whilst still retaining the fabric of the play or the story. I suggest that this work should be placed in the hands of really competent entrepreneurs skilled in stagecraft and theatrical production. Such plays as "Lady Windermere's Fan," "The School for Scandal," and similar plays which do not require the visual effect superimposed upon the plot are really well done, but those which require facial expressions and other effects which cannot be produced by words should be left alone.

Donegall Discs

I AM glad to learn that my old friend Lord Donegall has entered the gramophone record industry and is marketing records recorded in his own studio. He has had many years of experience of sound-recording and is quite an expert on the subject. His discs which I have heard are of extremely high quality, and whilst at present they are confined to recordings of music and song in the modern idiom, I have no doubt that he will turn his attention in time to other forms of music. I am not a dance-music fan myself: I loathe rock 'n' roll, and consider it a retrograde step to imitate the crude music of the Negro. But the fact must be faced that there are many people, mostly teenagers and bobby-soxers, who do, and the passing phase must be catered for.

Electronic Device Which Reads

MOST computors of the electronic type require the previous preparation of a punched card or tape. There was a demonstration recently at Dorking of the Solartron E.R.A., which means Electronic Reading Automaton. This can "read" from an original document direct into the computor. The machine has three main units—the recogniser, the scanner, and the paper feed. The reading speed is 120 words per second, but it is hoped to step this up to over 300 words a second.

Cyril Stapleton's Band

I AM not sorry in some ways that the BBC decided to end Cyril Stapleton's band. After all, it has been running for five years, and as I have before remarked, there are now so many bands that they should all be given a chance. Bands split and multiply like germs. From the original band which performed on the air has sprung about 100. It works like this. A fiddler or trumpeter or some other member of the band will argue that his conductor gets most of the credit and the cash and that he should therefore break away and form his own band. He does so, only to find that the members of his band have the same views, and so they break away and form their bands. There are far too many of them competing for programme time, that none of them can really make much money out of it.

However, the BBC should not tie itself at any time to one band. It amounts to granting an unfair monopoly. But then the BBC likes monopolies, whether it is a Brains Trust, 20 Questions, or some other parlour game quiz: it is the same old panel all the time, and people get tired of them. The panels should be changed in every programme. A variety theatre would not last a month if it had the same old turns on week after week. So I should like to see the purging of the BBC Augean stable carried much further and be extended to other continuing programmes, even to the "Archers," "Life With the Lyons," Wilfred Pickles, Archie Andrews and similar comic turns with which many have become sated.

TRANSMITTING TOPICS

SIMPLE RIGS

By O. J. Russell, B.Sc., A.Inst.P. (G3BHJ)

BOTH the beginner and the experienced amateur may find a considerable amount of interest in ultra-simple rigs. Indeed, for the newly licensed amateur a very simple rig may serve to maintain the station on the air, while more elaborate rigs are being planned and constructed and tested. In any case some form of standby transmitter may be very useful in the event of a major reconstruction of the main station, or a breakdown just when a local net is due to operate. The RAEN enthusiast may even need a special rig for work solely on RAEN frequencies and so on.

The simplest type of rig for spot frequency working is some form of crystal oscillator. Indeed, many top-band stations use only a crystal oscillator rig, and many RAEN nets operate on spot crystal frequencies. Indeed some amateurs to-day operate only with crystal control, despite the almost universal acceptance of V.F.O. working. A simple "straight" oscillator such as shown in Fig. 1 will be found useful for top-band working, especially as it is often possible to acquire top-band crystals secondhand quite cheaply at "ham auctions." It should be noted that the output depends markedly upon the tuning of the anode circuit in a simple "straight" crystal oscillator, as this also controls the regenerative feedback. In fact oscillation is only possible when the anode circuit is tuned *higher* in frequency than the crystal. As anode circuit tuning approaches the crystal frequency, the output increases, suddenly ceasing as the anode tuning reaches the crystal frequency. As the output may be link-coupled into a conventional aerial tuner unit, some interplay between the anode tuning and the aerial tuning may be experienced, so that some compromise adjustment short of maximum output will be found most satisfactory. This is particularly evident when keying such an oscillator, as adjustment for maximum output may cause keying to be sluggish, and even introduce a chirp. Crisp keying will be achieved by tuning for somewhat less than maximum R.F. output.

However, as the common use for such a simple crystal oscillator rig is for top-band "ragchews," a simple means of modulation is a necessity. A single small pentode may, in fact, be swung by a carbon microphone to give effective modulation (Fig. 2).

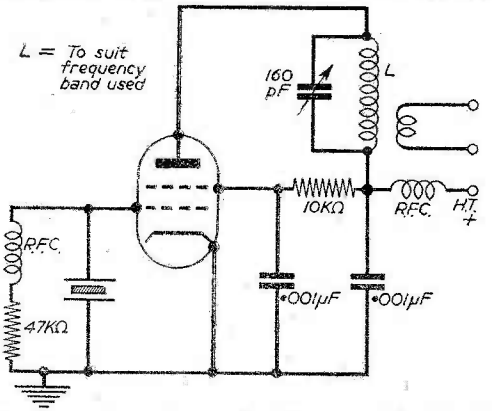


Fig. 1. — A simple crystal oscillator capable of useful output with suitable crystals for 1.8, 3.5 *or* 7.0 *Mc/s.*

However, Mullard now provide an interesting "triode pentode," the ECL80, with a common cathode for the two elements, thus enabling a simple two-stage Heising modulator to be made with "one valve." The extra gain of the triode stage enables a carbon microphone comfortably to swing the pentode modulator. Thus a very simple "two valve" rig may be made that provides opportunity for at any rate top-band "ragchewing." It should be noted that a very wide range of oscillator tubes may be employed, such as the 6F6, 6V6, 6L6, 6AM5, 6AM6, 8D3, 5763 and even TT11s or indeed the ubiquitous 807 if run at low power. However, while considering the question, such an oscillator may easily be run at 7 watts input, or even ten watts. Thus they are hardly in the

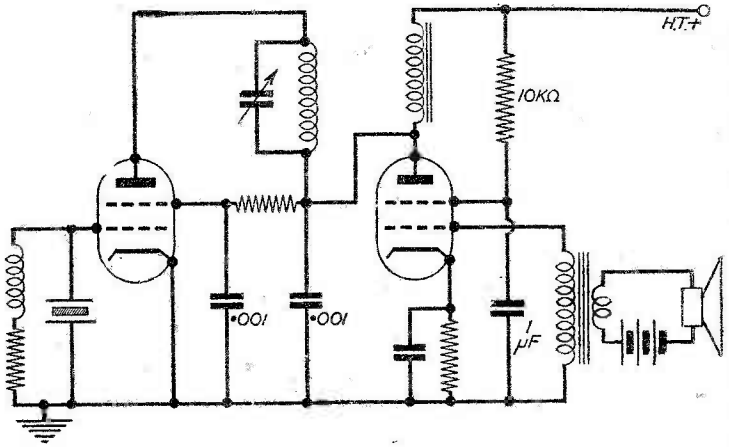


Fig. 2.—A simple choke modulated telephony transmitter.

QRP class, and if coupled to reasonable aerial systems, not only good distances, but real DX may be worked with such simple gear. In fact one amateur on 7 Mc/s using a 1.4 watt input to a battery valve crystal oscillator has had many interesting contacts. The writer has had very many enjoyable top-band QSOs on a simple Heising modulated crystal

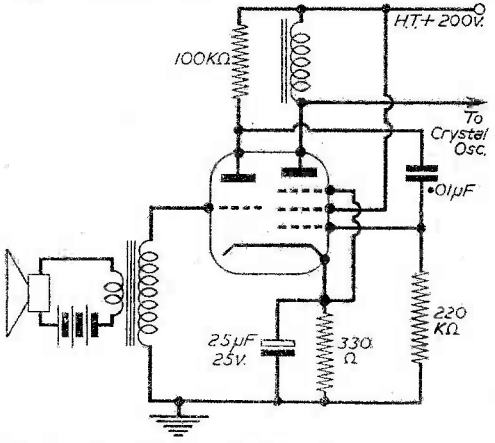


Fig. 3.—The Mullard ECL80 triode-pentode used as a two stage modulator.

oscillator rig, and has had many Continental CW QSOs on the same rig with an 80-metre crystal at the L.F. end of 80 metres ! A simple rig should never be despised therefore, as recent performances on "flea-power" transistor rigs has shown that good results may be obtained. In fact, of course, as a simple crystal oscillator can run at several watts input, it is capable of good results. Naturally a selection of crystals is a help in dodging QRM, as being "rock-bound" upon a badly jammed frequency is most frustrating and deteriorates the temper as the writer can testify !

Single-valve Rigs

Although we have shown circuits with which phone working can be achieved with two valves, it is possible to obtain local "ragchew" phone operation with "single valve" rigs. The modern small double triodes, for example, will enable this to be achieved by using one half as the crystal oscillator, and the other half as the modulator. However, to obtain a good depth of modulation, a valve such as the 12AT7 is recommended, rather than the 12AU7. The 12AT7 only requires a volt or so to swing it for audio modulator use, so it may be driven direct from a good carbon microphone provided with a correct high-ratio microphone transformer. The D.C. input to the crystal oscillator should be restricted to some two to three watts at the most for reasonably full modulation, so a by-passed dropper resistor is advisable to ensure reasonably full modulation. Incidentally, the single triode section of a 12AT7 can be run at some five to six watts input as a crystal oscillator. A further point is that a carbon microphone may be easily energised by feeding it via a dropper network from the H.T. supply, thus obviating the irritation of providing a battery polarising supply. Thus the complete "choke modulated" 12AT7 rig is shown in Fig. 4.

It is clear that a "single valve" rig of this type may be made quite compact, especially as a small "short wave" receiving type condenser may be utilised for the tuned anode circuit. The choke can also be of modest dimensions, as only some 25 to 35 milliamps current need pass. However, there are still further possibilities. For the avoidance of the limitation of crystal control on one frequency, it is possible—at any rate upon top band—to operate a modulated self-excited oscillator rig using a miniature double triode.

To ensure tolerable stability, it is essential to use a high C oscillator if a Hartley type circuit is used. Thus, if a 100 pF variable is used, it should be padded by some 330 pF of silver mica fixed condenser to assist in stability. Moreover, even with a high C circuit, coupling of the aerial tuner will cause frequency shifts on tuning up. Provided an experienced operator wishes to try some such arrangement for QRP local "ragchews" on top band, a circuit such as Fig. 5 might be tried. It is only upon top band that such a rig should be attempted, as despite the use of plain Hartley oscillators by the old-timers upon the H.F. bands, it is unlikely that stable performance will be achieved without very much experimentation except on top band, where careful operation, particularly loose aerial tuner coupling to the tank circuit, will give reasonable stability. Of course, it is essential that suitable frequency monitoring equipment be used in putting a self-excited rig of this type into operation. Due to the influence of the aerial tuner in slightly "pulling" the frequency of the oscillator, care has to be taken in "netting" to a frequency. Thus the aerial tuner should be resonated to the region one is working on, and the final frequency adjustment made on the oscillator tuning. The aerial tuning should *not* be adjusted after the oscillator has been set to frequency, unless it is used for a final slight correction of frequency, and the fact that the aerial tuner will "pull" the oscillator must always be borne in mind by vigilant frequency monitoring for every adjustment of the aerial tuner.

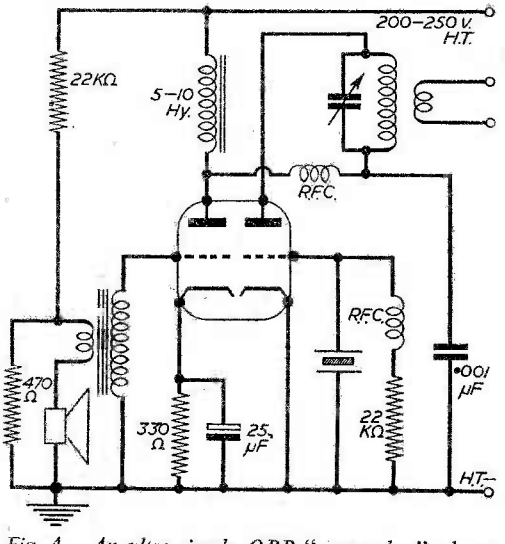


Fig. 4.—An ultra-simple QRP "one valve" phone rig using a single 12AT7.

Crystal Control

Thus a simple self-excited oscillator rig, while quite practical for local "ragchews" upon top band, is not really to be recommended. The use of crystal control in the earlier simple rigs enabled such "pulling" and stability problems to be overcome at the cost of fixed frequency operation, or for those possessed with many crystals of spot frequency operation throughout a band. Moreover, of course, the simple crystal oscillator rigs may be used up to at least 7 Mc/s with suitable crystals, whereas a simple self-excited oscillator rig is a difficult proposition except possibly upon top band, and then only with stringent precautions.

The difficulty of self-excited or V.F.O. operation may be eased considerably if we employ the triode-pentode ECL80. This enables the triode section to be used as a Hartley oscillator, and the pentode section to be used as a P.A. By thus isolating the oscillator from the aerial tuning network, the pulling may be greatly reduced, and true V.F.O. operation may be achieved. For stable Hartley operation, not only should a high C circuit be used, but also the triode oscillator valve should be tapped down the coil. If taps for anode and grid are taken at about one third from each end of the tuning coil, stability will be increased. A refinement is to couple the pentode grid via a small variable capacitor to the oscillator, so that the minimum coupling consistent with output is achieved. It should be noted that several watts input to the pentode P.A. is feasible with this circuit, which may be operated upon 80 metres, and with care even on 7 Mc/s. However, it is suggested as a top-band rig for local working rather than upon the higher frequencies.

Modulation

Modulation of a simple oscillator-P.A. rig of this type may be effected by the Heising choke coupled system, and a compact "two tube" rig may be effected by using a further triode-pentode as a pentode modulator with triode pre-amplifier for a carbon microphone as previously described. For local "ragchews," it is at any rate feasible to obtain a limited modulation percentage by grid modulating the pentode P.A. directly from a carbon microphone. To obtain reasonable results, however, it is desirable to reduce the drive to the pentode section by reducing the capacity of the coupling capacitor from the oscillator, and to apply battery bias in addition. This also involves a sacrifice of P.A. input. Therefore it is advisable to use a separate modulator valve if phone operation is desired.

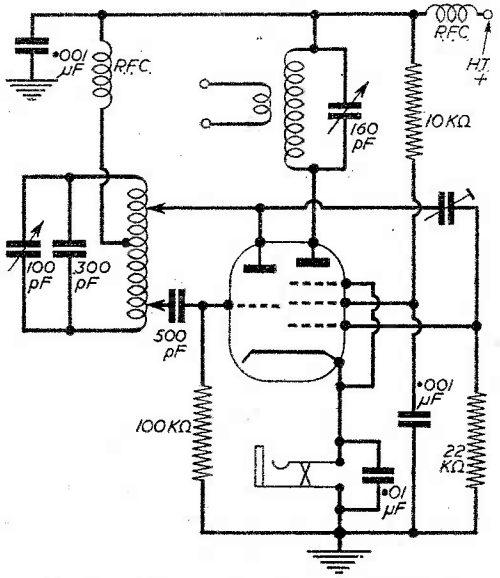


Fig. 6.—The ECL80 as an oscillator P.A. rig.

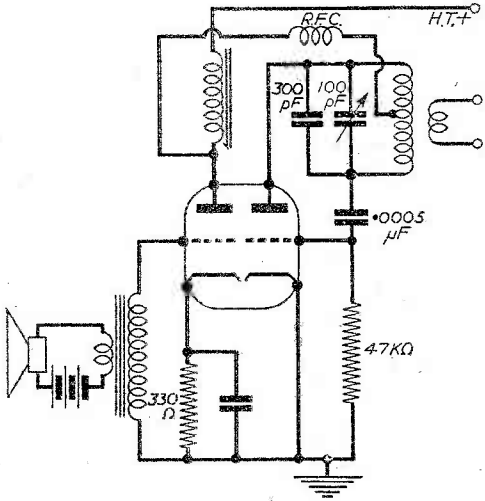
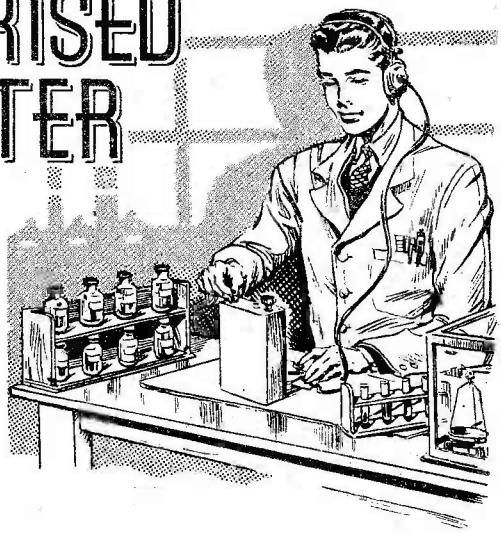


Fig. 5.—A self-excited modulated oscillator rig, using a 12AT7.

In all cases, of course, the simple rigs may be keyed. This may be effected by cathode keying. As shown in Fig. 6.

A TRANSISTORISED GEIGER COUNTER



CONSTRUCTIONAL DETAILS OF A RADIATION MONITOR

By J. Harvey

THE average commercial radiation monitor is primarily a measuring instrument, and is necessarily bulky and expensive. For simple purposes, such as the initial detection of the presence of uranium, a cheap and small counter can be made with one transistor.

Circuit Details

A Mullard OC72 transistor oscillator converts the 4.5 volts of the torch battery to A.C. in the primary of the high step-up ratio transformer. The output of this is multiplied and rectified by the chain of capacitors and selenium rectifiers to give 400 volts for the Geiger-Muller tube, which is a 20th Century Electronics type G5H halogen-quenched tube. This tube was chosen in preference to the cheaper alcohol-quenched type because it operates at a much lower voltage, has a longer life and is not so easily damaged by excess voltage.

In the interest of economy and simplicity no automatic voltage control is provided. Instead, a variable resistor R3 controls the current to the transistor.

The 400 volts supply is applied to the G-M tube, with the anode connected to the positive side. The anode in this tube is the centre wire and the connecting pin on the base is marked "A." When a gamma ray penetrates the tube and causes ionization a pulse of current flows which is limited by the resistor R4. Capacitor C3 is charged up and a click is heard in the headphones. The headphones should be high-impedance types and the amplitude of sound depends on the size of C3. A larger value than 100 pF produces more noise but allows larger pulses of current to pass through the G-M tube, with deleterious effects.

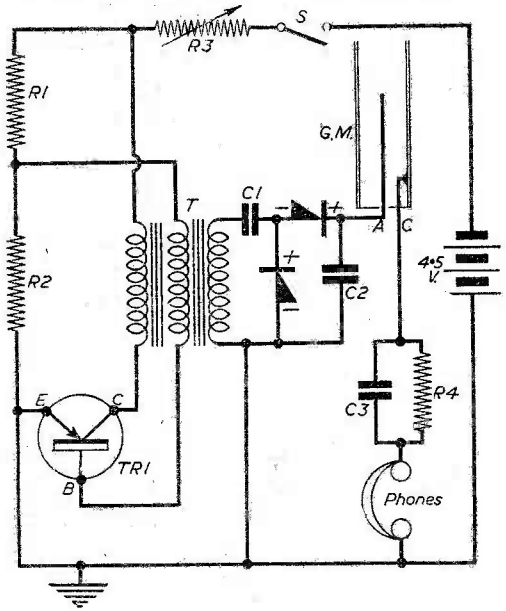


Fig. 1.—Theoretical circuit of the Geiger counter.

Constructional Details

In the photograph the unit is shown constructed on a metal chassis that is joined to the lid of the metal box. The whole unit is made of 22-gauge tinplate. The outside dimensions of the box are 4¼in. x 1⅝in. x 5¾in.

The components are mounted on tagstrip which can be conveniently soldered to the chassis by the feet. If no facilities are available for cutting and bending sheet metal a plywood or Perspex sheet box would be quite suitable. Attention should be paid to good insulation of the voltage multiplier. Good quality capacitors should be used; wax-covered

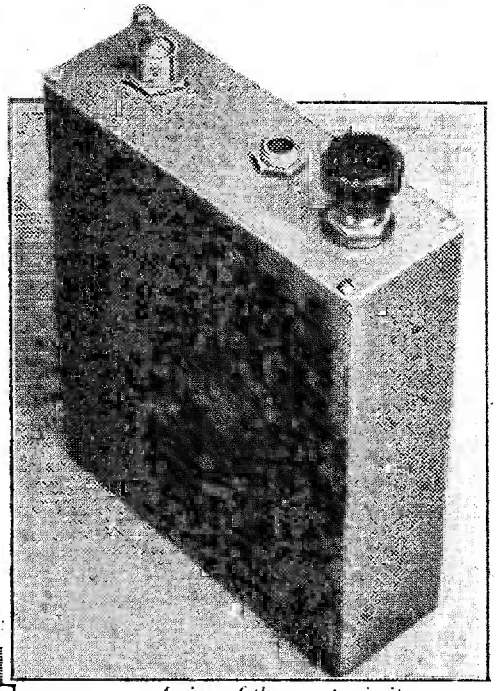
LIST OF COMPONENTS

Transistor—Mullard OC72.
G-M—20th Century Electronics Ltd. Type G5H.
Rectifiers—Standard Telephones and Cables Ltd. K3/10.
Headphones—High impedance type.
C1, C2—.02 μF 500 v. wkg.
C3—100pF.
R1—3.3 K Ω ½ watt.
R2—180 Ω ½ watt.
R3—200 Ω variable, miniature Colvern.
R4—10 M Ω ½ watt.
S—Single pole single throw toggle.
Transformer—Base winding 35 turns, 36 s.w.g.
Collector winding 65 turns 36 s.w.g.
High tension winding 3,000 turns 44 s.w.g. interleaved .001in. paper.
Core—M.E.A. Type 21 Radiometal ¼in. stack.

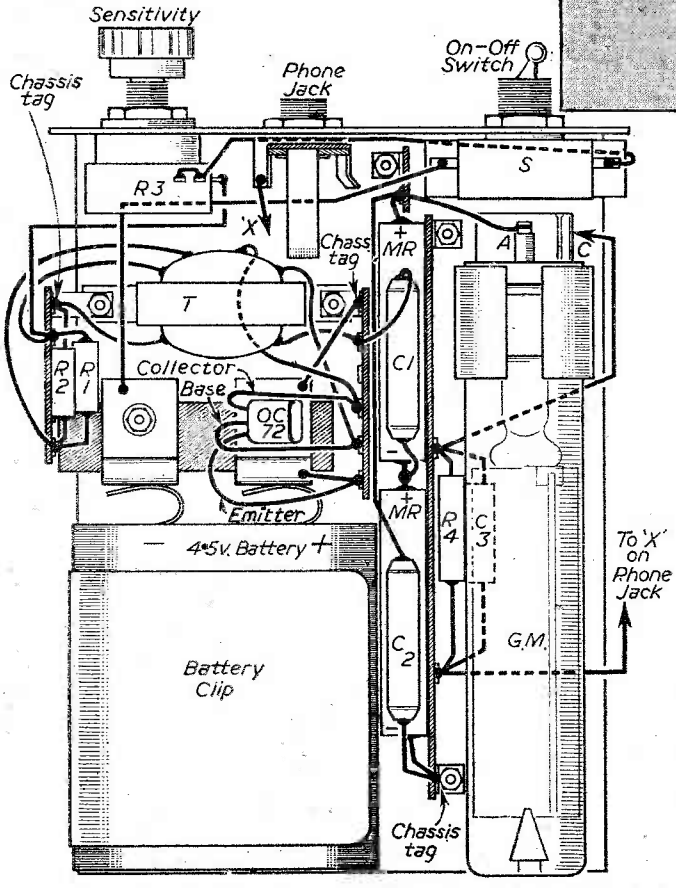
types are suitable only if perfectly clean on the outside. The Geiger-Muller tube is held in position by a capacitor mounting clip with the flanges cut away, or by a Terry clip. Sponge rubber sheeting is used to surround the tube at the mounting point to reduce vibration. Clips for connection to the pins are obtained from the sockets used in standard television feeder connectors. Two spring clips fitted on a piece of Perspex make contact with the battery terminals. The clips used were the ones supplied by Mullard Ltd. as cooling fins for the OC72 transistor. The one on the positive (earthed) side of the battery also serves to mount the transistor. Wire in the potentiometer using the centre and one outer terminal so that maximum resistance is in circuit when the spindle is fully anti-clockwise. The transformer requires careful construction. If wound on a bobbin with cheeks there is a danger of short-circuit turns due to wires slipping down the sides. For this reason interleaving is used on the high-voltage winding.

Testing

Before connecting the 4.5-volt torch battery and switching on make quite sure that the collector winding of the transformer goes to the negative battery terminal. The variable resistor should be turned fully anti-clockwise so that the full resistance is in circuit. Switch on and check the battery current ; it should be about 10 mA. Rotate the resistor control clockwise until the circuit begins to oscillate ; at this point the battery current should be about 20 mA and the generated H.T. should be enough to operate the tube. Clicks should be heard in the headphones at the background count rate, which for the G5H tube is about 40 per minute. Convenient sources of radioactivity for testing are luminous watches and meters. If desired, samples of common uranium minerals can be obtained from Messrs. Geo-Electronics, 33, Edgcumbe Street, Plymouth, Devon.



A view of the counter in its case.



Wiring details for the counter. The collector of the OC72 is marked with a red spot.

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Type A. Low leakage windings. Ratio 1 : 1.25 giving a 25% boost on secondary.
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Ditto with mains primaries, 12/6 each.
Type B. Mains input 220/240 volts. Multi Output 2, 4, 6.3, 7.3, 10 and 13 volts. Input has two taps which increase output volts by 25% and 50% respectively. Low capacity, suitable for most Cathode Ray Tubes. With Tag Panel, 21/- each.
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NOTE.—It is essential to use mains primary types with T.V. receivers having series-connected heaters.

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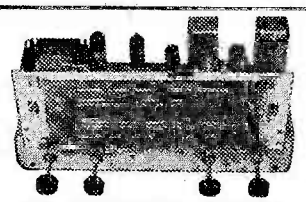
5U4	8P41	3/6	HVR2	ECL80
6AM6	EF92	(near)	6K8G	ECH42
6AT6	PEN 46	3D6	6SK7	EF41
6J7		6T6M		EF89
6K8	7/6	7/6	7/6	EL41
6SL7	6BE6	6V6G	12BE6	EL84
6SN7	6BW6	6X4	EL32	EZ80
6V6GT	6D6	6X5	HVR2A	KT66
EBC33	6F6	807	PEN25	MU14
EF50	6K7GT	EF39	VP23	PY81
Sylv. Red		11/6		12K7
EF91				35Z4
EZ80	EY51	U25	PL81	6Q7



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Screw Base Type 512, 8/500 v., 3/- ; 16/500 v., 4/-.
SENTERCEL RECTIFIERS. E.H.T. TYPE FLY-BACK VOLTAGES. K3/25 2 kV., 5/- ; K3/40 3.2 kV., 7/- ; K3/45, 3.6 kV., 7/6 ; K3/50 4 kV., 8/- ; K3/100 8 kV., 14/6. **MAINS TYPE CONTACT COOLED** 250 v. 50 mA., 8/6 ; 250 v. 85 mA., 9/6.
COILS Wearite. "P" type, 3/- each. Denser Midget "Q" type adj. dust core, 4/- each. All ranges.
TELETRON, L. & Med. T.R.F., with reaction, 3/6.
FERRITE ROD AERIALS. M.W., 8/9 ; M. & L., 13/6.
T.R.F. COILS A/HF, 7/- pair. **H.F. CHOKES, 2/6.**

ALUMINIUM CHASSIS. 18 s.w.g. undrilled. With 4 sides, riveted corners and lattice fixing holes, 2½in. sides, 7 x 4in., 4/6 ; 9 x 6in., 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.

FULL WAVE BRIDGE SELENIUM RECTIFIERS. 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 amp., 13/6 ; 4 amp., 21/-.
VALVE and T.V. TUBE equivalent books 5/-.
TOGGLE SWITCHES. S.P. 2/-. D.P. 3/6. D.P.D.T. 4/-.
ACID HYDROMETER. New Ex Govt. Unbreakable. Packed in metal case 7 x 1¼in., dia., 4/6.
WAVECHANGE SWITCHES.
5 p. 4-way 2 wafer, long spindle 6/6
2 p. 2-way, 3 p. 2-way, short spindle 2/6
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
VALVEHOLDERS. Pax. Int. Oct., 4d. EF50, EA50, 6d. B12A, CRT, 1/3. Eng. and Amer. 4, 5, 6, 7, and 9 pin, 1/-. MOULDED Mazda and Int. Oct., 6d. B7G, B8A, B8G, B9A, 9d., B7G with can, 1/6. VCR97, 2/6, B9A with can, 2/6. CERAMIC EF50, B7G, B9A, Int. Oct., 1/-, B7G with can, 1/9.
BLACK CRACKLE PAINT, air drying, 3/- tin.

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Stereophonic Reproduction

DETAILS OF A NEW TRUVOX HEAD AND A NEW IDEA—THE STEREO SIMULATOR

STEREOPHONIC tapes are now available on the market, and the Truvox company recently introduced a new stereophonic head for addition to their existing tape recorders. This is a two-channel head suitable for ¼in. tape, in which cross-talk has been limited to an extremely low level and which is primarily intended for playing back standard stereophonic tapes. At a demonstration of the new head the apparatus used was a Truvox R.1 recorder fitted with the head, a Type "C" amplifier and two corner diffusion speakers by the same firm. The tapes used for the demonstration included some made by the Truvox company and also standard E.M.I. stereophonic tapes.

The R.1 recorder which formed the basic unit was a two-speed instrument (7½in. and 3¾in. per sec.). It takes 7in. reels and tracks in accordance with B.S.S. The amplifier is interlocked with the deck controls, thereby preventing accidental erasure. Tape speed is controlled to within ± 2 per cent. at 7½in. per second and the "wow" and "flutter" content does not exceed a total of 0.2 per cent. Hum level is 45 db down relative to 4 watts output unweighted.

Recent modifications include a redesigned oscillator using a triode-coupled pentode for greater purity of waveform and stability, and to prevent inter-action with carrier frequencies when recording from R.F. sources.

The amplifier circuit is conventional and employs an EF86 (Z729) low-noise high-gain pentode in the first stage, followed by a tone correction network having fixed characteristics for recording and variable response on playback. Second and third stages are handled by a twin triode, ECC83 (B339), from between the two halves of which the signal can be taken to feed additional equipment for greater output. At this point about 0.5 volt is available at ½ megohm impedance. An EL84 (Z729) is used in the output stage, feedback being applied to the cathode of the preceding stage. It should be noted that when feeding additional equipment from the second stage, output from the built-in loudspeaker is unaffected and is still variable by the volume control. It can, therefore, be used for monitoring.

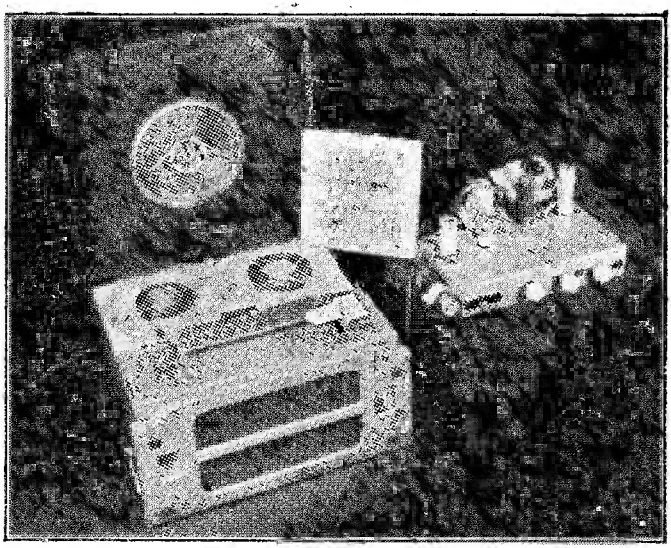
Two inputs are provided, one at 1 megohm impedance for inputs 1-2 mV, the other at ½ megohm impedance for inputs of 0.5 volt.

Two outputs are provided, one of which has been described in a previous paragraph; the other is at 3 ohms impedance for extension speakers. This socket will also mute the internal speaker when a jack is inserted.

A stereophonic head of the "stacked" type was fitted in place of the normal half-track head. This is a direct replacement, no modifications being required. The upper track was connected to the record lead on a standard Truvox Type C amplifier.

The Truvox Type C amplifier handling the second channel has performance characteristics similar to the Type G amplifier used in the recorder. However, it is not as versatile, as this is only possible with amplifiers designed as integral parts of complete recorders.

The Truvox Corner Diffusion loudspeakers are the result of a completely different approach to loudspeaker enclosure design. The speaker chassis projects vertically into a heavy aluminium reflector. This is 18in. high by 12in. across. A specially designed cone speaker of only 8in. diameter is used. The resultant effect is vivid clarity, particularly in the upper frequencies, no attempt having been made to over-emphasise. The bass response is pleasant without being obtrusive.



The new Stereophonic Tape Deck by Truvox.

Stereophonic Recordings

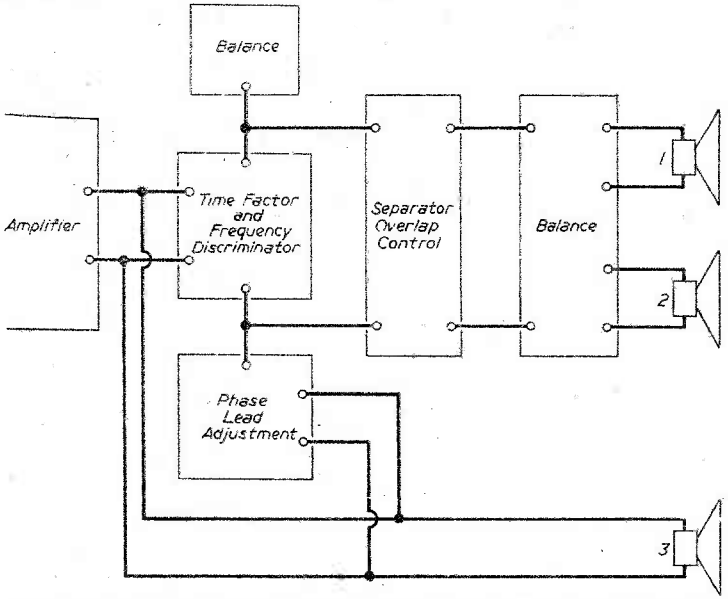
The makers emphasise that the head is, of course, suitable for making stereophonic recordings, not only for playing them. However, the technique of achieving this successfully and the equipment required is sufficiently involved for them to advise against this practice, as it requires not only special microphones but also realistic studio conditions which are virtually impossible to achieve by anyone outside the profession. Recordings made under unsuitable conditions will generally be worse and certainly no better than single-channel recordings and will naturally use more tape.

For those who have the necessary equipment, it should be pointed out that it will be necessary to start with a clean tape which has been previously erased by a bulk eraser, but beyond this no further precautions are

required so far as the head and deck are concerned.

A Stereo Simulator

A completely different approach to stereophonic reproduction has been made, and was also shown recently in a demonstration using standard gramophone records, standard tape and BBC transmissions picked up at the time on F.M. With the aid of the new idea these single source items produced a most realistic stereophonic effect. Three loudspeakers were set up on the stage of a large West End cinema, and to aid the illusion were screened from view. A standard Leak 12-watt amplifier was used in conjunction with a standard tape deck, record player and small F.M. tuner connected to an aerial on the stage. Between the monaural (single) source and the speakers was the new device which it is anticipated will be called a "stereo simulator." Although this is the subject of a patent application and full details cannot at the moment be given, it may be stated that it consists of a separator network feeding two speakers, the third being independently fed. The separator network is not a cross-over. In addition, provision is made for altering the phase relationship of the signal in the appropriate channels, and an artificial time factor is introduced in a specific portion of the harmonics.



Block diagram of the stereo simulator (phase-frequency-time discriminator).

By means of this network, as we saw in a demonstration of a vocalist accompanied by a pianist, where similar frequencies may be fed into a single speaker from one or more sources, the phasing enables one of them to be suppressed. In the case of the vocalist, for instance, not once did her voice appear to come to the right-hand side of the stage, where the speaker reproducing the piano was situated. Conversely, the piano stayed on that side of the stage and did not intrude on the other speaker. This was a live BBC broadcast so was definitely a single source of sound. It is understood that the apparatus may be marketed as an adaptor unit for inclusion with existing equipment, and that it is preferable to use three speakers, even although they may have to be placed around a room.

For home use, where it is necessary to have the speakers, record-player, etc., in one cabinet, it is recommended that the three speakers are placed in the rear of the cabinet to face the wall. The speakers are arranged facing in different directions to each other and pointing slightly upwards. Only reflected sound is thereby utilised and the width of the sound picture is controlled by the distance from the cabinet to the wall, more or less 1ft. for a medium-size room.

The stereophonic effect—unlike that of normal stereo systems—is not confined to the point at which the speaker axes intersect, but is distributed over the whole area.

AN F.M. TUNER

(*Continued from page 160*)

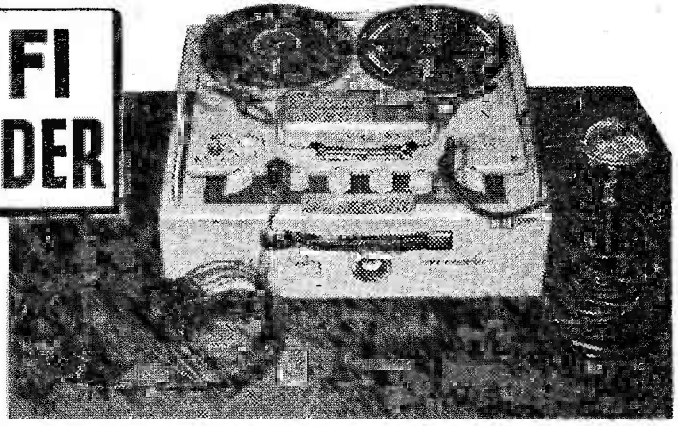
After this the heater wiring between V1 and V2 and between V2 and TS1 should be connected. The leads should be twisted for as much of its length as possible to nullify A.C. pick-up on the grids, and thereby reduce hum. One side of the heater wiring should be earthed on the valvebase of V1, unless the heater wiring of the transformer has a centre tap. In this case the centre tap should be earthed to the earth rail.

Next, all of the smaller components should be wired in and connections taken to the output transformer. The mains transformer can then be fitted: if it is fitted before the majority of the wiring-up is done the chassis becomes unwieldy to handle. After completing the transformer connections the unit should be checked for complete and correct wiring.

Transferring attention to the tuner, a hole 0.375in. diameter should be drilled approximately 1.5in. above the dial drive hole to take the volume-control and switch (R1 and Sw. 1). The power leads from the tuner should then be threaded through the hole provided for them in the amplifier and the latter held against the tuner so that the position of the fixing holes to be drilled in the tuner can be marked.

The amplifier should next be bolted to the tuner and the H.T. and heater wires from the tuner soldered to the tag strip TS1. The screened-grid lead should be connected between one side of the volume control and the grid of V1, the output of the tuner being connected to the other side of the volume control. The mains lead should be connected to one side of the switch on the volume control, led along the front of the tuner between I.F. cans and front panel, and then connected to the input of the mains transformer. The live side of the mains lead should be connected to the switch. The set is now ready for testing, and valves V1 and V2 only should be plugged in. The mains should be switched on and a check made that all the valves are alight.

THE P.W. HI-FI TAPE RECORDER



A NEW EFFICIENT DESIGN WHICH HAS BEEN EXHAUSTIVELY TESTED

By B. L. Phillips

THE circuit to be described is an improved version of a design published in these pages last year. After many queries and suggestions from readers the author decided to design this circuit incorporating many of these suggestions. The result is an amplifier which can be used for reproducing gramophone records, as a public address amplifier, and, of course, its prime job of recording and reproducing from magnetic tape.

The amplifier output power is approximately 12 watts peak on either tape, gramophone pick-up, or microphone. Frequency response from tape at a speed of 3¾in./second is 40 to 7,000 c.p.s. ± 3 db, and 7½in./second is 40 to 13,000 c.p.s. ± 3 db. The amplifier direct has a response sensibly flat between 30 to 10,000 c.p.s., and is ± 1 db between the range 20 to 15,000 c.p.s. Noise and hum level is down at least 40 db on any signal referred to 10 watts, with all controls at maximum.

The input voltage (R.M.S.) required at J1 for full output is 4 mV. into 1 MΩ. Input J2 requires approximately 500 mV. into 500 KΩ for full amplifier output. Separate "Bass" and "Treble" controls are included, and there is a cathode-follower type monitor amplifier for headphones, and a magic-eye level indicator for recording. Although the author is using a Lane tape deck with this amplifier, most high-impedance head decks can be used in lieu, as long as they have no push-button switching which alter the equalising, etc., as these latter types of deck are designed around a specific amplifier circuit and do not lend themselves easily to modifications for use with a different amplifier.

The Circuit

This is a six-valve, eight-stage design consisting of V1, an EF86 low-noise preamplifier, V2(A) and V2(B), the signal correction stages (V2(B) is also the recording output valve) which are two triodes in one envelope, namely a 6SN7. Stage V3(A) is the phase-inverter on playback, and V3(B) is the monitor amplifier for headphones. Again these two valves

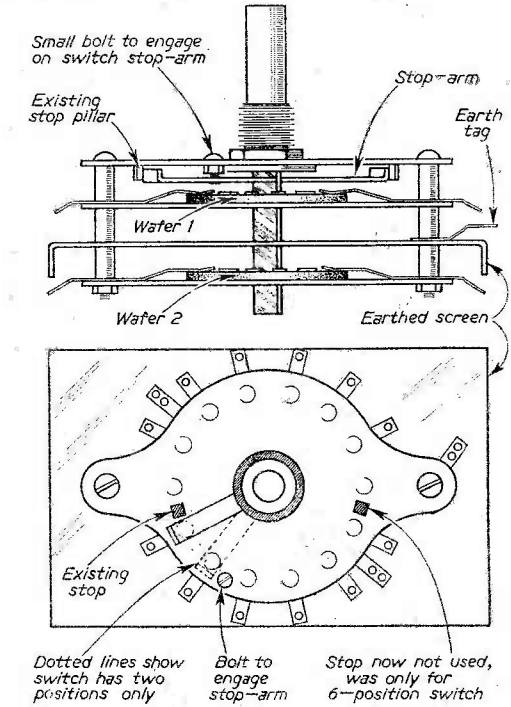
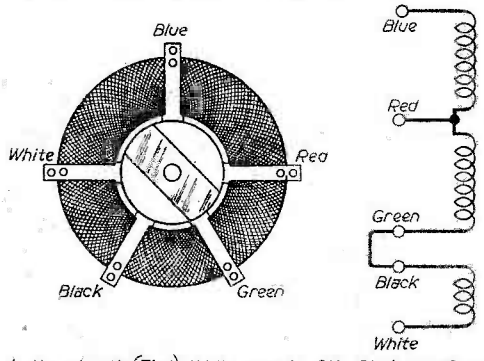
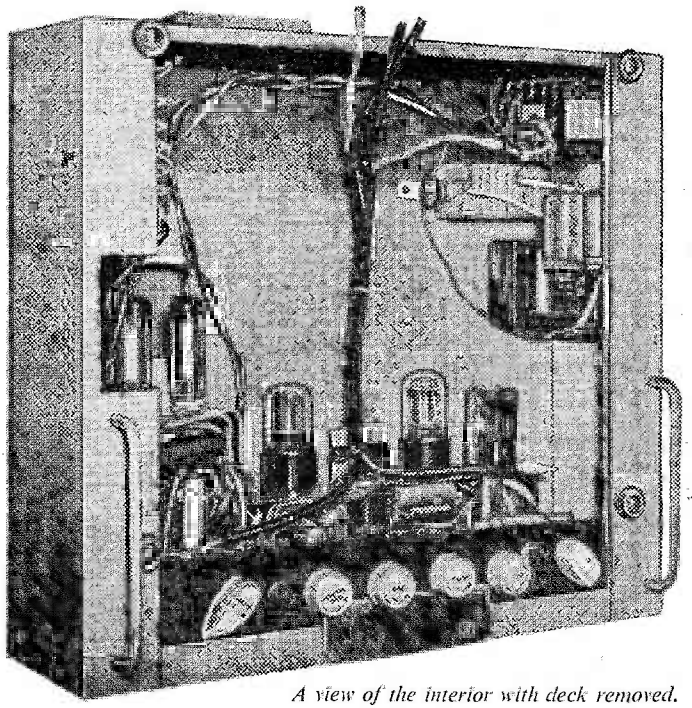


Fig. 1.—Details of the switches.



In the circuit (Fig.) White goes to C16, Black and Green are strapped, Red goes to H.T.+ and Blue to switch. C18 connects across Blue and Red, C17 connects across White and Red

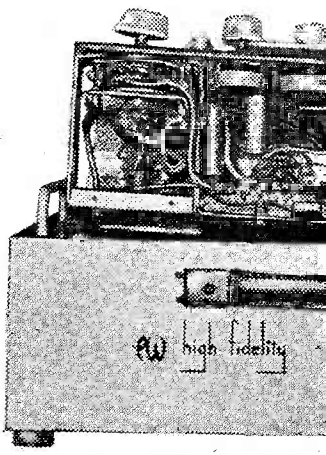
Fig. 2.—Details of the oscillator coil connections.



A view of the interior with deck removed.

Power Supplies

The actual power-pack is the essence of simplicity, as it must be to keep the weight of the unit down to a minimum. This is the reason that a mains transformer with an H.T. winding is not used. As will be seen from reference to the circuit diagram (Fig. 3) the mains supply is common to the chassis, and the only transformer present is the filament transformer. The constructor is reminded here that on *no account* should the "live" side of the mains be connected to the chassis. The correct polarity *must* at all times be observed, the neutral only going to the chassis. Incidentally, with the mains reversed, the hum level is increased, making recording virtually impossible. There is no mains on/off switch fitted on the amplifier, as it was found unnecessary. The minimum amount of wiring in the amplifier carrying mains A.C. is to be aimed at, but if the constructor so desires, a D.P.S.T. switch may be fitted. The H.T. supply is fed to the H.T.+ rail via the rectifier type "Brimar" RM4, and the smoothing choke T3. Capacitors C22(A) and (B) are in one envelope, another 6SN7. The output stages are two EL84 pentodes in Class "A" push-pull (V4 and V5), and V5 is also the bias and erase oscillator when recording. The magic-eye level indicator is a 6U5, (V6), which only operates on recording. The erase oscillator coil (T4) is so arranged as to provide adequate R.F. voltage to enable even badly over-modulated tapes to be erased with only one passage through the erase head.



The underside of the

Resistors

R1—1 MΩ ¼ watt.
R2—1 MΩ ¼ watt.
R3—220 KΩ ¼ watt.
R4—2.2 KΩ ½ watt.
R5—22 KΩ ½ watt.
R6—220 KΩ ½ watt.
R7—1.5 KΩ ½ watt.
R8—33 Ω ¼ watt.
R9—10 KΩ ½ watt.
R10—470 KΩ ½ watt.
R11—10 KΩ ½ watt.
R12—100 kΩ ½ watt.
R13—1 MΩ ¼ watt.
R14—2 KΩ ½ watt.
R15—100 KΩ ¼ watt.
R16—500 KΩ ½ watt.
R17—10 KΩ 1 watt.
R18—100 KΩ ½ watt.
R19—470 KΩ ½ watt.
R20—270 KΩ ½ watt.
R21—220 KΩ ½ watt.
R22—5 KΩ ½ watt.
R23—33 KΩ ±1% ½ watt.*
R24—200-300 KΩ (see Text).
R25—220 KΩ ½ watt.
R26—220 KΩ ½ watt.
R27—150 Ω 3 watts (wirewound).
R28—150 Ω 3 watts (wirewound).
R29—(See Text).
R30—33 KΩ—1% ½ watt.*
R31—1.2 KΩ ½ watt.

Variables

VR1—0.5 MΩ Carbon "Amplion."
VR2—100 KΩ Carbon "Amplion."
VR3—0.5 MΩ Carbon "Amplion."
VR4—5 KΩ Wirewound "Amplion."
*—Matched.

COMP

Capacitors

C1—0.1 μF 500 v.w. Paper.
C2—25 μF 25 v.w. Midget Electrolytic.
C3—0.1 μF 500 v.w. Paper.
C4—25 pF 500 v.w. Mica.
C5—25 μF 25 v.w Electrolytic
C6—0.1 μF 500 v.w. Paper.
C7—100 pF 500 v.w. Mica.
C8—0.005 μF 350 v.w. Paper.
C9—25 μF 25 v.w. Electrolytic.
C10—25 μF 25 v.w. Electrolytic.
C11—0.1 μF 500 v.w. Paper.
C12—25 μF 25 v.w. Electrolytic.
C13—0.1 μF 500 v.w. Paper.
C14—0.002 μF 350 v.w. Paper.
C15—0.1 μF 500 v.w. Paper.
C16—47 pF 1,000 v.w. Mica.

are the electrolytic reservoir and smoothing types for the H.T. Generous decoupling is applied to the H.T. supply to the early stages of the amplifier by R17, C24(A), R5 and C24(B).

Switching

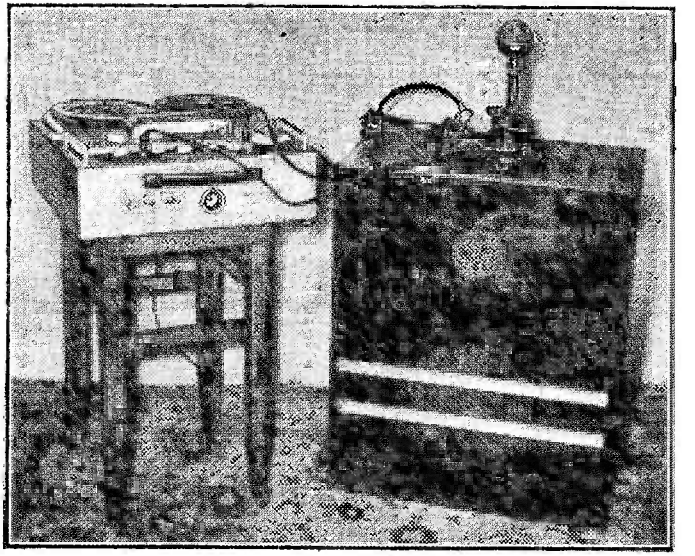
The two switches used are Yaxley types, each type is of two-wafer, four-pole, six-way. As only two positions are required on each switch the two switches were modified as follows: The two mounting bolts are removed from each switch, allowing removal of the two wafers. The faceplate of the switch is now drilled at the second position of the "stop-arm" (see Fig. 1) and a small nut and bolt inserted to prevent the switch arm from going any farther than the second position. Before mounting the wafers back on the switch the metal screens must be made to fit between each wafer on each switch. This is of aluminium and made just larger in size than one of the wafers. A central hole is drilled in the centre of the screen to clear the switch spindle, and two smaller holes are drilled for the switch bolts. The first wafer is mounted on the spindle, then the screen, finally the second wafer is mounted. The usual paxolin washers or pillars are placed on the bolts in between the switch sections.

This modification now makes each switch a four-pole, two-way, two-wafer type. If two switches of this type can be obtained, the above modifications will not be required, apart from the screening, which *must* be fitted. The switch contacts are as follows:

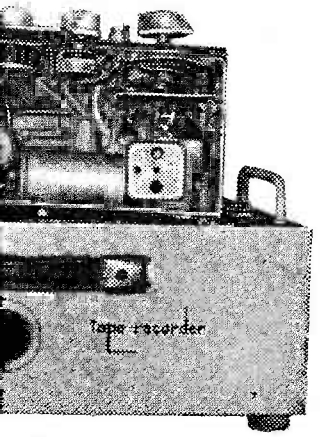
Switch S1: Contact S1A is on one wafer, screened from contact. S1B on the other wafer. The remaining contacts are not used.

Switch S2: Contacts S2A and S2B are on one wafer; screened from contacts S2C and S2D on the remaining wafer.

(To be continued)



The complete recording and play-back equipment.



r chassis seen above.

ENTS LIST

C17—3,200 pF 1,000 v.w. Mica.
C18—0.005 μF 1,000 v.w. Mica.
C19—500 pF 500 v.w. Mica.
C20—25 μF 25 v.w. Electrolytic.
C21—25 μF 25 v.w. Electrolytic.
C22—32 μF+32 μF 450 v.w. Electrolytic Can.
C23—0.1 μF 1,000 v.w. Paper.
C24—16 μF+16 μF 450 v.w. Electrolytic Can.
C25—200 pF 350 v.w. Mica.

Miscellaneous Components

T1—Heater Transformer 200-250 v. primary, 6.3 v. 3 amps secondary.
T2—15 watt Output Transformer, match 2-6L6s to 3, 4, 8 and 15 Ω.
T3—20 henry Choke to carry 100 mA max.
T4—45 kc/s Oscillator Coil (Hatfield Radio, 78, Stroud Green Road, London).
S1 & S2—6-way 4-pole 2-wafer Switches (2) (Yaxley type).
J1, J2, J3—Coaxial Sockets.
I.F. Transformer Can for EF86 base.
Fuse Mounting Coaxial and 2-core Screened Lead, Mains Lead, Grommets, Nuts, Bolts, Tags.
5-ply Wood for Cabinet, Hardboard for Panels, Aluminium for Chassis (18 s.w.g.).

Tape Deck

Lane 2-speed Mk. VI (Verdik Sales, Ltd.).

Valves

V1—EF86
V2 (A+B)—6SN7.
V3 (A+B)—6SN7.
V4+V5—EL84.
V6—6U5G.

Metal Rectifier

Brimar R.M.4 (200 mA max.).

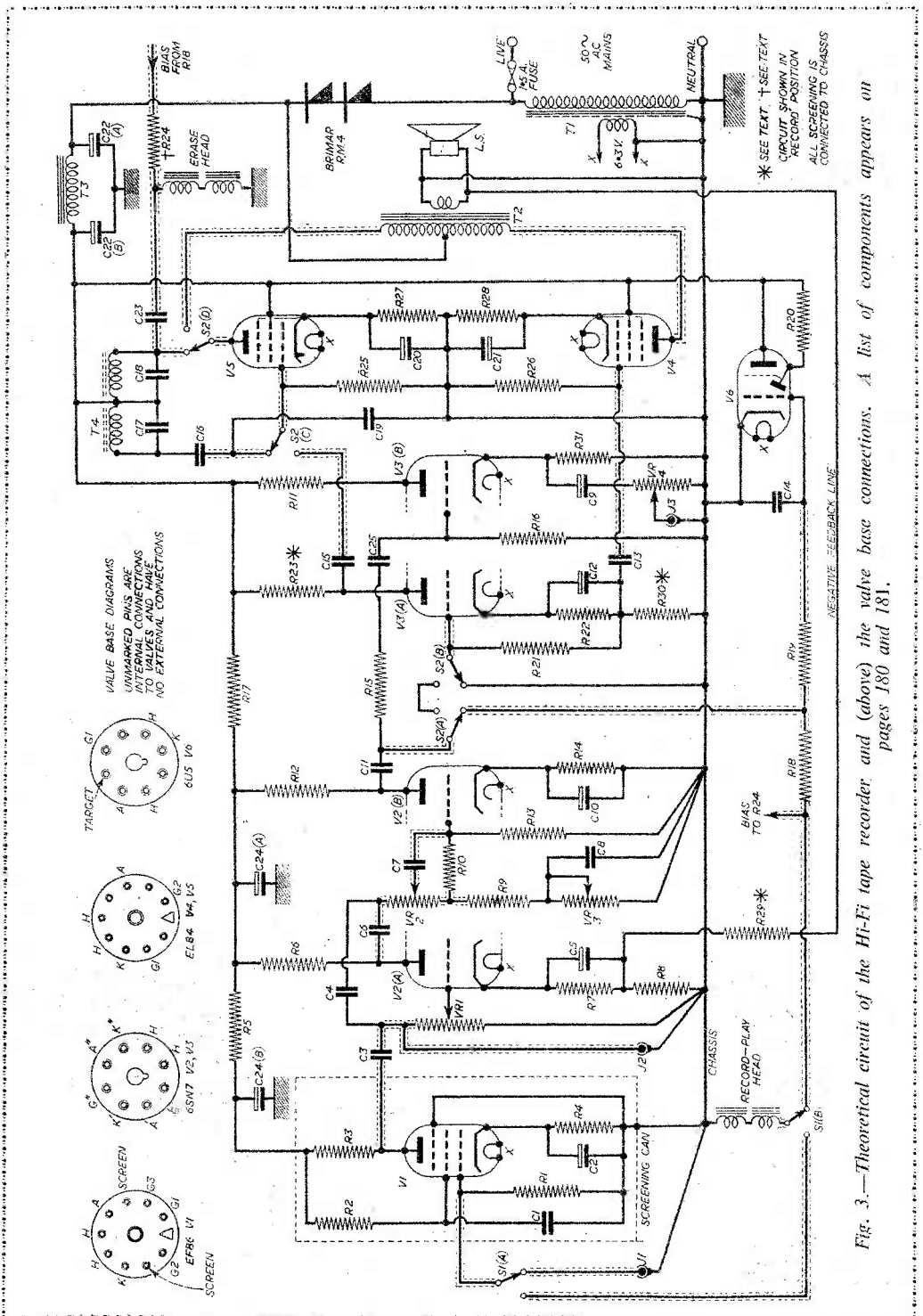
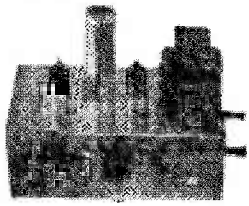


Fig. 3.—Theoretical circuit of the Hi-Fi tape recorder and (above) the valve base connections. A list of components appears on pages 180 and 181.



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Suitable for London, Birmingham and Northern Transmissions

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A highly successful unit (*W. World* circuit), incorporating variable oscillator tuning. Midget BVA valves, etc. Chassis size 7" x 4 x 2½in. Thousands already in use. Suitable for most types of T/V sets. TRF or Superhet. Kit of parts 45/-. Blueprint 1/6, Power pack kit 30/-. Switch kit (Band 1—Band 3 Ae switching), 6/6—all Post free. Wiring and aligning of above 20/- extra.

Full range of Band 3 aerials in stock. Adaptors from 7/6 per set. Indoor or outdoor dipoles with 4 yds. cable, 13/9. Band 1—Band 3 cross-over filter unit, 7/6. Variable attenuators 6 db—36 db. 7/6. BBC Break-through Filter, suitable for BBC pattern rejection, 8/6.

Volume Controls

Log. ratios, 10,000 ohms —2 Megohms. Long spindles. 1 year guarantee. Midget Ediswan type.

No Sw. S.P.Sw. D.P.Sw.
3/- 4/- 4/9

Linear Ratio, 10,000 ohms — 2 Megohms. Less switch, 4/- each

Coax plugs, 1/2. Coax sockets, 1/-. Couplers 1/3. Outlet boxes, 4/6.

TWIN-FEEDER, 80 ohms, 6d. yd.; 300 ohms, 8d. yd.

TWIN SCREEN FEEDERS, 80 ohms, 1/3 yd.

50 OHM COAX CABLE, 8d. per yd., ½in. dia.

TRIMMERS, Ceramic, 4 pf.—70 pf., 9d.; 100 pf., 150 pf., 1/3; 250 pf., 1/6; 600 pf., 1/9. **PHILIPS** Beehive Type—2 to 8 pf. or 3 to 30 pf., 1/3 each.

RESISTORS.—Pref. values 10 ohms 10 megohms.

CARBON	WIRE-WOUND	
20% Type, ¼ w.,	5 w.	25 ohms—1/3
½ w., 5d.; 1 w., 6d.;	10 w.	10,000 1/6
2 w., 9d.	15 w.	ohms 2/-
10% Type, ½ w., 9d.;	5 w.	15,000— 1/9
5% Type, ½ w., 1/-;		33,000
1% Hi-Stab. ½ w., 2/-.	10 w.	ohms 2/3

WIRE-WOUND POTS Pre-Set Min. T.V. Type Knurled Slotted Knob. All values 25 ohms to 30 K., 3/- ea. 50 K., 4/-. Ditto Carbon Track 50 K. to 2 Meg., 3/-.

CONDENSERS.—Mica or S. Mica. All pref. values 3 pf. to 680 pf., 6d. ea. Ceramic types, 2.2 pf. -5,000 pf. as available, 9d. each. **Tubulars**, 450 v., Hunts and T.C.C., .0005, .001, .005, .01 and .1 350 v., 9d. .02, .05, .1 500 v. Hunt T.C.C., 1/-. .25 Hunts, 1/6. .5 Hunts, 1/9. .1 1,300 v. T.C.C. (simplex) 3/6. .001, 4 kV., T.C.C., 5/6. .001 20 kV., T.C.C., 9/6.

STANDARD 3-WAVEBAND COIL PACK. Size 2¼in. x 2¼in. in depth, 4-pos. switching. Long, Med., Short, Gram. Dust-core coils prealigned for 465 Kcs I.F. Complete with trimmer, ready to use. A very sensitive and efficient coil pack. **Manufacturers' Surplus. Bargain Offer, 27/6.**

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SPECIAL — Semi-air spaced polythene. 80 ohm Coax ½in. diam. Stranded core. Losses cut 50%.

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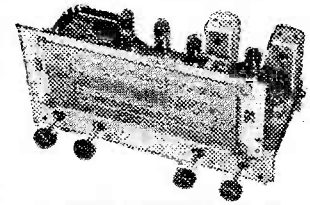

ALL-WAVE RADIOGRAM CHASSIS

3 WAVEBANDS 5 VALVES

S.W. 16 m.—50 m. LATEST MIDGET
M.W. 200 m.—550 m. BVA
L.W. 800 m.—2,000 m. SERIES

Brand new and guar. A.C. 200/250 v., 4 pos. W/C sw. Short-Medium-Long-Gram. P.U. socket. High Q dust core coils. Latest circuit technique, delayed AVC and neg. feedback. O/P 4 watts. Chassis size, 13½ x 5½ x 2½in. 10in. x 4½in. hor. or vert. station names. Walnut or ivory knobs to choice. Aligned and calibrated ready for use. **Sensitivity and Quality at Low Cost.**

Chassis isolated from mains. **BARGAIN PRICE 9½ gns.**
Carr. and ins., 4/6.

8 or 10in. speakers to match, 20/- and 25/-.

7 Valve De Luxe, push-pull EL41 version, 7 watt output, £12/10/0. Carr. & ins. 5/-.

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Latest Model UAS BSR Monarch 4-speed auto-changer £8.15.0, carr. 4/6. B.S.R. Three-speed Single Player, Model T.V.8, £4.12.6, carr. 3/-. Cut mounting board 5/-, carr. 1/-. Garrard and Collaro 4-speed Changers from 9½ gns. (as available).

SCOTCH BOY, EMITAPE, etc., 1,200ft., 30/-. Long playing, 1,800ft. reels, 45/-. Paper tape, good quality, 1,200ft., 12/6. Reels only, 3in., 3/8, 7in., 4/3.

I.F. TRANSFORMERS—465 kc/s

Brand new ex-manufacturer's midget I.F.T. size 2½in. x ¾in. x ¾in. dust core tuning. Litz wound coils, High Q. Bargain offer, 7/6 pair.

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8+8/500 v. Dub. 4/6	32/350 v. Dub. 4/-
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32/350 v. Dub. 4/-	60+100/350 v. 11/6
32/500 v. Dub. 5/-	60+250/275 v. 12/6
50+50/350 v. B.E.C. 6/6	100+200/275 v. 12/6

SENTERCEL RECTIFIERS. E.H.T. Type, Fly-Back Voltages. K3/25 2 kV., 5/-; K3/40 3.2 kV., 6/9; K3/45 3.6 kV., 7/3; K3/50 4 kV., 7/9; K3/100 8 kV., 12/9, etc.

MAINS TYPES.—RM1 125 v. 60 mA., 4/6; RM2 125 v. 100 mA., 4/9; RM3 125 v. 120 mA., 6/9; RM4 250 v. 250 mA., 16/-; RM4B type 270 mA., 17/6.

CHARGER TRANS. Prim.—0-200/250 v., sec., 0-9 v.-15 v. (for charging 6 v. and 12 v.), 1.5 a., 13/6; 3 a., 19/6; 4 a., 22/6; 6 a., 28/6.

FULL WAVE BRIDGE SELENIUM RECTIFIERS.—6 or 12 v. 1½ amps., 8/9; 3 a., 15/6; 4 a., 18/6; 6 a., 24/6.

MAINS TRANSFORMERS.—Made in our own Workshops to Top Grade spec. Fully interleaved and impregnated. **RADIO AND AMPLIFIER TYPE.**—250 v. 60 ma., F.W. sec., 5 v. or 6.3 v. 1 a. rect. 6.3 v. 2.5 a. set Htrs., 22/6, etc. **C.R.T. HTR. ISOLATION TYPE.**—Low leakage with or without 25% sec. boost voltage. Ratio 1 : 1 or 1 : 1.25, 2 v., 4 v., 6 v. or 13 v., 10/6 ea. Ditto with mains primaries 200/250 v., 12/6. Special to order. **SPECIAL TYPES.**—To designer's spec. Viewmaster, 35/-; Mullard 3—3 Mains transformer, 35/-; output transformer, 35/-.

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L.F. CHOKES.—10 H. 65 ma. 5/-; 15 H. 100 ma., 10/6; 10 H. 120 ma., 10/6; 20 H. 150 ma., 15/6; Simplex, 10/6; Soundmaster, 10/6. **OUTPUT TRANSF.**—Standard pentode, 4/6; ditto tapped prim., 4/9; small pentode, 3/9; Midget battery pentode (1S4, etc.), 4/6.

LOUDSPEAKER.—PM. 3 OHM 5in. R. and A. 16/6; 6in. Celes., 18/6; 7 x 4in. Goodmans Elliptical 18/6; 8in. Elac., 20/-; 10in. R. and A., 25/-; 12in. Plessey, 35/-; 12in. Goodmans heavy duty Audiom 50, 15 ohms 85/-; 2½in Elac. 17/6.

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7C5	9/-	ECH42	10/6	PCF80	10/6
7Y4	8/6	ECH81	10/6	PCF82	10/6
				PCL83	12/6
				PCL85	12/6
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				PL82	10/-
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				PY80	9/6
				PY81	9/6
				PY82	8/6
				U22	8/6
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DK96, DF96, DAF96, DL96 ... ... 35/-
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SPEAKER FRET.—Expanded Bronze anodised metal 8in. x 8in., 2/3; 12in. x 8in., 3/-; 12in. x 12in., 4/3; 12in. x 16in., 6/-; 24in. x 12in., 8/6, etc.

TYGAN FRET (Murphy pattern).—12in. x 12in., 2/-; 12in. x 18in., 3/-; 12in. x 24in., 4/-; etc.

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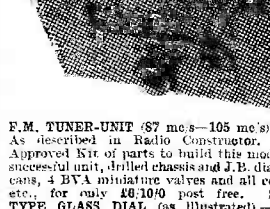
Cabinet size 18½in x 13½in. x Ht. 8½in., with unent motor board 13½in. x 12½in. £3.3.0, carr. 2/6. 2 valve amplifier to fit above, ready wired and tested with 6½in. speaker. £3.12.6, carr. 2/6. Record changers available to suit this cabinet.



F.M. TUNER-UNIT (87 mc/s—105 mc/s) by Jason. As described in Radio Constructor. Designer Approved Kit of parts to build this modern highly successful unit, drilled chassis and J.B. dial, coils and cans, 4 BVA miniature valves and all components, etc., for only £6/10/0 post free. **SUPERIOR TYPE GLASS DIAL** (as illustrated).—Calibrated in Mc's and edge lit by 2 pilot lamps, 12/6 extra. Illustrated handbook with full details, 2/- post free

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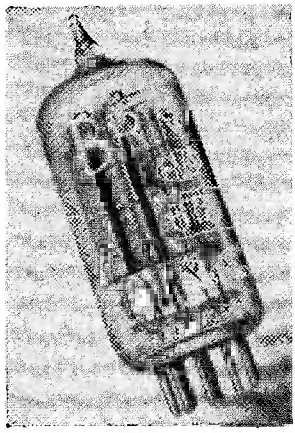
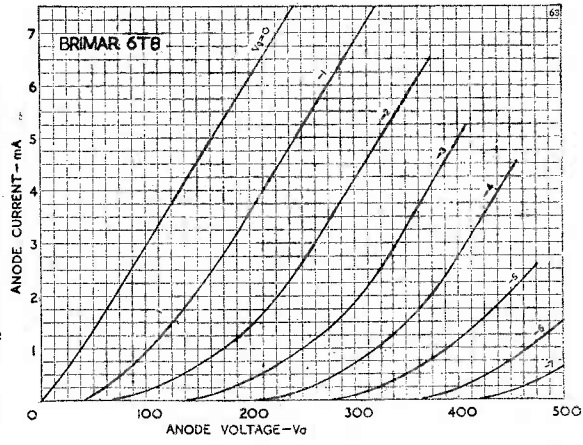
BRIMAR 6T8

The Brimar 6T8 is a triple-diode-triode in which one diode has a separate cathode. The triode section has a high amplification factor making the valve suitable for use in AM/FM receivers in the demodulation and first stage audio circuits. The diodes may be used in series shunt limiter circuits, for example, in the audio sections of television and communications receivers, followed again by the triode section for A.F. amplification.



Near Equivalents
EABC80 DH719
6AK8



Typical Triode Operating Characteristics as an R.C. coupled amplifier.

Anode Supply Voltage	250	250 volts
Anode Load Resistor	0.25	0.25 megohms
Grid Resistor	1.0	10 megohms
Cathode Bias Resistor	3	0 kilohms
Peak Output Voltage	43	40 volts
Stage Gain (for 24 V peak to peak output) ...	42	42
Distortion (for 24 V peak to peak output) ...	1	5%

Keep this for further reference or write to the Publicity Department for a data sheet.

Standard Telephones and Cables Limited **FOOTSCRAY SIDCUP KENT** **Footscray 3333**

Cross-over Networks

MAKING VARIOUS FILTERS FOR DUAL SPEAKERS

THE recently published article on a loudspeaker cabinet aroused considerable interest and led to the need for publishing details of a simple cross-over unit to enable two loudspeakers to be used. Many readers have asked for winding data for other types of cross-over unit, and this is, of course, rather beyond the scope of a letter. Accordingly, in view of the interest which there appears to be in this type of circuit, we are giving some details which were published some years ago in these pages.

Cross-over Frequency

The first step necessary is to decide at what frequency the change-over from one speaker to the other shall take place. The bass speaker will handle all below this cross-over frequency, and the top speaker will take nothing below but everything above this frequency. In commercial practice there is some variation in the choice of cross-over ; the Western Electric Mirrophonic sound-film system, for instance, changes over at 300 c.p.s., whilst the Vitavox Bitone system adopts 1,000 c.p.s.

Whatever the cross-over frequency adopted, the all-over response of the network must be so designed that the output to each speaker is as indicated by Fig. 1. The attenuation on either side of the cross-over should be not less than 10 decibels per octave for good results ; that is, the cross-over is fixed at 1,000 c.p.s., then the output to the bass or low-frequency speaker is down 10 decibels at 2,000 c.p.s., and the output to the high-frequency speaker is down 10 decibels at 500 c.p.s., relative to the level at 1,000 c.p.s. A 12-decibels cut at these points would be even better, corresponding to a voltage or current ratio of one-quarter.

Since 1,000 c.p.s. is a suitable cross-over point for domestic use, as well as for P.A., this figure will be taken for the following calculations. Cinema systems usually have a very much higher power output at extreme bass frequencies (down to 25 c.p.s.) than domestic or P.A. apparatus, and a lower cross-over is suited to "woofer" speakers fed from 250-ohm feeder lines.

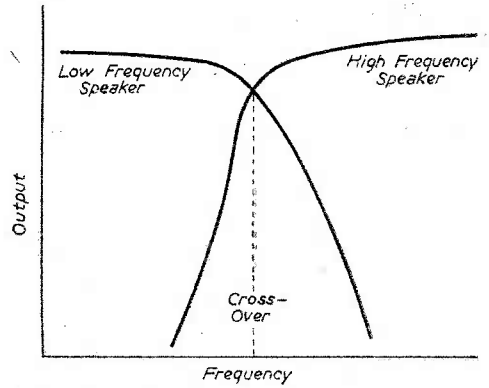


Fig. 1.—Curve showing effect of a cross-over network.

Formulæ and Calculations

The formulæ given can, of course, be used to work out network values for any desired cross-over frequency, but for normal purposes 1,000 c.p.s. is recommended.

Fig. 2 illustrates the simplest possible systems for feeding high and low frequencies to separate speakers. These two circuits have an attenuation of about only 6 decibels per octave on either side of cross-over, which is less than desirable. They are accordingly not used in practice, but the values calculated for them are the first steps for the practical networks of Fig. 3.

Values for the circuits of Fig. 2 given by

$$L = \frac{R}{2\pi F} \text{ and } C = \frac{1}{2\pi FR}$$

Where L is inductance in henries,
C is capacitance in farads,
F is cross-over frequency in cycles/second,
R is impedance of the amplifier output and of both speakers in ohms.

The networks as used in practice are shown in Fig. 3. The values here are given by :

$$L = \frac{L}{\sqrt{2}} \text{ and } L2 = \sqrt{2}L$$

$$C1 = \sqrt{2}C \text{ and } C2 = \frac{C}{\sqrt{2}}$$

These networks give a constant input resistance, and have an attenuation of approximately 12 decibels per octave past cross-over.

It will be noted that R is the output impedance of the amplifier, and also of both the speakers ; this system does not require unorthodox matching arrangements, but is correctly matched all the time. The most common values of speech-coil impedance are 3 and 15 ohms, and so, from the design data above, suitable circuit values for these impedances have been calculated for cross-over at 1,000 c.p.s. The results are given in the following table :

	L	L1	L2	C	C1	C2
R3 ohms...	480	340	680	53	75	37.5
R15 ohms..	2,400	1,700	3,400	11	15.6	7.75

The values for capacitance, originally calculated in farads, have been corrected to microfarads ; similarly inductances are in microhenries. For a cross-over at 500 c.p.s. all given values should be doubled and so on.

There should be no difficulty in constructors obtaining the required capacitances: for 15-ohm impedances, for example, C1 could be taken as 16 μF, and C2 as 8 μF. Paper condensers should be used, not electrolytics ; 100-volt working is adequate. To obtain other values remember that the capacitance of a number of condensers in parallel is the sum of their individual capacitances ; inductances in series are additive, provided that there is no mutual inductance.

The inductance coils must be of the lowest resistance possible, and they must be wound of wire sufficiently large to carry the speech currents of the full output. The following table gives winding details for single-wound, air-cored inductances :

Inductance Microhenries	Dia. of winding ins.	Length of winding ins.	Number of turns/inch
340	2	4	30
680	2	4	45
1,700	3	6	35
3,400	3	6	55

If commercial coils of suitable inductances are to be used they must be of a sufficiently low resistance type (not more than about 20 ohms).

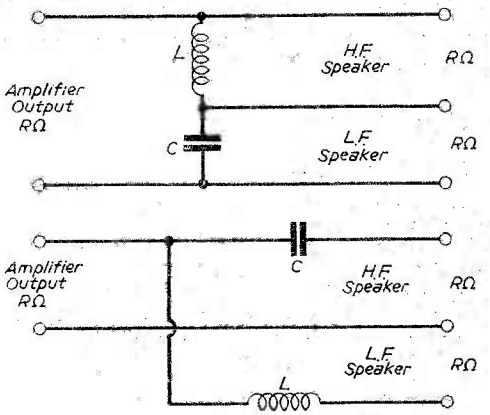


Fig. 2.—Simple systems giving attenuation of 6 db for octave layout crossover.

Construction

The mechanical details of the unit will be left to individual choice or experiment, but there are several points of acoustic importance that must be observed. The cabinet containing the two speakers must be large enough to ensure a good bass response, and it should be made of heavy wood. The back should not be enclosed unless the speakers, particularly that fed with the low frequencies, have been designed for operation under such conditions. Box-resonance is to be avoided; a highly absorbent lining will help. The bass speaker should be a heavy-duty type 10in. or 12 in. diameter. If a horn speaker for high

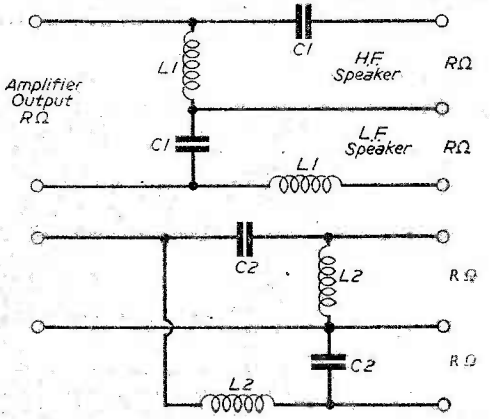


Fig. 3.—Practical systems giving constant input and good attenuation.

frequencies is not available, then a good 8in. or 10in. unit should be mounted above the bass speaker, both speakers having appropriate plain circular apertures.

Phasing

Care must be taken to see that the phasing of the speaker cones is correct, both speech coils being connected in similar polarity; if speakers are run in opposite phases then dead spots may be noticeable in the room or auditorium. To check the phase of a speaker, connect a four-volt battery across the speech coil temporarily and note which way the coils move in or out. Then mark the terminals of each speaker plus and minus for movement in one direction. If you suspect that two speakers are in opposite phase this can be easily checked by reversing the connections to one of them.

New Mullard Ultrasonic Generator

THE new Mullard composite low-frequency ultrasonic generator, type E.7589, provides from a single source suitable outputs for driving the Mullard 50-watt ultrasonic drill, the soldering iron or the tinning bath.

Two outputs are provided: one for the drill and one for the soldering iron or tinning bath. The former is transformer-coupled to the transducer, the latter capacity-coupled.

The method of connecting the various ultrasonic equipments to the generator is completely foolproof and eliminates any risk of wrong connection, or of damaging the generator by operating two equipments from it simultaneously. Six-pin and eight-pin sockets, respectively, terminate the drill and iron/tinning bath outputs, and a sliding shutter masks the socket not in use.

Nominal output is 50 watts, and the ultrasonic frequency is variable by means of a single control up to 30 kc/s. (The transducers incorporated in the drill, soldering iron and tinning bath are designed for operation at around 20 kc/s.)

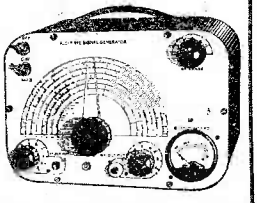
Ultrasonic Drilling

Unlike conventional drilling methods, in which a rotary motion is imparted to the cutting tool, the tool of an ultrasonic drill vibrates with a reciprocating motion. Its action is, in fact, similar to that of an ordinary road drill, but with the important difference that the ultrasonically-driven tool acts on a finely granulated abrasive material, suspended in water, which is interposed between the tool and the workpiece. The abrasive particles are hammered against the workpiece by the reciprocating tool-tip and chip away minute parts of it.

Since the shape of the hole produced closely follows the shape of the tool, holes and patterns of any shape, no matter how intricate, can be cut with the greatest facility. This is an advantage over conventional methods which, because of the rotary action of the cutting tool, are limited to the piercing of round holes.

The ultrasonic tool is suitable for the machining of hard and brittle materials such as glass, ceramics, germanium, tungsten and titanium carbides, diamond, synthetic gems, and so on. The technique is not confined to drilling and piercing.

COMPLETELY BUILT SIGNAL GENERATOR



Coverage 120 Kc/s-230 Kc/s. 300 Kc/s-900 Kc/s. 900 Kc/s-2.75 Mc/s. 2.75 Mc/s-8.5 Mc/s. 8 Mc/s-28 Mc/s. 16 Mc/s-56 Mc/s. 24 Mc/s-84 Mc/s. Metal case 10in. x 6¼in. x 4¼in. Size of scale, 6¼in. x 3¼in. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F. output continuous variable 100 milli-volts. C.W. and mod. switch. variable A.F. output and moving coil output meter. Black crackle finished case and white panel. Accuracy plus or minus 2%. £4 19.6 or 34/- deposit and 3 monthly payments 25/-. P. & P. 4/6 extra.

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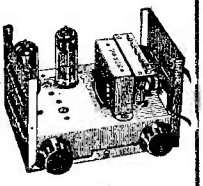

Complete with built-in power supply, 230-250 v. A.C. mains. Crackle finish case 5¼in. long, 3¼in. wide, 4¼in. high. Incorporating gain control and band switch. Illustrated with cover removed.

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A.C. mains 200-250 v. Fitted ammeter, selector switch, fuses, battery clips, indicator lamp. Incorporating G.E.C. Metal Rectifier. Ready for use. In grey hammer finish case. Wall fixing. 59/6. P. & P. 5/6.

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Point to point wiring diagram 1/-. Free with Kit. Plus P. & P. 1/6.

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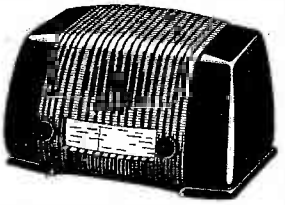

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8 MFD. 450 WKG. can size 2" x 1". 1/3 each. 12/- doz.
EXTENSION SPEAKER, in polished walnut complete with 8in. P.M. P. & P. 3/-. 24/6.
P.M. SPEAKERS, closed field. 6½in., 16/6; 8in., 18/6; 10in., 25/-; 12in., 25/-. P. & P. on each 2/-.
STANDARD WAVE-CHANGE SWITCHES. 4-pole, 3-way, 1/9; 5-pole, 3-way, 1/9; 3-pole, 3-way, 1/9; 9-pole, 3-way, 3/6. Miniature type, long spindle, 3-pole, 4-way, 4-pole, 3-way and 4-pole, 2-way, 2/6 each. 2-pole, 11-way, twin wafer, 5/-; 1-pole, 12-way single wafer, 5/-. P. & P. 3d.

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Replacing the Line-cord

MODIFYING RECEIVERS TO ELIMINATE A FREQUENT SOURCE OF TROUBLE

UNIVERSAL receivers employ a resistance to drop the mains voltage to a figure suitable for the valve heaters, and a line-cord is not infrequently used. Such cords contain a long spiral of thin resistance wire, susceptible to breakage, and are distinguished by a rise in temperature, sometimes quite considerable after a long period running. Replacing such a cord is easy, though an incorrect repair may just as simply damage the receiver. It is also possible to eliminate the cord altogether instead of renewing it, and there is much to be said for doing this when circumstances permit.

The usual line-cord circuits are shown in Fig. 1, and will also apply if a mains dropper is used instead. "A" is found when output valves with relatively low maximum anode voltage are used, such as the 43

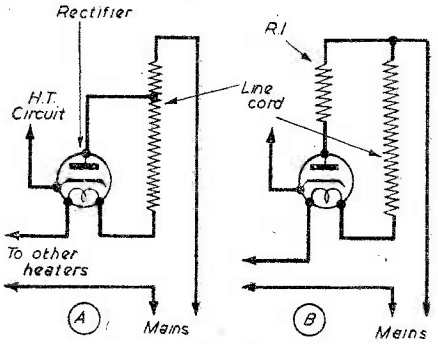

Fig. 1.—Typical line-cord circuits.

and 25A6 (160 volts maximum). As the H.T. voltage would be too great, the rectifier anode is taken to a tapping on the cord. This gives a suitably reduced voltage, usually about 160-180 volts, according to valve types. Circuit "B" is used when there is no need to reduce the H.T. voltage, R1 being a limiting resistor of about 100 ohms and serving to keep the peak rectifier current down. Dial or indicator lamps may be wired in series with the rectifier heater.

The resistance value of the line-cord (or dropper) is readily ascertained by the following, the result being in ohms:

$$\frac{\text{Mains voltage} - (V1 + V2 + V3, \text{ etc.})}{\text{Heater Current}}$$

That is, the voltage required by the valve heaters and dial lights is first found by addition. For example, 6K7, 6J7, 25A6, 25Z5 and two 6.3 volt bulbs total 75.2 volts. This is taken from the mains voltage—say, 230 volts less 75 volts=155 volts. The latter figure is thus the voltage to be dropped in the resistance. As the chain passes .3 amps., the required cord or dropper must be approximately 517 ohms.

As a guide, most .3 amp. heater chains will require a resistance value between about 500 and 750 ohms, while .15 amp. chains will need about 700 to 1,000 ohms.

The length of line-cord necessary can be found by dividing the resistance required by the ohms per ft. rating of the cord. For example, with 60 ohms/ft. cord, 8.6ft. would be required. Such cords should never be coiled, but should be extended so that the heat generated can readily dissipate.

Substituting by a Dropper

Miniature A.C./D.C. sets with line-cord may have no space to accommodate a dropper, but it can usually be fitted in other types of receiver. The dropper should be a .15, .2 or .3 amp. type to suit the heater circuit rating. Its resistance value may be found as already explained, and a component to suit obtained. Or a dropper with adjustable clips can be used, the clips being moved as necessary to secure correct heater and H.T. voltages.

Such a dropper is shown in Fig. 2, and the connections indicated would apply to "A" in Fig. 1. If the circuit is that at "B," then no centre clip for rectifier anode is necessary.

The dropper should be at least 1in. from the sides and back of the cabinet and other parts, as it grows hot in use. Sufficient ventilation will help keep the temperature down. It is particularly necessary to keep the dropper clear of coils, condensers or other components likely to be damaged. If space is limited, a metal screen may be erected about ½in. from the dropper to keep heat off other components. In sets of average size this will not be necessary, as a suitable location for the dropper should exist.

If the value has not been calculated as explained, a 800-ohm dropper will do for .3-amp. circuits, and a 1,000-ohm dropper for .2-amp. and .15-amp. circuits. Top or bottom clip is adjusted until a reliable meter indicates that heater voltage is correct. Alternatively, the clip may be moved until the receiver gains full operating volume from cold, in 45 seconds, the voltage being checked with a meter later, if possible.

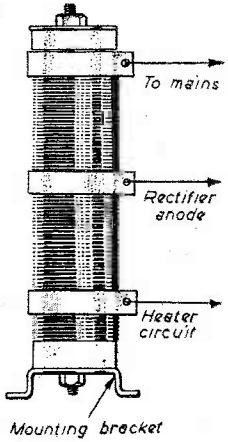

Fig. 2.—A mains dropper replacement.

Fitting a Transformer

If a damaged cord is to be replaced, and the set is to be worked on A.C. mains only, the possibility of using a heater transformer is well worth considering. Small transformers for this purpose are easy to obtain, cost only a little more than a dropper, and generate virtually no heat. Ventilation is not a problem, nor need space be left round the transformer.

For A.C./D.C. operation with line-cord or dropper, heaters are in series. For transformer operation they

should be wired in parallel, as in Fig. 3. It may be necessary to change the output valve or rectifier, or both. Even so, the modification is often justified.

Receivers using the 12.6-volt .15-amp. type of valve with a metal rectifier only need heaters to be wired in parallel for a 12.6-volt heater transformer. If the output valve has a higher heater voltage than this, it will need changing to a type such as the 12A6, which has a 12.6-volt heater. If the output valve is changed, the cathode bias resistor should be checked and modified if necessary, 350 ohms being suitable for the 12A6.

If a metal rectifier is used, this remains unchanged. If a .15-amp. valve rectifier was present, this will need removing, a metal rectifier replacing it.

With .3-amp. valves, parallel operation from a 6.3-volt transformer will be possible with the existing valves, except for output and rectifier. Such circuits frequently have a valve such as the 43 or 25A6 as output. A 6V6 will have a similar optimum load so that the speaker transformer will suit, and will only require 6.3 volts at .45 amps. The bias resistor should be changed to 270 ohms.

A metal rectifier can remain, but a valve rectifier of the 25-volt type will need replacing by a 6.3-volt rectifier such as the 6X5, which does not require a separate heater winding.

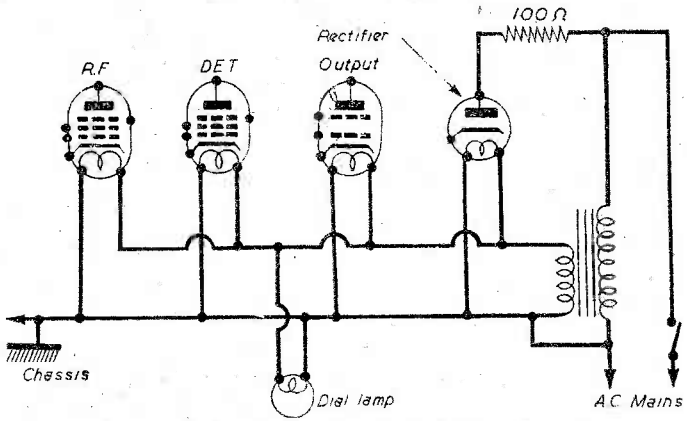

Fig. 3.—Circuit showing the use of a transformer.

With parallel operation, all valve heaters and dial lights must have the same *voltage* rating, the current rating being immaterial. On the other hand, for series operation from line-cord or dropper, all valves and bulbs must have the same *current* rating, the voltage being immaterial.

When a transformer is being chosen, the heater currents of all valves and bulbs should be added together. For example, 6K7, 6J7 and 6V6 would total 1.05 amps., requiring a 1½-amp. transformer, which would also operate a dial light. If a 6X5 is used, a further .6 amp. must be allowed for it. Heaters powered from a transformer gain full temperature rather more rapidly than with a series circuit with dropper or line-cord. This does not indicate a fault, and there is no real need to check the heater voltage if a suitable transformer for the correct mains voltage has been obtained. If heater voltages are checked, with either parallel or series method, they should be within 5 per cent. of the specified value, if possible. Both excessive voltage and under-running will reduce valve life.

R.N. Tactical Teacher

AN ingenious training device, designed by the Engineering and Materials Research Department of the Admiralty and known as the Action Speed Tactical Teacher, has been installed at the Royal Naval Tactical School, Woolwich. Other Departments have assisted in the production and installation.

The new trainer was formally set in operation at 11 a.m. on Wednesday, March 6th, by the First Sea Lord, Admiral of the Fleet Earl Mountbatten of Burma, K.G., etc.

The "Teacher" is a complex apparatus which, by electric and electronic means, enables the tactical operation of ships to be reproduced, and provides Naval officers with the opportunity to exercise tactical skill in meeting situations that arise in active service conditions.

The installation consists of an auditorium with which are associated a number of cubicles fitted as control rooms to be used to represent surface ships, submarines or aircraft as may be required. The control of the exercises is conducted by the Staff from the auditorium.

In setting an exercise the officer students are placed in two opposing teams and a tactical situation and objective is set before each team by the directing staff. The teams are allocated control rooms (cubicles), one for each of the craft engaged, and each of the two team commanders formulates his plan of action based on the data and intelligence given.

In his cubicle each student controls the speed and course of his "ship" which is automatically traced on his plotting table. Usual methods of sea communication enable him to plot the position of other craft and to transmit or receive orders. Electronic coupling between cubicles provides him with a picture of the tactical situation within the detection range of his own radar and asdics.

In the auditorium sit the Director and directing staff acting as controllers or umpires. Before them, on a wall screen 12 ft. square, is plotted in illuminated symbols the positions of the forces engaged, surface, submarine and air. Electric contacts from each control room cause these light symbols to move as the "ships" or "aircraft" change course or speed.

The Director and his assistants are thus enabled to watch the tactical situation as it develops. Behind the screen members of the W.R.N.S. track in coloured chinagraph pencils on a Perspex back screen the courses of the various units.

At the conclusion the whole operation can be reconstructed before the students by means of the Perspex screen and a detailed criticism of the manner in which it was conducted can be given.

The Director of the Royal Naval Tactical School is Captain H. R. Law, O.B.E., D.S.C., R.N.

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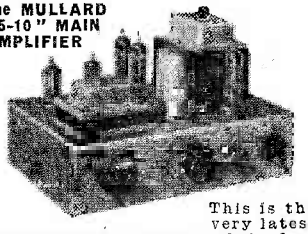

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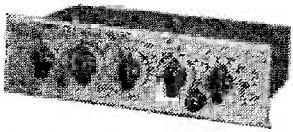

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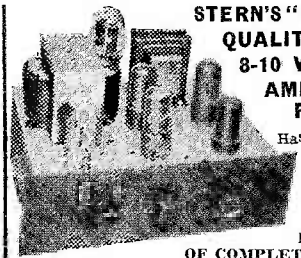

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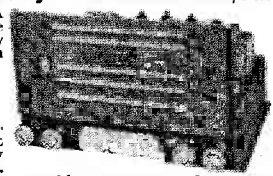

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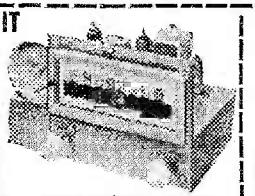

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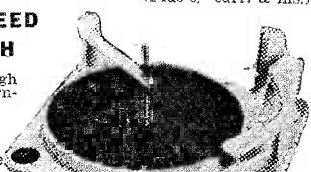

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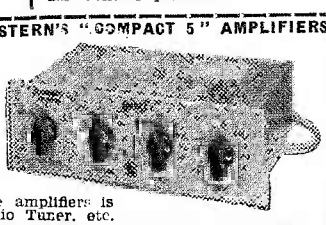

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Amplifier Progress

AN INTERESTING ACCOUNT OF THE DEVELOPMENT OF AUDIO AMPLIFIERS

By R. H. Cowlan

IT was round about 1900 when the writer made his first attempt to amplify and transmit phonograph records, and it occurs to him that readers may be interested in the development of amplifying equipment generally, and perhaps in some of his own endeavours. Some excellent modern amplifiers have been described in detail in PRACTICAL WIRELESS during the past few years, some quite cheap to construct, while manufacturers offer all sorts and classes of equipment, costing from a few pounds to a few hundred pounds. How did it all begin?

The writer's first endeavour was with a phonograph of 1900 vintage, when the little soundbox was placed on the grooves in the wax cylinder record, without any guide, and frequently slid off the record to the accompaniment of weird noises. A carbon microphone hung in the horn and was connected to the "Loud Speaker" in the next room, the speaker being a glorified earpiece complete with horn. With a step-up transformer and a higher than usual voltage it did work, but the noise was horrible, so was the phonograph for that matter, but we youngsters thought it was wonderful. Indeed, this arrangement was not so unlike a form of amplifier which appeared in the early days of broadcasting and was mentioned some time ago by "Thermion" in PRACTICAL WIRELESS.

Of course, true amplifiers were only made possible by the introduction of the three electrode valve, and in the true sense all of the earliest radio receivers were amplifiers, but the first amplifier proper, the forerunner of what we know to-day, was probably that introduced by the Western Electric Co. in 1923. It was a neat, compact little job with two 6-volt dull emitter valves having a filament consumption of .25 amps against the normal 1 amp of that period; it employed transformer coupling and introduced grid bias in the form of a 4½ volt flash-lamp battery. This became the pattern of the A.F. portion of most receivers, although gradually one stage, and later two stages, of resistance-capacity coupling became popular. One manufacturer indeed produced a set with three stages of R.C. coupling and an alternative of push-pull or cascade output, using the then popular 6 volt D.E. valves.

Mains Operation

The bugbear of the time was batteries; with the introduction of 6 volt and 2 volt dull emitter valves taking a quarter of an amp, or less, from the accumulator the recharging was not so troublesome, but the H.T. battery was ever a trouble. Large-capacity dry batteries and small accumulator H.T. batteries were introduced, and also the M.L. converter should be mentioned, although it never became very popular perhaps on account of the further drain on the accumulator, but it was the father of all the converters used in various equipment during the past war. The writer was always imbued with the idea that wireless should be plugged into the mains like any other electrical apparatus and, having a 250 volt D.C. household supply, set about rigging up an all-mains equipment. The project was ridiculed generally, fire, explosion or hum were predicted

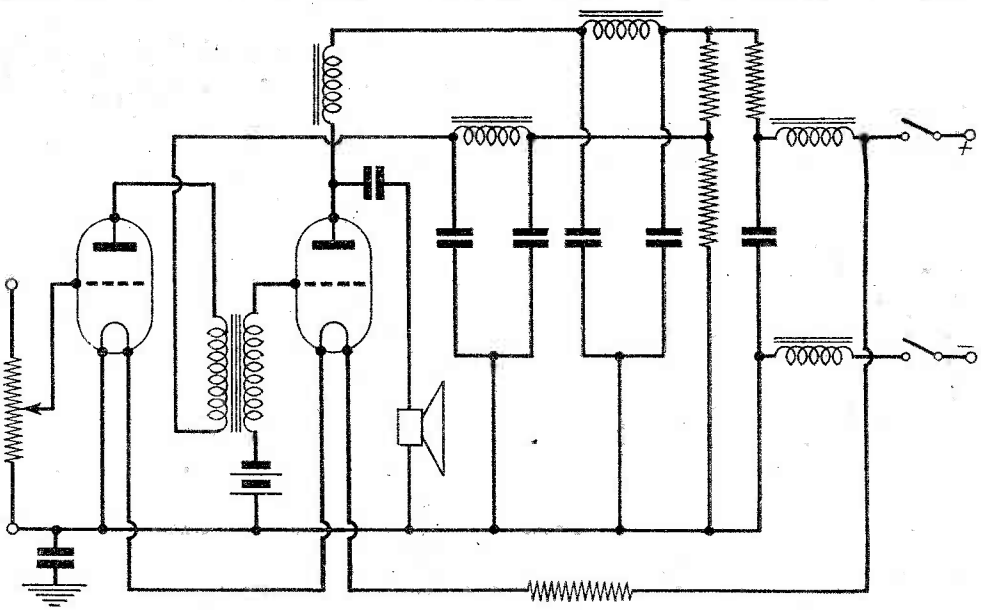


Fig. 1.—One of the circuits referred to by the author.

according to the knowledge of the prophet. D.E.R. valves were used in the original amplifier, these had a 2 volt filament which consumed 340 milliamps, and the anode from about 60 to 100 volts at 3 to 15 mA. A snag was that the positive side of the D.C. mains was earthed and in the early efforts hum was a difficulty. However, the circuit, shown in Fig. 1, was evolved and it proved quite satisfactory, so much so that a radio feeder was also made having two neutrodyne R.F. stages. It is interesting to note the chokes decoupling the anodes; they were laboriously made with strips of old bedstead laths as the cores. Note, too, the choke in the negative mains path: this went a long way to cutting out hum. When 100 mA valves came along it was possible to use a 25 watt lamp as a voltage dropper, and Philips produced an all-mains set using these valves, on the lines of my own effort, but my all-mains set of 1924 must have been one of the earliest.

(*Continued on page 197*)

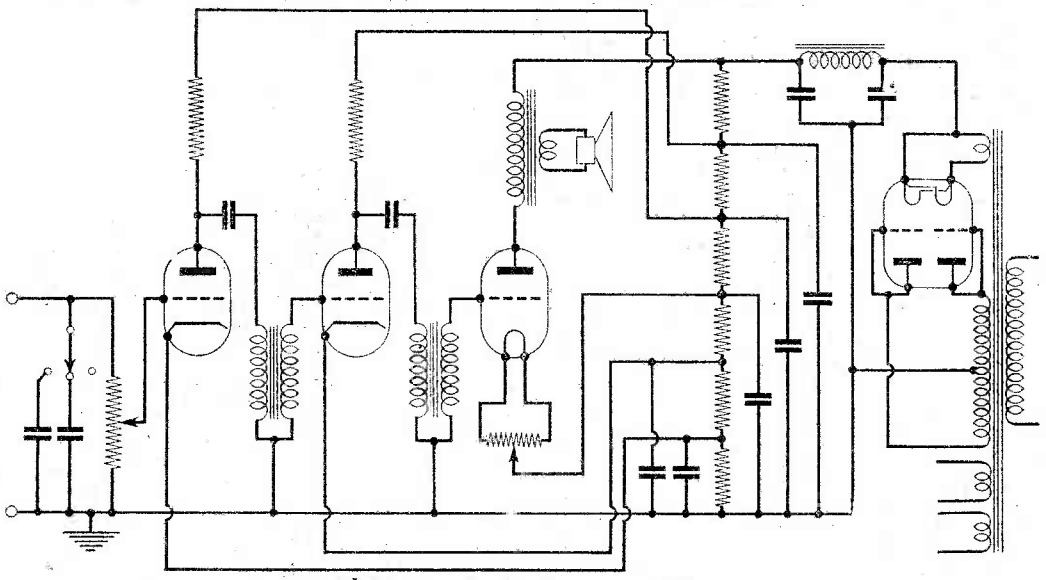


Fig. 2.—Circuit of a German amplifier.

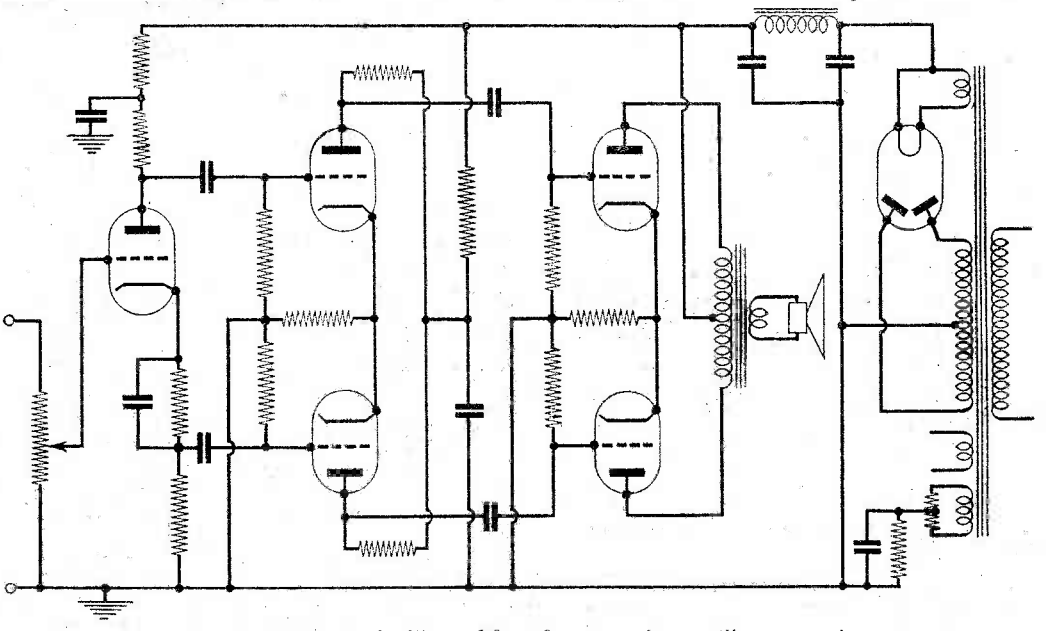


Fig. 3.—The "standard" amplifier of pre-war days—still very popular.

As will be gathered from the foregoing the writer was interested in the reproduction of gramophone records, and set to work with half a high resistance earphone and half a gramophone soundbox to produce a very early electro-magnetic pick-up. The mica diaphragm was replaced by one of stalloy and the halves were joined together so that the record grooves vibrated the diaphragm and generated a small current in the two 1,000 ohm coils of the earphone, to be fed into the amplifier. This contraption was very heavy and tore up records, but they were cheap then, also they were not electrically produced and their range was very limited; however, the volume could be controlled and that was a feature at that time, even though the results were awful by modern standards.

The advent of the indirectly heated cathode valve made possible the first-class amplifiers we take for granted to-day, and no doubt the electrically produced record, with its extended range of frequencies, started the demand for more efficient reproduction, while the talkies, in their turn, helped too. The moving coil speaker came to the fore and Public Address began to take hold, although not so quickly in this country as on the Continent. The circuit diagram of a German amplifier of that period is shown in Fig. 2, while in this country push-pull output was becoming popular, although it was, of course, a

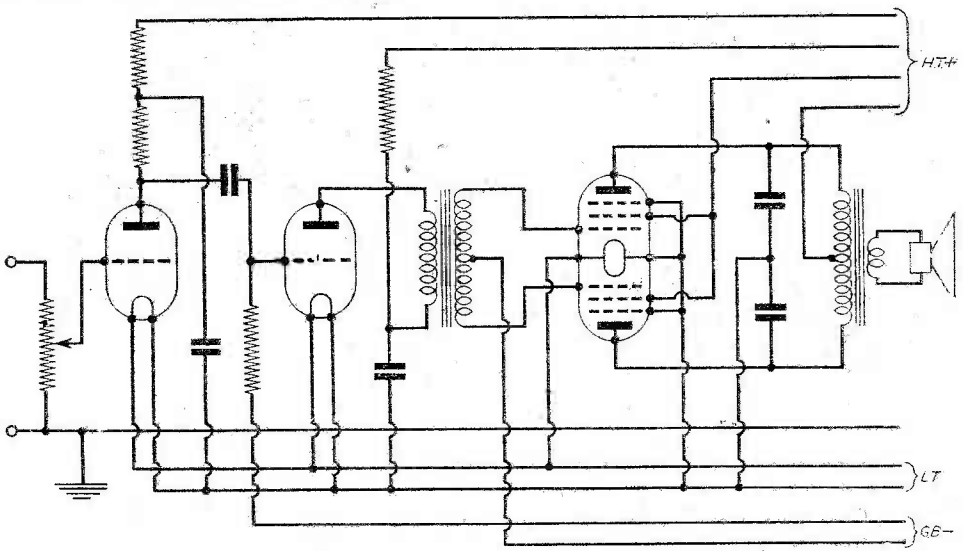


Fig. 4.—A good battery amplifier with Class B output.

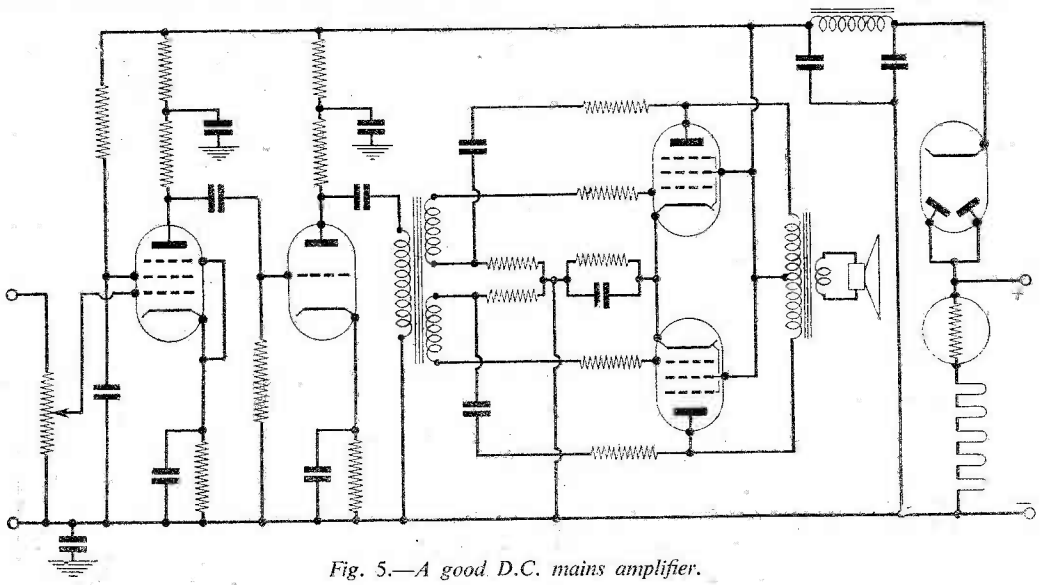


Fig. 5.—A good D.C. mains amplifier.

Western Electric Company's patent, and much public address equipment used a big single valve output with as much as 1,000 volts on the anode. When the PX4 valve came along it quickly became the most popular of all for amplifiers with an output up to about 12 watts. and the writer still thinks it takes a lot of beating for domestic equipment. It is sturdy and practically everlasting, it requires no more than 300 volts on the anode and has a very moderate consumption, also no negative feedback is involved, while in push-pull the directly heated cathodes produce no hum, nor should they in a single output of reasonable design. It would be correct to say that the standard domestic amplifier for years before the war was that of Fig. 3, and indeed. a careful study of this circuit will show that there has been little fundamental change since that design.

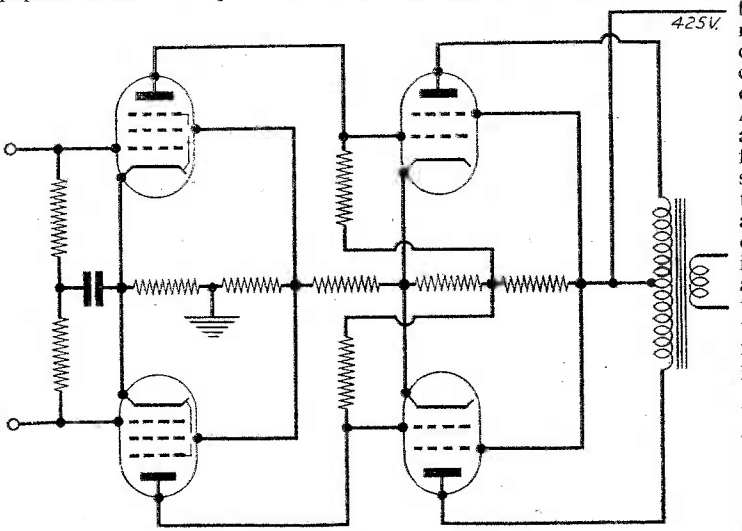


Fig. 6.—A direct-coupled amplifier.

Present-day Circuits

Of course, to-day we use pentodes or tetrodes with 6-volt heaters, negative feedback, etc., etc., but underlying it all remains that fundamental design in nine cases out of ten. In pre-war days many parts of the country were without an electric supply, but an efficient battery-operated amplifier was possible with the aid of Class B or double-pentode output valves, giving an output of about 2 watts. One such circuit was as Fig. 4. Then many districts had a D.C. supply, when a circuit similar to Fig. 5 was used, and the rectifier valve served the useful purpose of preventing a burn-out should the mains plug be reversed. In this case, too, no step-up voltage was possible so pentode outputs were usual.

Here, it will be noted, a form of negative feedback was used. Another popular circuit of this period used the Mullard Pen428 valves with fixed bias, and an output of some 30 watts was obtained very economically in the matter of volts and milliamps. The advantages of negative feedback were beginning to be realised and usually consisted of the resistance-capacity coupling from anode to grid of the output pentode. In America direct coupled amplifiers were quite the rage for a time, although they never seemed to find popularity in this country; high voltages and hum were the normal difficulties, but the circuit shown in Fig. 6 has possibilities, and a normal 425-0-425 mains transformer only is necessary; the writer thinks that experiments on these lines would prove interesting.

In the early days of the past war, being far beyond service age, our experiments and development continued and a cathode-anode output was devised (Fig. 7) and later, when the advertisements of a well-known manufacturer appeared, we discovered that our circuits were identical. There have been arguments as to whether this circuit or the now popular ultra linear is the better. The latter was developed in America some years ago. Although the U.L. was not readily popular in this country, manufacturers have recently proved that it can give a good account of itself. However, the writer does not

(*Concluded on page 201*)

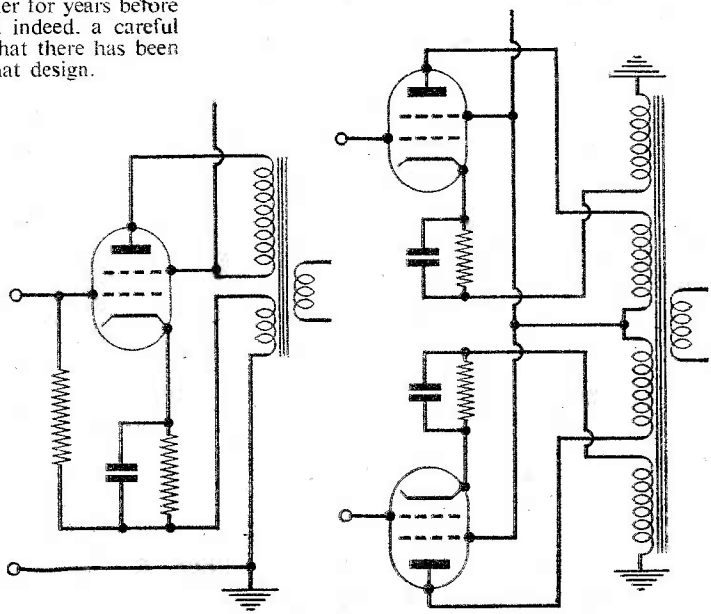


Fig. 7.—Cathode-anode output, and an American version.

Twin Beam Power Valves

DETAILS OF EX-GOVERNMENT SURPLUS

By E. G. Bulley

THESE valves are quite plentiful upon the surplus market and are extremely useful to the transmitting amateur or experimenter. Such valves are, however, designed for use on the higher frequency band and consist of two separate beam units in one envelope but having a common indirectly heated cathode. The heaters are, nevertheless, centre tapped, so that such valves can be used in parallel or series operation.

Twin beam power valves employ the same principle of operation as that of the single valve types, that is to say, the electrons from the cathode are directed and converged into beams, thus providing an improved valve performance. This converging characteristic is accomplished by the helix wires of the grids having the same pitch and in alignment with each other; this construction focuses or beams the electron stream on to the anode concerned.

This beaming arrangement reduces the screen grid current, thus reducing the secondary emission. Further, this characteristic provides the valve with a high value of sensitivity. The electrode spacing in such valves is small and the internal leads are usually of a fairly large cross sectional area. Such leads are, however, kept as short as possible. This reduces the internal inductance of the valve; a characteristic which is important to valves of this design as they are used at high frequencies.

Twin beam power tubes are to-day useful in such applications as push-pull frequency doublers, modulators, oscillators and R.F. amplifiers. These valves will, therefore, provide the V.H.F. enthusiast with the urge to experiment with them. However, when these valves are used in push-pull R.F. amplifiers, they should be adequately shielded for stable operation. They can, therefore, be mounted vertically with one end protruding through a suitable hole in the metal chassis, or alternatively in an horizontal plane with the valve protruding through a vertically mounted metal plate or panel.

These methods of mounting assist in the screening of the valve, and furthermore the chassis or plate as the case may be must be level with the internal shield of the valve or valves. It is, however, advisable to include suitable R.F. chokes in the supply leads to the valves, and at the same time any bypassing arrangement should be as close to the valve pins as possible. Furthermore, any circuit returns must be taken to the common cathode connection.

One must, of course, bear in mind that free ventilation of the valve is essential so as to avoid overheating of any nearby components. For the information of the reader, however, a table is included which gives the characteristics of the valves under discussion. These valves are obtainable from many of the advertisers in this journal.

U.S.A. surplus No.	U.S.A. comm. No.	Brit. surplus No.	Heater volts	Heater current	Max. anode volts	Max. anode current	Max. input watts	Max. anode diss.	Max. freq.	Mu	Gm	Note
VT259	829B	CV2666	6.3	2.25	750	.24	120	40	200	9	8,500	1
VT118	832	CV1088	6.3	1.6	750	.09	36	15	200	7	3,500	2
VT287	815	CV2663	6.3	1.6	400	0.15	60	20	125	6.5	4,000	3
VT286	832A	CV 788	6.3	1.6	750	.09	36	15	200	7	3,500	2

Note.—**All heaters shown for parallel operation.** 1. For series, rating is 12.6 v. at 1.125 amps. 2. Heater for series 12.6 v. at 0.8 amp. 3. Heater for series 12.6 v. at 0.8 amp.

AMPLIFIER PROGRESS

(*Concluded from page* 198)

profess to be clever enough to take up the extreme scientific and mathematic cudgels to prove one or the other superior; it is a thought that to-day too often too little practice gives way to too much theory. The aim of our modern Hi-Fi amplifier is to give us a linear output, and we promptly start to feed it with tone controls and bass and treble cuts and boosts. This is confusing until we remember that our records in manufacture have, of necessity, their extreme frequencies cut, so we must try to return to the normal and realistic. At the other end, too, what speaker can reproduce the full top and bottom to suit us, so we resort to cross-over network and two, or more, speakers. That, however, did not suit the writer, who was not content to leave the middle frequencies to take care of themselves, while boosting or cutting the high and the low, so we built an amplifier with a three-channel output with three speakers, whereby we could add or subtract as much bass or treble as we wished. Again, such a system was much used in America but found little favour here. It is very simple and there is nothing original about it, while surely the reproducer of records should be able to hear them as he, or she, wishes.

The cascode amplifier was designed by the writer last winter and is of interest since a somewhat similar, though more complicated, circuit has recently been published which, we understand, is subject to a pending patent. Whether Mr. P. J. Walker patented the cathode-anode output or not, we certainly never did. The long-tailed pair has been used in many amplifiers of recent years, and the cascode in place of pentode in various types of V.H.F. equipment, so since R.F. pentodes have found their place in so many A.F. amplifiers it is rather to be expected that the cascode should find its way there, too. Indeed, in association with the long-tailed pair we should hear a lot about it in the future. Of course, amplifiers making use of transistors are a modern trend.

News from the Trade

ELIZABETHAN F.M. TUNER UNIT

E.A.P. are now producing a high-stability V.H.F. tuner known as the Elizabethan F.M. Tuner Unit, designed primarily for use with this company's range of Elizabethan tape-recorders. It may, nevertheless, be used with any other quality tape-recorders, Hi-Fi amplifiers or radio receivers.

Brief Technical Specification : A six-valve circuit of conventional design is used incorporating an ECC85 as a grounded grid triode. Two EF89 I.F. amplifiers followed by an EABC80 discriminator/A.F.

The new Elizabethan F.M. Tuner.

amplifier. Visual tuning is obtained by an EM81 " magic eye." The self-contained power pack eliminates the necessity for an external unit.

Frequency stability : Maximum drift expected less than 20 kc/s.

Frequency coverage : 85-101 Mc/s.

Width, 11¼in. ; height, 6⅜in. ; depth, 7⅝in. Weight, 5½lb. Designed for A.C. mains only.

Styled in attractive heavily veneered cabinet with black and cream dial. The unit can be supplied without cabinet if required. Price 24 gns.—E.A.P. (Tape Recorders) Ltd., 9, Field Place, St. John Street, London, E.C.1.

NEW EDITION OF MULLARD POCKET DATA BOOK

THE new edition of the above includes details of entertainment valves, television picture tubes and germanium devices introduced since the previous edition published in 1954.

An improved format has been devised which presents the information in a simplified form. For example, base connections, type numbers, descriptions and characteristics are now given in a single line, thus enabling all the information about any particular valve to be obtained by reference to only one page.

A new section has been added which deals with Mullard Varite thermistors, and there is a list of communications and industrial valves and tubes.

Comprehensive equivalents lists for entertainment valves and picture tubes are also included.

NEW BRIMAR VALVE APPLICATION REPORT AND INDUSTRIAL VALVE BROCHURE

AN application report on the latest Brimar receiving valve, type EL84/6BQ5, and a glossy brochure of industrial valves, are the two latest publications from Standard Telephones & Cables Ltd., for subscribers to the Brimar Application Report Service.

The new Brimar valve, a miniature indirectly heated high-slope output pentode, is intended for operation in parallel with other valves in A.C.-operated or mobile equipment. The valve is primarily designed as an audio output stage in receivers or amplifiers, either singly or in push-pull. It consists of a high mutual-conductance pentode unit mounted in a standard T6½ bulb and fitted with the B9A (Noval) base. Up to 17 watts of audio power may be obtained from a pair of these valves in push-pull.

The application report on this valve tells of its characteristics and of its use as pentode or triode in single-ended and push-pull amplifiers.

The new industrial valve brochure gives concise information about the whole Brimar range and includes electronic devices suitable for industrial equipment or communications.

Both publications are sent free to subscribers of the Report Service, but copies of the brochure (free of charge) and application report (price 3s. 6d.) are available on application to : Standard Telephones & Cables, Ltd., Footscray, Sidcup, Kent.

OSMOR TRANSCRIPTOR COILS

OSMOR coils for the Collaro tape transcriptor are officially recommended by Messrs. Collaro. The types are : QT6, QT7 and QT9.—Osmor Radio Products, Ltd., 418, Brighton Rd., S. Croydon.

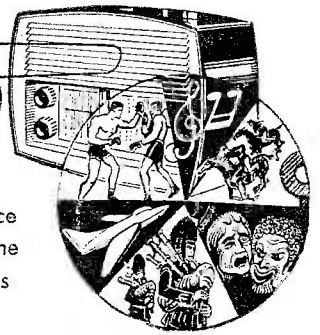
NEW PORTABLE AUTOGRAM

A COMPACT, artistically styled and highly efficient automatic record reproducer—Model 2006—is announced by " His Master's Voice."

An attractive two-toned cabinet covered in hard-wearing light and dark brown leathercloth houses an eight record auto-changer for 33⅓, 45 or 78 r.p.m. records ; a three-valve, two-stage high-gain amplifier, and a hypersensitive 10½in. elliptical speaker—all within the compass of 19½in. by 16½in. by 9½in., and a weight of about 25lb. Quality and volume are outstandingly good (output is rated at 3 watts) ; the pick-up is a high quality lightweight type with a wide response turnover crystal cartridge ; the robust auto-changer handles at one loading up to eight 33⅓ or 78 r.p.m. records (10in. or 12in. or mixed), or up to eight 7in. E.P. or standard 7in. 45 r.p.m. records, with a single selector switch for the three speeds and automatic switching at the end of the last record.

Other refinements include a safety clip to hold the pick-up firmly during transit, quickly adjusted transit screws for the auto mechanism, convenient carrying handle, snap catches on the lid and protective feet on the side and base of the cabinet. Operation is from 50 cycle A.C. mains of 195 to 255 volts. The inclusive price of Model 2006 is 27 guineas.—Gramophone Co., Ltd., Hayes, Middlesex.

Programme Pointers



Our Critic, Maurice Reeve, Reviews Some Recent Programmes

THE Victorian era was notable, among other things, for producing a large number of very brilliant men and women who made it their business to rebel against many of the beliefs and institutions of those days of eight-course dinners; threepenny or so income tax, there's no work but a bench on the Embankment, twopenny pints of beer, and the most austere and forbidding religious observance. Amongst the most prominent of these sons and daughters of rebellion was one Samuel Butler, two of whose books, "The Way of All Flesh" and "Erekwon," are still best-sellers. Co-founder with Shelley, Dickens and one or two other worthies of that remarkable firm of G. B. Shaw & Co., Unlimited, which continued the good work right into our own times, Butler's chief target was organised religion.

"The Way of All Flesh" was turned into a very good play—Against the Wind series—by Barbara Bray, Hugh Manning and Jessie Evans, with Michael Warre, Carleton Hobbs, Gladys Young and a long cast.

"What Do You Know"—Mondays at 7.30 on the Light—has improved in spite of the fact that it was always pretty good. Gone are the sketches based on technical errors in their subjects, and the more recent "professor." And, above all, the execrable and murderous "orchestral passage" that used to mark the halfway stage. Instead, we have "what do you *want* to know" questions answered by a different expert each week. Quite a bright and breezy programme, with Franklin Engleman an admirable chairman.

Educating Archie

I found "Educating Archie" rather "flat beer," and immediately preceding "Take It From Here" lacking in snap and pungency. The whole thing sounded too padded : too little humour chasing too many minutes.

Concerts

I make one of my rare incursions into the concert world to praise both the new concerto for 'cello and orchestra by Sir William Walton and its performance by Piatigorsky, with the BBC Symphony Orchestra under Sir Malcolm Sargent at a Royal Philharmonic Society concert. It was the first European performance. At first hearing it sounds a most luscious and exciting work. The soloist who commissioned it is probably, in the absence of Casals, the greatest of all 'cellists. So it was a memorable evening for highbrow musicians all round.

Talks

An absorbing series of six short talks by Bertrand Russell, O.M., on "Books that Influenced Me in Youth," has just been completed. None could have heard them without comparing his impressions with their own and learning much thereby.

Plays

Sir Compton Mackenzie's "Whisky Galore" lost none of its alcoholic humour in either its adaptation for radio by Moray McLaren or its performance by the BBC's Scottish cohorts. It is an immensely amusing story of the island of Toddy which, dependent for its livelihood on the golden liquid, finds itself cut off by war and gales from all further supplies until a shipwreck drops, I think, fifty thousand barrels, or cases, right into its lap.

Another excellent play was an adaptation of Joseph Conrad's story, "The End of the Tether," made by Helena Wood. Few novelists come over in radio form better than Conrad, that master of the mysterious, perspiring, gin-drinking Far East, where men drive and women are driven. In the present instance, the Conrad "mystique" came over throughout ; one wanted to knock the flies off one's face and to mop one's brow. Brewster Mason brought old Captain Whalley vividly before us, and Toke Townley, Alan McClelland, John Sharp, Wm. Fox, Norman Wynne, G. A. Tinn and Felix Balangit were all very good.

A little-known novel by A. P. Herbert, "The Secret Battle," was adapted by Lance Sieveking and done in the Against the Wind series. A terrible story of the first world war it is, telling of how a young officer of consummate bravery, sacrifice and devotion to duty is made the victim of a swinish C.O., whose back he happened to rub up the wrong way, brought on a charge of cowardice before a court martial, found guilty and duly shot !

The long cast, headed by David Spenser as the unfortunate 2nd Lieut. Penrose, acted quite brilliantly, and Val Gielgud's production of the war atmosphere completely satisfactory.

Signing-off

Shaw may have been up a gum tree with his alphabet and the amount of time its use would have saved in offices, etc. But there can be little dispute regarding the wastefulness, uselessness and unpleasantness of most of the "signing-off" clatter that concludes almost all items. Every word of it is in the *Radio Times*. The quiet and unostentatious conclusion to the little morning feature, "Lift Up Your Hearts" proves beyond argument how preferable our radio would be without it.

The debate on the Civil Service, "The Bureaucrat—Servant or Master," was a model of its kind. The chairman was Neil Pearson and the guest speaker Dame Alix Meynell.

The Radio Trades Examination Board

WE give below details of the results of the examinations since 1944, and in addition some details regarding the Radio Servicing Examination.

Radio Servicing Certificate Examination

The Radio Servicing Certificate Examination provides a recognised qualification in radio service work and the scheme has been drawn up jointly by the City and Guilds of London Institute and the Radio Trades Examination Board. Entry is limited to those persons who have had gainful experience in commercial radio service work in accordance with the following conditions :—

Persons Eligible for the Examination

In order to be eligible for the examination candidates must prove that :

(a) They have had full-time gainful occupation in commercial radio engineering or commercial radio servicing for a minimum period of three full years and be not less than 19 years of age on February 1st preceding the examination they wish to sit, but will not be eligible for the award of the certificate until attaining the age of 21 years.

(b) They have completed a course of technical instruction approved by the Board and have had one year's full-time gainful occupation in radio service work provided they are not less than 18 years of age on February 1st preceding the examination, but will not be eligible for the award of the certificate until attaining the age of 21 years.

(c) They have undergone an approved course of training in Her Majesty's Forces and have also had a minimum of six months' commercial radio servicing or radio engineering experience.

The examination is held in May of each year and consists of two written papers, set on Sections A and B of the syllabus. The written tests are arranged by the City and Guilds of London Institute and may be taken at any college where City and Guilds examinations are normally held.

The Practical Test, held under the auspices of the Board, lasts for three-and-a-half hours and consists of a soldering test, followed immediately by a Practical Test based on Section C of the syllabus. Due to the complex nature of the Practical Test, and the need for providing examination equipment, the number of centres at which the Practical Examination may be taken is limited.

Written papers are normally held on a Tuesday and Thursday evening from 6 p.m. to 9 p.m. and the Practical Test on a Saturday afternoon from 2 p.m. to 5.30 p.m.

Further details may be obtained from the Radio Trades Examination Board, at 9, Bedford Square, London, W.C.1.

ANALYSIS OF EXAMINATION RESULTS
RADIO SERVICING CERTIFICATE EXAMINATION

Year	Entered	Sat	Passed	In one sitting	Having been referred	Referred	Failed	% Pass
1944	55	42	19	19	—	7	17	45
1945	61	58	28	24	4	12	18	48
1946	74	68	44	38	6	6	18	65
1947	First Examination Held Jointly with the City and Guilds of London Institute. 69	65	44	41	3	2	19	69
1948	108	96	65	62	3	15	16	68
1949	167	153	96	89	7	24	33	63
1950	First Television Servicing Certificate Examination Held. 264	255	137	122	15	45	73	54
1951	306	292	196	177	19	46	50	67
1952	314	302	152	133	19	69	81	50
1953	323	309	126	96	30	87	96	41
1954	378	370	144	116	28	96	130	39
1955	533	523	263	213	50	167	93	50
1956	822	802	322	261	61	185	295	40
TOTALS	3,474	3,335	1,636	1,391	245	761	938	49

Open to Discussion

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

Suppression of Interference

SIR,—With respect to the article on "The Suppression of interference" when installing car radio receivers. I would like to make the following comments.

First. Suppression of ignition interference. It was recommended that a 10,000 ohms resistor type suppressor be fitted in the coil lead and possibly additional suppressors to each sparking plug. On modern cars, i.e., cars first registered since 1954, there is a resistor already fitted in the H.T. line; this is in the form of a special pick-up brush in the distributor cap. The old type of pick-up brush is approximately ½in. in length, while the new resistor type is 13/16in. in length, as the value of this resistor is about 12,500 ohms the fitting of an additional one in the coil lead, and, on the plug leads would bring the total resistance in one circuit to more than 25,000 ohms which, it has been recommended by the manufacturers is the maximum resistance allowable to avoid any degradatory effect on the performance of the ignition system. The term "earth" or "chassis earth" is used rather loosely with reference to the suppression of the coil and the dynamo; the earth ends of the suppressor condenser should in each case be connected to one of the mounting bolts of the piece of equipment requiring suppression.

Secondly. It was suggested that interference from the dynamo may easily be cured by fitting a 0.1 μF condenser between the field terminal of the dynamo and earth. I would like to point out that where the dynamo charge is controlled by a vibrating contact regulator, this may result in damage to the regulator. The most efficient method of suppressing dynamo interference is by fitting a 1.0 μF condenser between the "D" terminal and the frame of the dynamo.

The by-pass condensers used for suppression are required to pass very high frequencies. Owing to this non-inductive type condensers must be used, and for the same reason the condenser leads should be as short as possible, 2in. or 3in. at the most. There are many metal cased condensers on the market with one side of the condenser connected to the case; when using these the case can be bolted direct to the frame of the component being suppressed, thereby eliminating one lead. As these condensers are connected between the live terminal and earth a short circuit in one may cause a fire or burn out the car wiring. The normal circuit voltage is 6-12 volts, but transient voltages of up to 200 volts can be produced by some items of equipment in operation, and as the condenser will have to operate satisfactorily over a wide range of temperatures it is advisable to purchase only condensers actually made for the job.

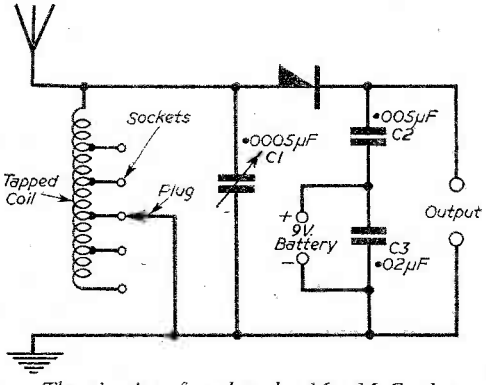
In addition I would respectfully suggest that anyone contemplating fitting a car radio receiver should enquire from the nearest distributors of the radio in question as to the correct fitting, aerial position, and suppression necessary. This information will be freely given as it is not the manufacturers' wish or the distributor's wish that a car shall be on the road with an unsatisfactory radio installation as it would be a bad advertisement of their product.—R. E. PORTER (Manager, Car Radio Department, Bristol).

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 cover.

A Transistor Hint

SIR,—With reference to the letter from Mr. McCawley in the February issue under the above heading I am sure many readers do not know the circuit arrangement to which he refers. I wonder if he could pass on the information to those of us who are not familiar with the circuit?—G. BEESTON (Northampton).

(The following diagram illustrates the basic circuit which was referred to in my letter. The charge is built up in the .02μF fixed capacitor, and is changed to a positive current where it passes through the coil. This becomes superimposed on the positive charge being rectified by the detector thereby increasing signal strength. Experiment with various voltages in the battery and also with capacitance values so as to get the best results from this extremely simple receiver. Experiment has shown that best results are obtained by using a galena cat-whisker type detector, rather than a germanium diode. There is a decided gain as compared with results obtained when using a germanium diode.—R. MCCAWLEY.)



The circuit referred to by Mr. McCawley.

Sound Reproduction—a Reader's Views

SIR,—With reference to the letter in the February issue from G. Arthurell, of Croydon, I would like to say that if his taste in sound reproduction is such that he prefers the bass of pre-war reproducers, he has wasted a lot of money on his Williamson amplifier and Goodman's speaker. The so-called "good" bass response of the pre-war sets was due to a deliberate resonance at about 150 c/s, the lowest frequency these sets could handle. If the bass from a reproducer makes itself readily obvious, it means there is too much of it. The aim should be to produce a level response down as far as possible, not to produce as much power as you can in the region 100-150 c/s.

Referring to Mr. Arthurell's query on de-emphasis on F.M., this is done simply to level out the pre-emphasis applied at the transmitter, thus giving a flat response. It should not be necessary to apply treble boost in the preamp., as modern high quality loud-speaker systems are certainly not deficient at the top end.

Mr. Arthureli's trouble is probably in the matching of his electrostatic unit: they are sometimes difficult in this respect. I would advise him to try a tweeter.—D. SHARP (N.14).

Converting a Hearing Aid

SIR,—Having recently purchased a Medresco Hearing Aid, I decided to convert it into a miniature radio set on the lines set out in the article by Mr. Dunn in your March issue. The conversion is, as described, very simple, but would-be builders will probably come up against a mystifying fault.

The symptoms are—no signals with just a hissing in the 'phones. The obvious conclusion is that something is shorting (as indeed it is) in the very confined space inside the case, but perfect insulation of all leads will explode this theory. The trouble is with the mounting of the trimmer, i.e., a standard 250 pF on a metal panel which is screwed down on the case as Mr. Dunn states. However, if the trimmer is inspected, on the rear side will be found two rivets. These both make contact on the panel when the trimmer is screwed down. As the panel is at earth potential, the rivet holding the tag to which the diode is soldered is directly shorted to earth, naturally resulting in no signals.

The remedy is simple. Either replace the metal panel with a bakelite or Paxolin one, or more simply still, just put a piece of insulating tape over the offending rivet.

I hope this will clear up what can be a most baffling problem. By the way, thanks for the index you now provide in the front of the magazine, it's a long needed want.—ROGER SKYRME (Chesterfield).

Ohmmeter Design Problems

SIR,—To any readers contemplating the construction of an ohmmeter on the lines advocated by W. Cleland in his excellent article on Ohmmeter Design (March issue), I should like to offer the following words of caution. There are two distinct types of ex-R.A.F. blind approach L/R indicator—or crossing needle 10Q2 meter—available on the surplus market, only one of which is really suitable for the experimenter. The unsuitable type is instantly recognised by the raised Crown with the letters A. M. underneath it, moulded on the front of the case, whilst the five open mounted terminals on the back are marked A, B, C, D and F. This type has one magnet only in contact with two unseparable movements, which are heavily damped and therefore very sluggish in action.

The other and suitable type has literally everything to recommend it. The front of the case is quite plain and unmarked, as are the five shrouded terminals at the back. Inside, the two quite separate movements are of the highest quality indeed, are beautifully free in action, being neither under- nor over-damped, and are obviously of precision construction. The f.s.d. is around 120μA. I can thoroughly recommend these movements for many purposes, making the basis of an excellent ohmmeter, photo-electric exposure meter, galvanometer, or even a multi-range meter. The only slight drawback in the latter case is a not quite linear scale, though when sandwiched between an ohms scale and a capacitor scale this hardly becomes noticeable.—JOHN C. WILLIAMS (Crawley).

A Superhet Portable 4

SIR,—As a novice I decided to attempt the construction of the "Portable 4" as your issue of January (page 761).

However, I have been advised by Astral Radio Products of Brighton that the I.F. transformers are pre-aligned slug tuned—without top trimmers.

Could you please advise me as to whether the set will be just as successful with these as with those you list in the components as with top trimmers.—W. COLLIS (Stoke Poges).

(It is regretted that between preparation of the design and its publication, the transformers were discontinued, but any standard 465 kc/s transformers will be equally suitable, from Astral Radio or any other maker. A very slight adjustment of cores, with a shaped ebonite or wooden rod, is often worth while, with pre-tuned L.F. transformers, to secure maximum volume.—ED.)

The Blattnerphone

SIR,—Reference Thermion's article in March issue of PRACTICAL WIRELESS. As a very old reader (I still have nearly every copy of PRACTICAL WIRELESS from its inception), I would like to make a few comments regarding the Blattnerphone.

Some 26 or 27 years ago I was living in Sheffield and distinctly remember visiting the Hippodrome Cinema there to see a demonstration of the Blattnerphone. This was given on the stage and, as stated by Thermion, consisted of a large, heavy and somewhat elaborate apparatus which recorded sound on to steel tape.

The week's demonstration, supervised throughout, I believe, by its inventor, was linked with a talent competition—in which the competitors sang or played an instrument—in each case their act being simultaneously recorded. It was later played back to the audience after the usual rewind.

At the time I think it was stated that the BBC made all their "master recordings" that way and that they maintained an elaborate library of these steel tape records. Whether this is current practice I do not know.

Incidentally, the quality of these recordings as played back, as far as I can remember, was remarkably good.—A. WHEATLEY (Chislehurst).

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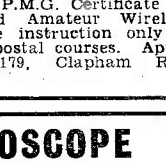

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Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

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