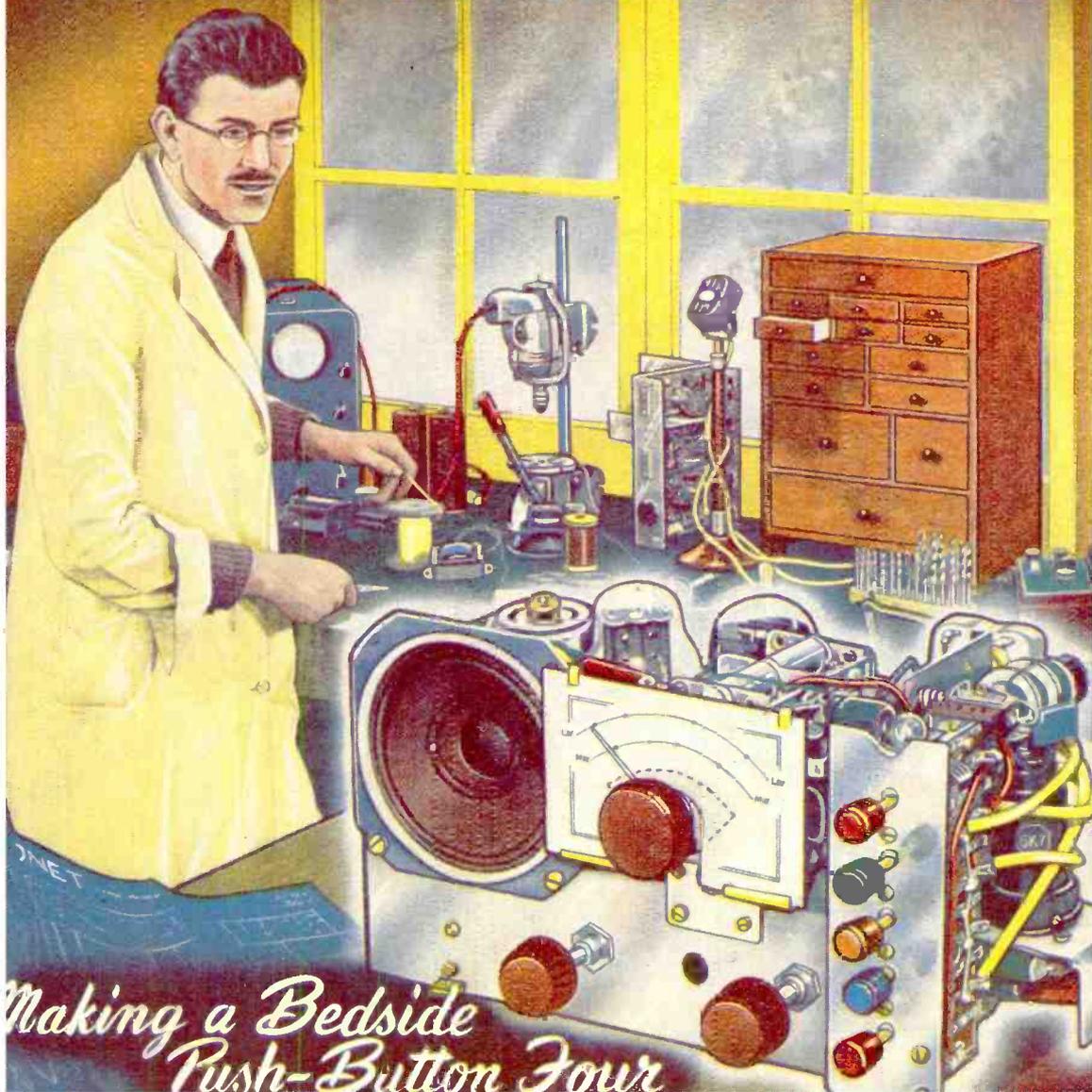


THE *Leading* MAGAZINE FOR THE RADIO CONSTRUCTOR

# PRACTICAL WIRELESS

APRIL  
1955

EDITOR: F. J. CAMM



*Making a Bedside  
Push-Button Four*

*Supreme in Service*

**'MICROMITE'**

**DRY ELECTROLYTIC CONDENSERS**

These small but high quality electrolytics have proved so popular that the range has been greatly extended. The use of high-gain etched foil electrodes keeps size and weight down, making the condensers suitable for suspension wiring. Conservatively rated; long shelf life ensured; green plastic insulating sleeving prevents short-circuits.



Capacity in $\mu$ F.	Peak Wkg. Volts	Surge Volts	Dimns. in Ins.		Type No.	List Price Each
			Length	Diam		
50	12	15	1 1/8"	1/8"	CE87B	2/9
25	50	60	1 1/8"	1/8"	CE88DE	3/-
1	350	400	1 1/8"	1/8"	CE86L	2/6
8	350	400	1 1/8"	1/8"	CE99LE	3/3
16	350	400	2 1/8"	1/8"	CE91LE	4/-
32	350	400	2 1/8"	1/8"	CE93LE	6/-
4	450	550	1 1/8"	1/8"	CE99PE	3/3
8	450	550	1 1/8"	1/8"	CE90PE	3/6
16	450	550	1 1/8"	1/8"	CE92PE	5/-
32	450	550	2 1/8"	1/8"	CE94PE	7/6



**THE TELEGRAPH CONDENSER CO. LTD**

RADIO DIVISION: NORTH ACTON · LONDON · W.3 · Telephone: ACOrn 0061

THE WORLD-FAMOUS  
*Stentorian* CAMBRIC CONE

**HIGH FIDELITY UNITS**

*now available with universal impedance speech coil*



Prov. Patent 10037/53

● A most notable advance in loudspeaker design acclaimed by experts (including F. J. Camm, John Gilbert, P. Wilson, H. J. Barton-Chapple and L. Ormond Sparkes). It provides instant matching of the speech coil impedance at 3 ohms, 7.5 ohms and 15 ohms, and is available on the models marked with an asterisk. This development has added immeasurably to the great popularity already achieved among Hi-Fi enthusiasts. Your dealer can show you these new units, or they may be heard at our London Office, 109 Kingsway, any Saturday between 9 a.m. and noon.

**AT REMARKABLY LOW COST**

- Model HF510 ... 5" Steel Unit ... **£1.17.6**
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Easily assembled polished walnut veneer cabinet, designed to give maximum reproduction from either the 10" or 12" Cambric Cone unit. Packed flat, with screws, ready for assembly. Size 32" x 22" x 16".

Price **£10-10-0**

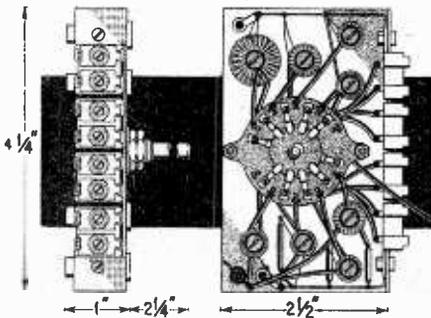
Corner Console Cabinet (8" unit). . . . **£5.10.0**

**WHITELEY ELECTRICAL RADIO CO. LTD · MANSFIELD · NOTTS**

**MAXI-Q**  
REGD.

**IN RESPONSE TO NUMEROUS REQUESTS FOR THE INCLUSION OF THE TRAWLER BAND ON OUR PRESENT RANGE OF SEVEN MINIATURE COIL PACKS WE NOW INCREASE THE RANGE TO EIGHT AND PRESENT THE FOUR WAVEBAND CP.3/F FOR 500pF. TUNING CONDENSER.**

CP.3/F



This Coil Pack is for use with a 500pF 2 Gang Condenser and covers the standard Long, Medium and Short Wavebands with the addition of the Band 50/160 metres, 1.85/6 Mc/s. This covers the Trawler Band, 105/160 metres, Shipping, 68/74 metres, Aeronautical 52/55 and 95/105 metres, and the 80 and 160 metre Amateur Bands.

The CP.3/F comprises of Aerial and Oscillator coils wound on "Neosid" formers complete with iron dust tuning cores, Wavechange Switch and Mica Compression Trimmers mounted on an aluminium plate. Fixing is effected by an additional nut on the Wavechange Switch. The I.F. is 465 kc/s. For use with any standard frequency changer.

Retail Price : 49/- plus 16/4 P.T.—Total 65/4.

The following Coil Packs are also available :

CP.3/370 and 500pF. Three Waveband Coil Packs for use with either 370 or 500pF tuning condensers.

Retail Price : 32/- plus 10/8 P.T.—Total 42/8.

CP.3/G. Three Waveband Coil Pack for 500pF tuning condensers with provision on the Wavechange switch for gramophone position.

Retail Price : 39/- plus 13/- P.T.—Total 52/-.

CP.4/L and CP.4/M. These compact 4 station Coil Packs are available for either—1 Long and 3 Medium wave stations (CP.4/L) or 4 Medium wave stations (CP.4/M). Retail Price : 25/- plus 8/4 P.T.—Total 33/4.

CP.4L/G and CP.4M/G. As above but with provision for gramophone pick-up on the Wavechange switch. Retail Price : 31/- plus 10/4 P.T.—Total 41/4.—See Technical Bulletin DTB.9 for details of all coil packs, 1/6.

Send 1/- for General Catalogue. Obtainable from all reputable stockists or in case of difficulty direct from :

**DENCO (CLACTON) LTD : 357/9 OLD ROAD · CLACTON-ON-SEA**

STOP PRESS : "Osram 912" and "Mullard 5-10" Amplifier Chassis and Bronze finished Front Panel—Price 21/- each. The "P.W. Fury Four" uses the "Maxi-Q" Yellow (3/11) and Green Chassis Mounting Coils (4/9) (please state frequency range when ordering). Also available are the "Fury Four" Chassis and Paxolin Front Panel, 19/6. Long and Medium Wave T.R.F. Coils, wound on Polystyrene Formers, 9/- per pair.

# WEYRAD SIGNAL GENERATORS

Improved versions are now in large-scale production. A number of modifications have been introduced in the circuit which provide superior performance and higher efficiency.

Fundamental coverage 100 Kc/s-70 Mc/s. Calibration accuracy  $\pm 2\%$  on all bands. R.F. output C.W. or M.C.W. to co-ax. cable. Separate fixed A.F. output. Controls on front panel—range switch, attenuator, tuning, modulation on/off and mains on/off.

Fitted in stout metal case finished cream with leather handle. Front panel black with natural lettering.

**S.G.M.I.**—Mains operated with double-wound impregnated transformer.

**S.G.B. I.**—All-dry battery operated.

Illustrated Leaflet, 2d.

**WEYMOUTH RADIO MFG. CO. LTD.**  
CRESCENT ST., WEYMOUTH, DORSET

## Finest Soldering? Always specify ERSIN MULTICORE to be precise

Wherever precision soldering is essential, manufacturers, engineers and handymen rely on MULTICORE. There's a MULTICORE SOLDER just made for the job you have in hand. Here are some of them.

### SIZE 1 CARTON

4 specifications for radio enthusiasts.

5/-



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Sufficient for 200 average joints. 6d.

### TAPE SOLDER

MELTS WITH A MATCH! Real tin/lead solder containing cores of Ersin Flux. Needs no soldering iron or extra flux.

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PER CARD



### BIB WIRE STRIPPER AND CUTTER

The 3 in 1 tool. For stripping insulation without nicking wire, cutting without leaving rough edges and splitting extruded flex. 3/6 EACH



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MULTICORE WORKS, HEMEL HEMPSTEAD, HERTS (BOXMOOR 3636)

# HENRY'S

(RADIO LTD.)

## SPECIAL OFFER '38' WALKIE TALKIE SETS

We have purchased large quantity of the above "38" Sets, and can now offer same complete with 5 valves: 4-VP23 and ATP4. Throat microphone, headphones, junction box and collapsible aerial. Freq. range 7.4 to 9 mcs. Range approx. 5 miles. In absolutely new condition and Guaranteed Air Tested at 59/6 carriage 5/-.

We have over 20,000 American and B.V.A. valves in stock. ALL VALVES NEW AND GUARANTEED.

1D8GT	10/- 6AM3	9/- 12SA7GT	8/6 EF38	6/6 SP41	4/-
1A7GT	12/6 42	8/6 12SQ7GT	8/6 EF39	6/6 D41	5/-
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154	7/6 6SG7GT	8/6 6A8G	8/6 KT2	5/- QP21	8/-
174	7/6 6S7GT	8/6 TZ40	35/- VP22	8/6 TP22	8/6
1R5	7/6 6SK7GT	8/6 0Z4	7/- SP2	8/6 ATP4	4/-
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EY51	12/- UL41	11/- EF80	10/6 PL81	12/6 12A7E	8/-
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88 100 Mc's

We can now offer this self-contained Unit comprising 9 valves: 2-6BA6, EB91, VR137, EF54, EF54. Two I.F. stages and separate local oscillator, also Muirhead Graduated Vernier Drive ensuring easy tuning.

Components Offered to Complete F.M. Unit New RF "26" Unit with 3 valves, VR137, EF54, EB91. Chassis stamped out for easy conversion £11.50

Complete set of all components for conversion including 2-6BA6 and EB91, tuning condenser, I.F.T.'s and Osc. coils, resistors and fixed condensers, plugs, wire and tag strips ... £4.12.6

Instruction Book with technical circuit and complete lay-out diagrams ... 2.0

Special offer of all above items and RF26, including circuit, postage 3/- ... £8.50

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Assembled, aligned and ready for use £8.10.0

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Ideal for tape recording and amplifiers. No matching transformer required.

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1A7GT	1N5GT	1H5GT	1A5GT (or 1Q5GT)	40.- Set
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EXIDE (CANADA) HYDROMETERS complete with float, etc., in wooden storage case. 6/6 each.



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- PHILIPS ROUND CAN IF TRANSFORMERS,** 470 Kcs, 8 - pair.
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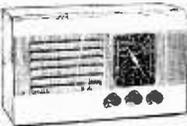
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# BARTON'S (Radio)

## BUILD YOUR OWN RADIO!



We can supply all the parts (including valves, 5in. moving coil speaker, cabinet, chassis, and everything down to the last nut and bolt) to enable YOU to build a professional-looking radio. The chassis is punched and drilled ready to mount the components. There is a choice of any of three attractive cabinets 12in. long, 5in. wide by 6in. high, as follows: either ivory or brown bakelite, or wooden, finished in walnut. Complete, and easy-to-follow point-to-point and circuit wiring diagrams supplied.



follows: either ivory or brown bakelite, or wooden, finished in walnut. Complete, and easy-to-follow point-to-point and circuit wiring diagrams supplied.

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This is a 3 valve plus metal rectifier T.R.F. receiver with a valve line-up as follows: 6K7 (IF), 6J7 (Det) and 6V6 (Output). The dial is illuminated. Coverage is for the Medium and Long Wave bands. Operates on 200/250 volts A.C. Mains. A.C./D.C. Model now available.

Plus 2/6 Packing, Carriage, Insur. **£5.10.0**

**T.R.F. RECEIVER** - We can supply this Receiver ready built at £6.15s. 6d. plus 3/6 packing, carriage.

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### THE NEW T.R.F. MODEL 1 PLUS.

#### THE RECEIVER WITH THE SENSATIONAL PERFORMANCE :

This is a completely new design 4 VALVE, 2 Wave Band radio, incorporating the LATEST MINATURE HIGH GAIN VALVES and the most modern design HIGH " Q " IRON CORED COILS, ensuring greatly increased sensitivity and selectivity over the whole of the Medium Band and providing outstanding performance on the Long Wave band. 4 VALVES, 6B3E R.F. Amp., 6BH6 Anode Bend Det., 6A45 Output, 6X4 Rect. Operates on 200/250 volt A/C Mains.

This Receiver can be supplied Ready Built at £8 5s. 0d., plus 3/6 packing, carriage and insurance.

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Office : (Dept. P.W.). 34, Montpelier Rise, London, N.W.11. Telephone : Meadway 1786.

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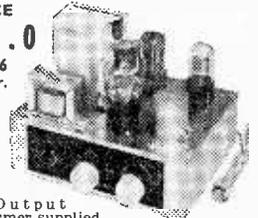
### 4-watt AMPLIFIER KIT

This is a 3 valve 3 stage Amplifier for use with Gramophone, Microphone or Radio. Valve line-up is as follows: 6SL7, 6V6, 5Z4. Negative feed-back, Tone Control, Voltage adjustment panel, incorporated. 4 watts output. For operation on A.C. Mains 200/250 volts.

The complete Kit includes every item down to the last nut and bolt, drilled and punched chassis, and comprehensive point-to-point wiring circuit diagram. Chassis dims.: 8in. x 6in. x 2 1/2in.

PRICE **£4.5.0**

Plus 2/6 Pkg., Carr. & Ins.



The Output Transformer supplied is for use with a loudspeaker of 3 ohms. Circuit Diagram only, available separately at 1/-. To those who require this Amplifier ready-built we can supply it at £5.10. plus 3/6 pkg., carr., ins.

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A new T.R.F. Tuner Unit designed for High Quality local station reception. 2 Valves—6K7 and 6J7. Controls—Volume, Tuning and Wavechange. Waveband coverage—Medium and Long. Dimensions—H. 5 1/2in. D. 4 1/2in. Power requirements—6.3 volts at 0.6 Amps. 250-300 volts 15 mA. (This supply is already available in the Amplifier illustrated above.) All the parts to build this Unit can be supplied at £2 15s. 0d., plus 2/6 p. & c. Ready Built £3 15s. 0d., plus 2/6 p. & c.

## RADIO SUPPLY CO. (Leeds) LTD.

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Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/- extra under 10/- 1/6 extra under £1. 2/- extra under £2, 2/6 extra under £3. Open 9 to 5.30, Sats. until 1 p.m. Catalogue 6d. Trade List 5d. S.A.E. please with enquiries.

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16 s.w.g. receiver type. 12in. x 8in. x 2 1/2in. 5/3 16in. x 8in. x 2 1/2in. 7/6 20in. x 8in. x 2 1/2in. 8/11

16 s.w.g. amplifier type, 4-sided. 12in. x 8in. x 2 1/2in. 7/11 16in. x 8in. x 2 1/2in. 10/11 20in. x 8in. x 2 1/2in. 13/6 14in. x 10in. x 3in. 13/6

EX-GOVT. TRANSSES. 220 v. 50 c/s. Following suitable for chargers, etc. 8.8 v. 4 a. 9/9; 0.11-22 v. 30 a. 72/6; 0.16-18-20 v. 35 a. 79/6; 7.7 v. 7 a. C.T. 4 times, 25/9. Carr. 5/-.

Misc. Types 4 v. 2.5 a. 4/9; 4 v. 6 a. High Ins. 7/9; 4 v. 1 a. 9/9. Carr. 5/- extra on following types: 460 v. 200 mA. 6.3 v. 5 a. 27/9; 400 v. C.T. 150 mA. 4 v. 6 a. 6.3 v. 6 a. 6.3 v. 0.6 a. 4 v. 6 a. 4 v. 3 a. 4 v. 3 a. 4 v. 3 a. 5 v. 2 a. 22/9; 1,220 v. 350 mA. 610-0-610 v. 150 mA. 300-0-300 v. 150 mA. 29/9; 865-775-680-0-690-775-865 v. 500 mA. 29/9; 250-0-250 v. 200 mA. 6.3 v. 8 a. 5 v. 3 a. 22/9; 300-0-300 v. 150 mA. 6.3 v. 4 a. 5 v. 3 a. 22/9.

AMMETERS Moving Coil (EX-GOVT.) G.E.C. 0-5 amps. 2in. scale, 11/9.

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 40, 50, 100, 150, 200, 250, 300, 400, 500, 1,000 (.001 mfd.), 2,000 pfd. (.002 mfd.), 8d. each; 3/9 odd. One type.

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#### EX-GOVT. AUTO TRANSFORMERS

Double Wound, 50 c/s. 10-0-200-220-240 v. to 10-0-275-295-315 v. 1,000 watts, 69/6; 0-230 v. to 0-230 v. tapped every 11 volts; from 57.5 v. 5,000 watts (21 amps.). 26/15/- . Carriage on above 5/- extra. 15-10-5-0-195-215-235 v. 500 w., 27/9.

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250 mA. 10 H 50 ohms ... 14/9 250 mA. 10 H 100 ohms ... 14/9 150 mA. 10 H 100 ohms ... 11/9 150 mA. 10 H 150 ohms Trop. ... 6/9 100 mA. 10 H 150 ohms Trop. ... 5/11 50 mA. 5-10 H 200 ohms ... 2/9 L.T. type 1 amp. 2 ohms ... 2/9

#### EX-GOVT. METAL BLOCK (PAPER) CONDENSERS

4 mfd. 500 v. 2/9; 4 mfd. 1,500 v. 4/9; 4 mfd. 2,000 v. 7/9; 6-6 mfd. 400 v. 5/11; 8-8 mfd. 500 v. 8/11; 4 mfd. 400 v., plus 2 mfd. 250 v. 1/11; 8 mfd. 500 v. 5/9; 15 mfd. 500 v. 6/9.

#### EX-GOVT. E.H.T. SMOOTHERS

.02 mfd. 8,000 v. cans, 1 1/2 x 2 1/2 mfd. 4,000 v. Blocks, 4/9; .5 mfd. 2,500 v. Blocks, 3/9; .5 mfd. 3,500 v. cans, 3/3; 1.5 mfd. 4,000 v. Blocks, 5/9; .1 mfd., plus .1 mfd. large Blocks, 8,000 v., 9/6.

#### EX-GOVT. ACCUMULATORS

With Non-Spill Vents. Unused and guaranteed 2 v. 16 A.H., 5/9.

#### 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. acc. Price with steel case and circuit, 29/6. Or ready for use, 8/9 extra.

## R.S.C. 4-5 WATT HIGH GAIN AMPLIFIER TYPE A5

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the high-fidelity pick-up heads, in addition to all other types of pick-ups and practically all ndkes. Separate Bass and Treble controls are provided. These give full long-playing record equalisation. Hum level is negligible below 7 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape Deck preamplifier. For A.C. mains input of 200-250 v. 50 c/s. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate), with green crackle finish, and point-to-point wiring diagrams and instructions. Exceptional value at only £4/15/-, or assembled ready for use 25/- extra, plus 3/6 carr.

TV. PREAMPLIFIER (Plessey) For Fringe Areas. Brand New. Complete with 6F13 valve. Only 22/6.

RF28 UNITS BRAND NEW, CARTONED. Only 39/6. Carr. 2/6.

#### EX-GOVT. VALVES (NEW)

Each	Each	Each
IT4 7/9	6SN7GT 8/11	AC5PenDD
1R5 7/9	6V8G 8/9	EF35 9/9
1R5 7/9	6V8CT 7/9	EF38 8/9
384 7/9	6X5GT 8/9	EF81 5/9
5Y3G 8/9	8D2 2/11	EF91 7/9
5U4G 10/6	807 7/11	EL33 9/6
5Z4G 9/6	12A6 7/9	MU11 8/9
6F6G 7/9	12K7GT 10/6	MS/Pen 5/9
6T7G 8/9	15D2 4/9	SP4 5/9
6K7G 5/11	25Z4G 9/6	SP41 1/11
6K8G 8/11	35Z4GT 10/6	SP61 2/9
6SK7Met 7/9	EBC33 7/9	VU123 2/11

SPECIAL OFFER. Ex-Equip. Goodmans 3in. P.M. Speaker with Battery pentode trans. 12/9.

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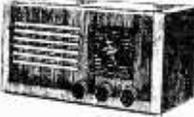
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## BUILD THESE NEW PREMIER DESIGNS

**3-BAND SUPERHET RECEIVER**  
MAY BE BUILT FOR **£7.19.6** Plus 2/6 Pk. & Carr.

Latest type Superhet Circuit using 4 valves and metal rectifiers for operation on 200/250 volts A.C. mains. Waveband coverage—short 16-50 metres, medium 180-550 metres, and long 900-2,000 metres. Valve line-up 6K8 freq. changer, 6K7 I.F. 6J7 Detector AVC and first AF, 6V6 output. The attractive cabinet to house the Receiver size 12in. long, 6 1/2in. high, 5 1/2in. deep can be supplied in either WALNUT or IVORY BAKELITE or WOOD.



INSTRUCTION BOOKS 1/- each, (post free) which includes Assembly and wiring diagrams, also a detailed Stock List of priced components.

### CABINETS—PORTABLE

**Model PC/1**  
Brown Rexine covered, 15 1/2in. Overall dimensions 15in. x 13 1/2in. x 5in. Clearance under lid when closed 2 1/2in.

**Model PC/2**  
Grey Lizard Rexine covered, 45/- Overall dimensions 15in. x 13 1/2in. x 6in. Clearance under lid when closed 3in.

**Model PC/3**  
Rexine type covering in various colours, 69/6.

Overall dimensions 16 1/2in. x 14 1/2in. x 13 1/2in. Clearance under lid when closed 6in. All the above Cabinets are supplied with Panels, Carrying Handles and Clips. Packing and Postage 2/6.

Send for details of the Premier Wide angle Television design which may be built for £30.

**TRF RECEIVER**  
MAY BE BUILT FOR **£5.15.0** Plus 2/6 Pk. & Carr.

The circuit is the latest type TRF using 3 valves and Metal Rectifiers for operation on 200/250 A.C. mains. Wave band coverage is 180/550 metres on medium wave and 100,2,000 metres on long wave. The dial is illuminated and the Valve line-up is 6K7 I.F., Pentode 6J7 Detector and 6V6—Output.

illuminated and the Valve line-up is 6K7 I.F., Pentode 6J7 Detector and 6V6—Output.

### DECCA MODEL 37A

**DUAL SPEED RECORD PLAYER**  
Includes turnover crystal pick-up with sapphire stylus and a light-weight plastic spring-balanced arm. Heavy gauge pressed steel case with brown enamel finish in good quality for operation on A.C. mains 200/250 v. 50 c.p.s. Supplied complete, £6.19.6. Plus pkg. and carr. 5/-.

### GARRARD S5

GARRARD Rim Drive 78 r.p.m., complete with magnetic pick-up and turntable, £4.19.6, plus 2/6 pkg. and carr.

SEND 2 1/2d. STAMP FOR OUR 1955 CATALOGUE.

**4-WATT AMPLIFIER**  
MAY BE BUILT FOR **£4.10.0** Plus 2/6 Pk. & Carr.

Valve line-up 6SL7, 6V6 and 6X5. FOR A.C. MAINS 200/250 VOLTS. The output Valve is of the beam type and feeds 4 watts into a specially designed output Transformer which is suitable for either 3-ohm or 15-ohm Speakers. Negative feedback is applied from the secondary of the output Transformer over the whole Amplifier to the input stage giving an excellent frequency response. Due to the high gain and wide range tone controls any type of pick-up may be used. Overall size 9 x 7 x 5in. Price of Amplifier complete, tested and ready for use, £5/5/- plus 3/6 pkg. and carr.



INSTRUCTION BOOK 1/- (post free) which includes Assembly and wiring diagrams, also a detailed Stock List of priced components.

### C. R. TUBES

VCR 517C 6 1/2in. picture. This tube is a replacement for the VCR67 and VCR517. Guaranteed full size picture. PRICE, 35/- Plus 2/6 pkg., carr. ins. VCR 516 9in. Blue picture. Heater Volts 4, Anode 4 Kv., in Manufacturer's original Carton. Plus 5/- pkg., carr. ins. PRICE, £1.19.6.

COMPONENTS AVAILABLE FOR THE MULLARD AND OSRAM AMPLIFIER DESIGN

**NEW!**

# EXPERIMENTAL KITS in Radio, T.V. etc.

## LEARN THE PRACTICAL WAY

Specially prepared sets of radio parts (which you receive upon enrolment) with which we teach you, in your own home, the working of fundamental electronic circuits and bring you easily to the point when you can construct and service radio sets. Whether you are a student for an examination; starting a new hobby; intent upon a career in industry; or running your own business—these Practical Courses are intended for YOU—and may be yours at very moderate cost.



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**RADIO (basic)**—A course in basic principles.  
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**TELEVISION**—Instruction and equipment for building a Television Receiver.

Also for Mechanics, Electricity, Chemistry, Photography, Carpentry, Draughtsmanship, Commercial Art, Amateur S.W. Radio, Languages.

## E.M.I. INSTITUTES

The only Postal College which is part of a world-wide Industrial Organisation

## Positively the 2 BEST T/Vs yet built for the Home Constructor!

### The STERN'S "TELE-VIEWERS"

5 CHANNEL SUPERHET RECEIVERS

Suitable for any transmitting channel and for which commercial adaptors will be available.



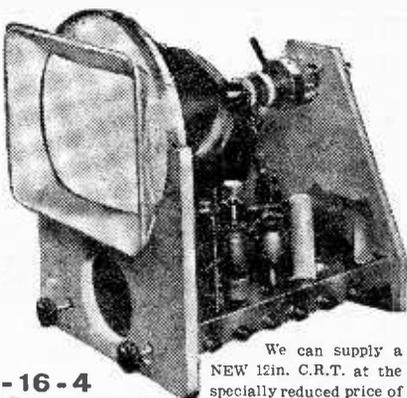
PERFECT PICTURE QUALITY

SIMPLE DIAGRAMS MAKE CONSTRUCTION EASY



PERFECT FRINGE AREA RECEPTION

BETTER RECEPTION AT HALF COMMERCIAL COST



We can supply a NEW 12in. C.R.T. at the specially reduced price of £12.10-6. (Carr. & Ins., 15/- extra.)

### The "WIDE-ANGLE" TELE-VIEWER

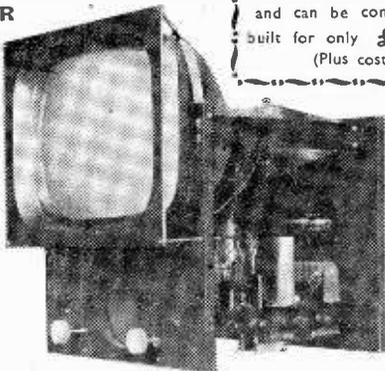
\* This is the most efficient large screen TV yet offered to constructors.

\* Excellent Time Base efficiency producing 15 to 16 Kv with ample scanning power for C.R.T.'s up to 17 inch.

CAN BE COMPLETELY BUILT FOR

£33-0-0

(Plus cost of C.R.T.)



This is the 12" TELE-VIEWER and can be completely built for only £28-16-4 (Plus cost of C.R.T.)

The complete set of ASSEMBLY INSTRUCTIONS for these T/Vs are available for 5/- each. They include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENT PRICE LIST. ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE.

## STERN RADIO LTD.

109 & 115, FLEET STREET, E.C.4.

Tel.: CENTRAL 5812-3-4.

### Great Britain's Valve Mail-Order House

1B4	9/6	6BH6	11/-	6X4	10/-	75	9/6
1C6	9/6	6BJ6	11/-	6X5	8/6	76	8/6
1G1	8/6	6BW6	10/6	7A7	10/6	77	10/6
1LN5	6/6	6C4	8/6	7B7	11/6	78	10/6
1LA4	9/6	6C6	9/-	7C5	10/-	79	10/6
1P5	9/6	6C8	11/-	7C6	10/6	82	10/6
1R4	9/6	6D6	9/-	7H7	10/-	85	9/6
1R5	10/-	6F6	10/-	7N7	10/6	86	10/6
1S4	10/-	6F7	9/-	7Q7	11/-	50L6	11/-
1S5	10/-	6F8	11/-	7R7	11/-	53KU	12/6
1T4	10/-	6G6	9/-	7S7	12/6	57	9/6
1T5	10/6	6G3	9/6	7V7	10/-	58	10/-
1U5	10/-	6H6	5/-	7Y4	10/-	59	10/-
1V	8/-	6J5	7/6	8A1	11/6	32	8/6
2A6	9/6	6J6	12/-	8D2	11/6	33	9/6
2A7	11/-	6J7	8/6	8D2	6/6	35	9/6
2X2	6/6	6K6	10/6	12AL5	8/-	35L5	10/6
3D5	9/-	6K7	8/6	12AT7	10/6	35Z4	11/-
3S4	10/-	6K7/M	9/6	12J6	6/6	35Z5	12/6
5U4	10/6	6K8	11/6	12SH7	8/6	84	6/24
5X1	12/-	6L5	7/6	12SA7	10/6	84	8/6
5Z3	11/-	6L6	11/6	12SHT	8/6	84	6/24
5Z4	10/6	6N7	11/-	12SJ7	9/6	117Z6	8/6
6A6	9/-	6Q7	12/6	12J7	11/6	117N7	17/-
6A8	12/6	6R7	7/6	12K7	11/6	210L6	6/6
6AB7	2/-	6R7/M	7/6	12SK7	10/-	805	30/-
6AC5	9/-	6SA7	9/6	12SL7	12/-	807	9/6
6AC7	8/6	6SG7	9/6	12SQ7	10/-	866A	9/6
6AG5	9/6	6SH7	8/-	12SR7	9/-	854	5/6
6AL5	9/6	6SJ7	9/6	12Y4	9/6	853	6/6
6AK6	9/6	6SK7	9/6	12AX7	9/6	856	6/6
6AM6	11/-	6SL7	11/6	14F6	10/-	1299A	8/-
6AQ5	9/6	6SN7	11/6	25AC5	6/6	1625	9/6
6AT8	10/-	6SS7	8/-	25Z4	9/-	1623	9/6
6B4	9/-	6TH8	9/6	25Z5	10/-	7193	6/6
6B7	11/-	6U7	9/6	62BT	14/6	9004	7/6
6B8	10/6	6V6	10/-	71A	9/6	9005	7/6
6BA5	11/6	6ZY5	10/-	72	10/6		
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**SALE**  
2000 VALVES  
BRITISH, AMERICAN, A.C. AND UNIVERSAL TYPES.  
All fully vacuum sealed  
FROM 2/-

### DEMORBED 2/6 VALVES MANUAL

Giving equivalents of British and American Service and Cross Reference of Commercial Types with an Appendix of B.V.A. Equivalents and Comprehensive Price List. We have still some Valves left at very old Budget Rates (33%), which are actually sold at the old price. (1951 rate.)

9" TUBE CRT 516 Manegtic 4 v. heater. 4 to 5 kv. E.H.T. Int. Octal Base. BARGAIN. Carr. and Crate. 4/6. 29/6

**TAYLOR METERS on EASY TERMS**  
Ask for Catalogue

**B.T.H. GERMANIUM CRYSTAL DIODE.** Complete with Blueprint and operating instructions. 2/-.

**ROD ANTENNAS.** 1ft. sections interlocking and extending. copper plated steel. BARGAIN. Dozen 2/6.

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**SERVICE SHEETS**  
The one you require enclosed if available in a dozen assorted of our best choice. 10/6.

### RADIO BULLS VALVES

**PIFCO**  
All-in-one Radio-meter A.C.D.C. Tests everything in Radio. Complete with Test prods.  
29/6 Post 1/6.

### Q-MAX

**Chassis Cutters with Keys**  
The easiest and quickest way of cutting holes in sheet metal. The cutter consists of three parts: A die, a punch and an Allen screw. The operation is quite simple. Prices incl. key: 1/2in., 12/4; 1in., 12/4; 1 1/2in., 13/4; 1in., 14in. and 1 1/2in., 16/- each; 1 1/2in. and 1 1/2in., 18/- each; 1 1/2in., 19/9; 2 3/8 in., 31/9; 2 1/2in., 36/9; 1in. square, 24/3. Post 1/-.

### 7/6 REDUCED FROM 21/-

Pre-heated Electric Soldering Irons. 24 v. 36 Watts. Pressure button switch fitted. Corrosion-free Bit. Specially designed for fine work. Limited quantity.

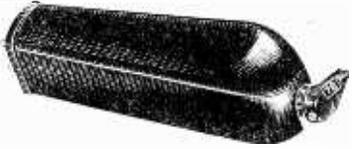
### EX-GOVT. LIGHTWEIGHT HEADPHONES

Brand new, in original boxes. Complete. 7/- a pair.

# Bring your equipment up-to-date with **ACOS** REPLACEMENT PICK-UP HEADS

If you already own a fine radiogram or record-player you now have the opportunity of rejuvenating it — of bringing it right up to date for a quite modest sum. Acos Hi-g crystal pick-ups are now available in a range of specially designed "plug-in" models to suit most famous makes of record reproducing equipment.

These Acos "Hi-g" pick-ups, you will find, represent a truly phenomenal advance in pick-up design — with regard to both reproduction and tracking characteristics (so important with many of the new microgroove recordings). Ask your Dealer!

MODEL		
HGP 37-1 Collaro		A Hi-g pick-up head incorporating the HGP 37-1 turnover cartridge with cantilever sapphire styli. Designed for both standard and microgroove records. Will fit Collaro units RC 532; AC 534; AC3/534; 3RC 532 and the Studio pick-up. Available in cream or walnut. <i>Ask for Data Sheet No. 4800.</i>
HGP 37-1 Garrard		A Hi-g pick-up head incorporating the HGP 37-1 turnover cartridge with cantilever sapphire styli. Designed for both standard and microgroove records. Will fit Garrard units RC 75M; RC 80M; RC 90; RC 111; Model TA. <i>Ask for Data Sheet No. 4800.</i>
HGP 39-1		Hi-g pick-up heads incorporating cantilever sapphire styli. Separate heads for standard and microgroove records. Will fit the Acos GP 20 pick-up arm and the Garrard C type adaptor. Used on the following units: RC 72A; RC 75A; RC 80; and the Model M unit. Can be used on any units which at present use the GP 19 heads. <i>Ask for Data Sheet No. 4400.</i>
HGP 35-1		Separate plug-in type Hi-g heads for standard and microgroove records; fitted with cantilever sapphire styli. The crystal unit is identical to that of the HGP 39-1 above. Can be used on Garrard units RC 75M; RC 80M; RC 90; RC 111; and the TA player. <i>Ask for Data Sheet No. 4000</i>
HGP 41-1		Separate Hi-g plug-in type heads for standard and microgroove records incorporating the crystal unit as used in the HGP 39 pick-up head. Will fit Collaro units RC 532; AC 534; AC3/534; 3RC 532. Available in cream or walnut. <i>Ask for Data Sheet No. 4500.</i>
HGP 45		Separate Hi-g pick-up heads for either standard or microgroove records. The crystal unit is identical to that used in the HGP 39-1 head. Will fit Garrard units RC 80; RC 72A; RC 75A; and the Model M player. Can be used on any unit which at present uses the Garrard C adaptor with GP 19 heads. <i>Ask for Data Sheet No. 4600</i>



*... always well ahead*

**PRICE 32/6 (PLUS 10/5 P.T.)**  
for all types except HGP 39 models which are  
**32/- (PLUS 10/3 P.T.)**

*ACOS devices are protected by patents, patent applications and registered designs in Great Britain and abroad.*

**COSMOCORD LIMITED ENFIELD MIDDLESEX**

# PRACTICAL WIRELESS

EVERY MONTH

VOL. XXXI, No. 582, APRIL, 1955

COMMENTS OF THE MONTH

EDITOR: F. J. CAMM

23rd YEAR  
OF ISSUE

BY THE EDITOR

## ADVANCES IN TAPE RECORDING

THE advance of interest in tape recording in this country is shown by the fact that nearly 40 manufacturers are now marketing complete apparatus. In addition, one well-known recorder is available in kit form.

It is impossible to assess how many amateurs are interested in this subject to-day, but the number is large enough to sustain an association whose only interest is in sound recording, and it is a number which is growing week by week.

Radio, television and recording have allied interests, and it is understandable that large numbers of our readers are interested in all three. This journal and our companion journal, *Practical Television*, cover the three subjects very fully, from the amateur point of view, and our associated journal, *Practical Mechanics*, has also described the construction of an efficient tape recorder. These instructions have been reprinted in the *Practical Mechanics How-To-Make-It Book* (12s. 6d., or 13s. by post from the publishers of this journal).

At present, however, tape recorders are costly, whether purchased ready made or home built. The tape deck is the costly item, for it must be purchased as a unit, being outside the skill and workshop facilities of the average amateur. We refer to this matter now because we have received requests for a greater amount of space to be devoted to this subject. We, therefore, invite readers who are interested in the subject to submit their views so that the matter may be given consideration. As a footnote, in addition to firms supplying complete recorders, nearly 30 others supply tape and accessories. There can be little doubt that recording has given rise to another absorbing hobby.

## ABOUT CLUBS

A CONTRIBUTOR has, in recent issues, dealt with the subject of clubs and the way in which they are run. His remarks have evoked a large amount of correspondence, mostly from members of particular clubs, some expressing satisfaction with their organisations and the way they are run, whilst others state that they had not given the matter a thought until the spotlight was turned on to the subject in this journal.

We have always encouraged the formation of local radio clubs, which are purely domestic

affairs whose finances are within the knowledge of every member. The membership of such clubs is always comparatively small, the subscription low, and in every case annual general meetings are held at which the officers are elected for the following year. When, however, a club is launched on a national basis the position is vastly different. The members are widespread and for many of them the only contact they have with headquarters and other members is through the club magazine, usually a duplicated affair.

In such cases it is even more important that the club, association or league should be run on accepted lines and account to its members each year for its activities, revenue and expenditure. Also, it is vital that annual general meetings be held to afford members an opportunity, if necessary, of criticism and of appointing fresh officers. If such clubs were run on the lines of the R.S.G.B. no criticism could arise.

When, however, a group of people form a club and become the proprietors of it, it ceases to be a club and becomes an ordinary business undertaking. Some correspondents suggest that an independent audit is unnecessary. Why? It allays any possibility of suspicion that the club is being run for private gain.

A member of a club should have a right to a say in the conduct of its affairs, since every member *jointly and severally* is responsible in law for any costs and damages awarded against it.

Legal advice should always be sought before founding any club which appeals for subscriptions or donations. Our only interest in this matter is to protect our readers against possible exploitation, and without wishing to impugn any particular organisation.

It is for this reason that we have to reassure ourselves as to the standing of any particular club, and the manner in which it conducts its affairs before we can publish any notices concerning them in this journal.

Readers who join particular clubs as a result of notices we publish are entitled to presume that all clubs are *bona fide*, and we therefore have a duty to protect them.

We have already published in this journal the details we require before we can publish any club notices herein. We are not, of course, referring to long-established organisations.

—F. J. C.



# Round the world of WIRELESS



## 300 Members

THE Mobile Radio Users' Association now has a membership of about 300, this number being 75 per cent. of land users of mobile radio.

## Broadcast Receiving Licences

THE following statement shows the approximate number of broadcast receiving licences issued during the year ended December, 1954. The grand total of sound and television licences was 13,872,633.

Region	Number
London Postal	1,502,332
Home Counties	1,436,842
Midland	1,180,153
North Eastern...	1,553,937
North Western	1,202,591
South Western	974,028
Wales and Border Counties	608,216
Total England and Wales	8,458,099
Scotland	1,039,152
Northern Ireland	219,393
Grand Total	9,716,644

By "QUESTOR"

## Talks Producer

MR. WALTER TAPLIN joined the temporary staff of the BBC on January 17th as a Talks Producer in Home sound programmes.

## BBC Commissions Concerto

DR. EDMUND RUBBRA has accepted a commission from the BBC to write a concerto for piano and orchestra for performance in the BBC Symphony Orchestra's 1955-56 Winter Season of Symphony Concerts.

## Export Record

PROVISIONAL figures issued by the Radio Industry Council reveal that radio equipment exports in 1954 reached a new high level.

The total value of exports last year was £29,100,000, 12 per cent. more than the value for 1953. Britain's best customer was Hol-

land—it was Sweden the previous year—and Canada was second best. Sales to the United States were worth more than £580,000, an increase of £140,000.

## Obituary

IT is with regret that we announce the death of Mr. Eric Dare, general manager of Mullard Australia Proprietary, Ltd. He died suddenly at the end of December, at the age of 56.

Mr. Dare was a well known and popular figure in Australian radio circles. His active interest in radio dates back as far as 1924 when he started a daily wireless newspaper.

## Gee System Lectures

A SHORT series of three lectures on the Gee system of navigation was delivered recently to the Derby and District Amateur Radio Society by Mr. G. M. C. Stone, of A. C. Cossor, Ltd.

The lectures covered both ground and airborne Gee and were supplemented by films. Mr. Stone also described its use in wartime.

## V.H.F. Radio for Newcastle Corporation

FIVE tower wagons and a maintenance van belonging to the Newcastle Corporation have been equipped with mobile V.H.F. two-way radio and a main control station set up at the Corporation headquarters.

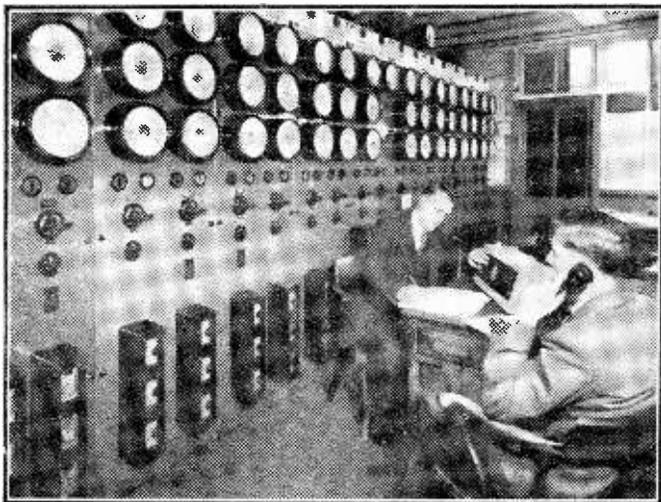
The tower wagons are responsible for the maintenance of the street-lighting installations and trolley-bus overhead lines throughout 40 miles of streets in Newcastle.

The radio equipment, which was supplied by The General Electric Co. Ltd., was introduced to facilitate repair work.

## Princess Royal to Open Show

H.R.H. THE PRINCESS ROYAL has consented to open the North Radio Show, City Hall, Manchester, on Wednesday, May 4th.

All space in the exhibition has been taken and the exhibitors include the leading manufacturers of radio and television receivers. The



The electrical control room in the Newcastle Corporation headquarters. Any electrical faults that occur in the city streets are telephoned to this office. The engineer-in-charge then calls one of the tower wagons by V.H.F. radio and directs it to the fault.

organisers, the Radio Industry Council, are to build a studio within the exhibition from which the BBC will broadcast sound and television programmes. The show closes on Saturday, May 14th.

**Change of Address**

**BRITISH INSULATED CABLE LENDER'S CABLES, LTD.**, announce that the new address of their London sales office is 10-14, White Lion Street, London, N.1. The telephone numbers are **TERminus 8696** and **0372**.

The company's central administrative offices remain at 21, Bloomsbury Street, London, W.C.1.

**British Institution of Radio Engineers**

**T**HE following meetings of the Institution will be held during March :

*London Section.* — Wednesday, March 30th, 6.30 p.m., at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1. Discussion meeting on "The Maintainability of Service Equipment."

*North-eastern Section.* — Wednesday, March 9th, 6 p.m., at Neville Hall, Westgate Road, Newcastle-upon-Tyne. "The Application of Negative Feedback to Electrical Measuring Instruments"—F. J. U. Ritson.

*West Midlands Section.* — Wednesday, March 9th, 7.15 p.m., at Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton. "Electrical Standards in Electronics"—P. M. Clifford.

*Scottish Section.* — Thursday, March 10th, 7 p.m., at the Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow. "Computing Circuits in Flight Simulators"—R. A. Marvin, B.A.

*North-western Section.* — Thursday, March 31st, 7 p.m., at the Reynolds Hall, College of Technology, Sackville Street, Manchester. "Electronic Control of Industrial Production Processes"—J. A. Sargrove. To be followed by the A.G.M.

**Singapore's First Radio-taxis**

**SINGAPORE'S** first radio-controlled taxicabs have recently appeared on its busy streets. A local firm, Radio Taxis Ltd., is installing Marconi mobile V.H.F. sets in its large fleet of vehicles.

About 25 of these taxis have been fitted with two-way radio so far,

and the operating company has already found that the system results in a great saving of time and expense.

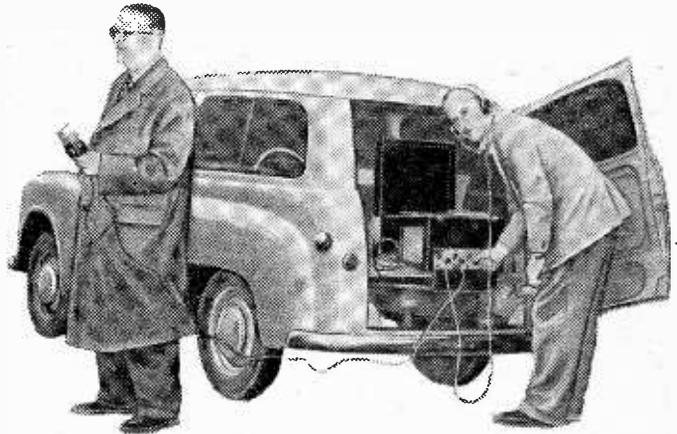
**E.M.I. Purchase Shares**

**T**HE directors of E.M.I., Ltd., have entered into a contract to purchase the majority of the 476,230 common shares of Capitol Records, Inc., of California, at the price of 17.50 dollars per share, and are offering to purchase the balance

Now mobile radio is to be adopted by hospitals in the northern part of Bedfordshire at an approximate cost of £4,011.

**Concern Over Welsh Reception**

**I**N reply to questions put to him in the House of Commons recently, Mr. L. D. Gammans, Assistant Postmaster-General, has stated that the BBC is well aware of the bad reception of the Home Service by Welsh listeners and is



For covering outside assignments, J. R. (sound) Reproductions of South Croydon, Surrey, have converted this Hillman Husky into a compact mobile recording unit.

of the common shares at the same price.

Treasury consent to the provision of the necessary dollars has been obtained.

**Mr. Bernard Moore**

**MR. BERNARD MOORE** has been appointed head of the BBC Colonial Service, the position which was formerly held by the late Mr. Grenfell Williams.

The appointment took effect from January 24th.

**ITMA Writer Opens Shop**

**MR. TED KAVANAGH**, who used to write the scripts for "ITMA," opened a radio shop in Southampton recently.

**Ambulance Economy**

**A** TRIAL period of thirteen weeks in Bedfordshire showed that the fitting of two-way radio to ambulances and hospital cars enabled 1,039 more patients to be carried to and from hospitals and that, in doing so, 2,428 fewer miles were covered compared with the same period in 1953.

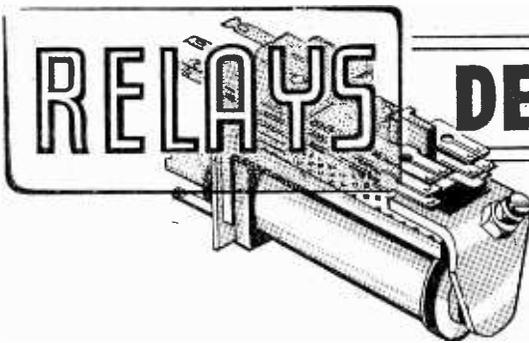
doing its best to find an answer to the problem.

Most of the interference is caused by a station in the Soviet zone of Germany that operates on the same wavelength and efforts to stop this have had negative results. Welsh Members of Parliament have asked whether Welsh listeners need pay the full licence fee in view of the poor service received.

**"Housewives' Choice" Anniversary**

**O**N March 4th, "Housewives' Choice" celebrated its ninth birthday. When the first programme went out in 1946 it was presented by Robert MacDermot and organised by Pat Osborne.

After some years on other programmes, Pat Osborne is once more working on "Housewives' Choice." Before the first edition was broadcast, she wondered whether there would be enough requests from housewives to keep the series going, but the announcement of the special programme brought in a flood of requests that has shown no sign of drying up.



# DESIGN & USES

THE SECOND ARTICLE IN A NEW SERIES DEALING WITH A MOST USEFUL TYPE OF RADIO ACCESSORY

By J. R. Davies

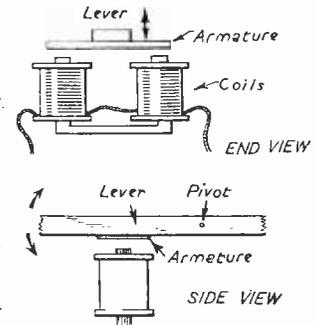
**A**LTHOUGH the relay works at relatively high speed (up to approximately 20 words a minute), its contacts travel through a distance of nearly half-an-inch each time it energises. This large degree of movement enables aerial switching to the transmitter and its associated receiver to be carried out each time the key is pressed or released.

Fig. 7 (a) shows the armature and coils of the relay. It will be noticed that the armature consists of two "leaves" these being inclined to each other. The "leaves" are pivoted at their junction.

The energising circuit of the relay is shown in Fig. 7(b) which illustrates also the position of the armature when the key is raised. This diagram includes one of the relay contacts as well, this contact making when the relay is in the "key-up" position (as it is in Fig. 7(b)). It will be seen also from this diagram that, until an energising voltage is applied to one of the coils, the armature and the contact bar are free to move on their common pivot. When the relay is used, as in the T1154, no energising voltage appears until the transmitter L.T. (6 volts D.C.) is switched on, whereupon coil A becomes energised and the armature takes up the position shown in the diagram. On pressing the key, coil B becomes energised. So also does coil C, the voltage appearing across this coil via the contact of the relay. Coil C is so wound that it sets up a magnetic field opposite in polarity and stronger than that of coil A. This new field causes that leaf of the armature adjacent to coil A immediately to be repulsed; this repulsion is due to the fact that the polarity of the core around which coil C is wound is now the same as that presented to it by the residual magnetism remaining

in the armature. This repulsion then assists and speeds the armature in swinging over to the already energised coil B. After the armature has swung sufficiently far, the relay contact breaks and coil C becomes de-energised. The armature, however, completes its movement and takes up the position shown in Fig. 7(c). It is, of course, necessary to de-energise coil C as soon as it has completed its task of starting the armature moving, since otherwise it would prevent or delay coil A from pulling the armature back again when the key is raised.

Fig. 6—A simplified diagram showing the armature and coil arrangement of a non-polarised relay capable of working at fairly high speeds. The lever to which the armature is attached may be made of any material. Contacts and springs, etc., may be fitted to the lever on either side of the pivot.

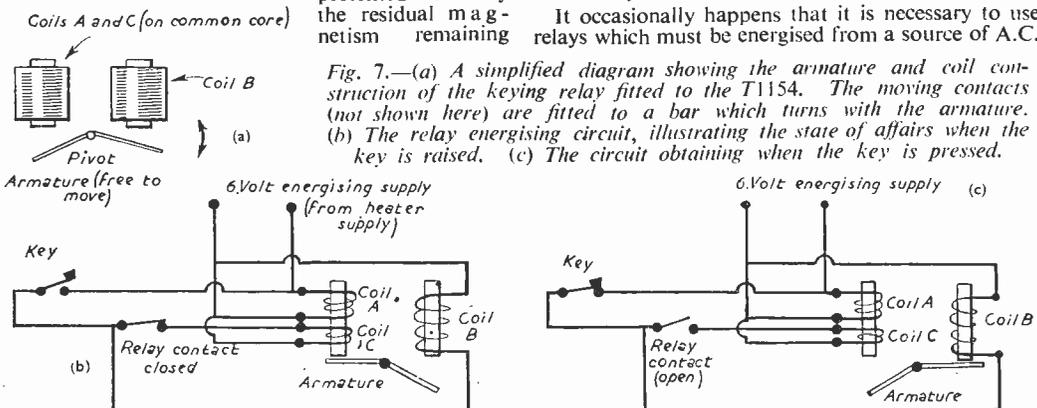


To prevent too much sparking at the key, resistors are connected in series with coils B and C. These resistors have been omitted from Figs. 7(b) and (c) for purposes of simplicity.

## A.C. Relays

It occasionally happens that it is necessary to use relays which must be energised from a source of A.C.

Fig. 7.—(a) A simplified diagram showing the armature and coil construction of the keying relay fitted to the T1154. The moving contacts (not shown here) are fitted to a bar which turns with the armature. (b) The relay energising circuit, illustrating the state of affairs when the key is raised. (c) The circuit obtaining when the key is pressed.



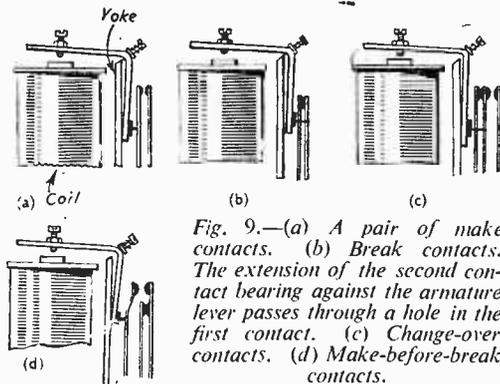


Fig. 9.—(a) A pair of make contacts. (b) Break contacts. The extension of the second contact bearing against the armature lever passes through a hole in the first contact. (c) Change-over contacts. (d) Make-before-break contacts.

As may be appreciated, this gives rise to certain difficulties, since the magnetic attraction holding the armature to the core of such a relay would be continually altering.

A common method of overcoming this trouble is shown in Fig. 8. This diagram illustrates the end of the core which is nearest to the armature, the latter having been omitted for purposes of clarity. What is known as a "shading coil" is fitted to half of the face of the core. The shading coil is simply a single short-circuited turn of heavy copper.

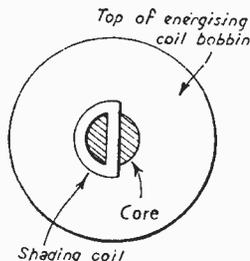


Fig. 8.—Top view showing how the shading-coil is inset into the core of an A.C. relay.

When the energising A.C. voltage applied to the relay core drops to zero at every half-cycle, the shading coil opposes the cessation of the field within the shaded area of the core. This shaded area, therefore, holds the armature down during the time when the rest of the core affords no magnetic attraction. Thus the armature is continually held against the core over the entire A.C. cycle and does not

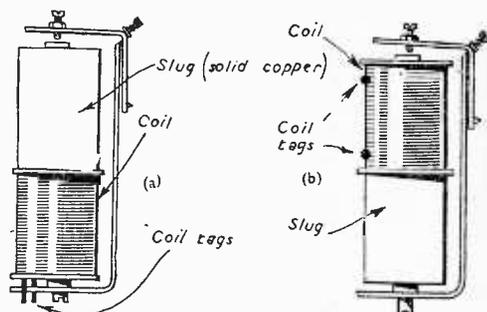


Fig. 10.—(a) A relay fitted with a heavy slug at the armature end of the coil. (b) A relay with the slug fitted to the heel end of the core.

"chatter" or vibrate in sympathy with the energising A.C. as would otherwise be the case.

A.C. relays usually employ a laminated, instead of a solid, core.

**Contacts**

Up to now we have discussed in some detail the construction and design of the more common relays likely to be encountered in radio work. Our next step consists of considering the various types of contact unit which may be used with these relays. (The term contact unit refers to a group, or set of two or three contacts, one of which is moved by the armature. Each unit is similar to a single-pole switch. A single relay may operate as many contact units as can reasonably be fitted to it.)

Fig. 9 shows four contact units, these being the most representative types likely to be met. For convenience, they are illustrated as though they were fitted to the conventional type of relay which was illustrated in Fig. 1.

Fig. 9(a) shows two contacts which are pushed together when the relay energises. These are known as "make" contacts.

Those of Fig. 9(b) carry out the reverse process and are called "break" contacts. Fig. 9(c) shows a set of "change-over" contacts, while Fig. 9(d) illustrates a set of "make-before-break" contacts. Make-before-break contacts are not so common as

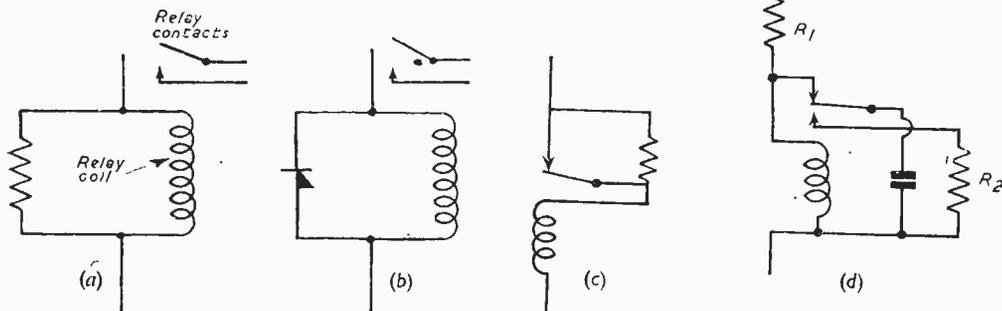


Fig. 11.—(a) Connecting a resistor across the coil of a relay to make it exhibit a slow to release characteristic. The resistor should have approximately the same value of resistance as that of the

coil. (b) Another relay circuit which gives a slow to release effect. (c) A relay that is quick to operate and release. (d) A relay which is made slow to operate only

are the other three types, but they are very useful in certain circuits where changeover contacts could not be used. The nomenclature and functions of the various types are simple enough to remember: each

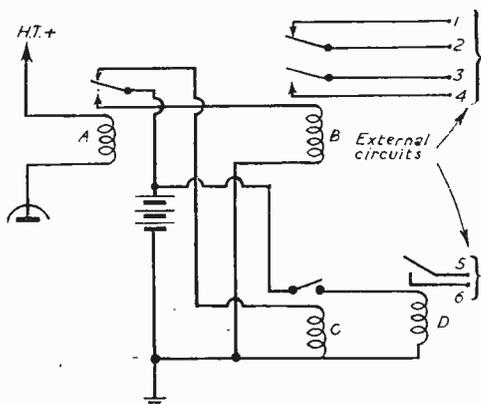


Fig. 12. — A relay circuit illustrating the attached method of presentation. Relay A is operated by anode current and its change-over contacts cause either relay B or relay C to be energised. Relay C, on energising, energises relay D. The contacts of relays B and D are used to switch external circuits via the terminals 1 to 6.

name describes the action carried out by the contact unit when the relay energises.

### Slugging

When we described the action of the shading coil of an A.C. relay above, we pointed out that this coil tended to oppose the change in magnetic flux given by the alternating energising voltage. This principle is often used with D.C. relays as well, its purpose being to slow down the speed with which the relay operates.

This slowing-down process is known as slugging, and instead of a small shading coil relatively large pieces of solid copper are used instead. These pieces of copper, called "slugs," are fitted around the core of the relay.

Fig. 10(a) shows a relay which is fitted with a heavy slug at the armature end of the coil. If desired, this slug could take up as much as half the winding space on the core, the remainder being left for the coil.

To understand the action of the slug let us imagine that a source of supply is about to be connected to the coil of the relay. As soon as this source becomes connected the coil immediately sets up a magnetic field. This field is opposed by the slug (by reason of the induced currents and consequent opposing field set up in it) and some time elapses before sufficient magnetic force can be built up to move the armature. When the energising voltage is removed from the coil the slug acts once more, this time opposing the collapse of the magnetic field. Thus, the slug causes the release of the armature to be delayed as well.

A relay constructed in this manner is described as being "slow to operate and release."

The relay of Fig. 10(b) operates in a slightly different manner. This time the slug is fitted to the heel end of the core. It will be found that, in this case, the slug does not delay the process of energising.

This is due to the fact that, when the relay becomes energised, there is sufficient attraction between the top of the core and the armature for the latter to move to the energised position. When the relay is de-energised, however, the slug opposes the breakdown of the field existing in the magnetic circuit formed when the armature moved over to the core. The de-energising of the relay is, therefore, delayed.

A relay of this type is described as being "slow to release." One occasionally hears the terms "slow to make-and-break" and "slow to break" used for the relays just described. These terms are incorrect and are liable to lead to confusion.

Alterations in the speed of working of normal relays can often be obtained by using external components, instead of relying on slugs fitted to the core.

Fig. 11(a), for instance, shows a relay which will exhibit a "slow to release" characteristic. On connecting the energising voltage, the relay energises normally, the resistor serving only to draw an additional current from the source of supply. When the energising voltage is broken, however, the resistor tends to short-circuit the coil, giving it something of the action of a slug. The main disadvantage with this circuit is the extra current needed when the relay is energised.

Fig. 11(b) shows a more efficient method. The rectifier across the coil is so connected that it does not conduct when the energising voltage is applied. When this voltage is removed, however, the collapsing magnetic field induces in the coil a voltage which is opposite in polarity, causing the rectifier to conduct and apply a partial short-circuit. This relay, therefore, exhibits a "slow to release" action also, without the disadvantage of requiring extra energising current.

By using the contacts of the relay itself, further alterations in performance may be obtained. Fig. 11(c) shows a typical example, this illustrating a relay which is made "quick to operate and release." At the instant of applying the energising voltage to the relay its break contacts are short-circuiting the resistor. Thus the full voltage appears across the coil and the relay energises quickly. However, as soon as it energises, the series resistor is brought into circuit and the voltage across the coil drops to a value that is just sufficient to hold the armature against the core. Thus, on removing the energising voltage, it is necessary for only a small magnetic field to collapse, and the armature releases more quickly than it would otherwise have done. Incidentally, this circuit allows the initial energising voltage to have a much higher value than would normally be required by the relay, thereby speeding up the process of operating still more.

### Circuit Diagrams

An interesting and unconventional circuit is shown in Fig. 11(d). This time the relay is "slow to operate." When the energising voltage is originally applied the relay is shunted, via its change-over contact, by a capacitor. Due to the series resistor, R1, the capacitor takes some time to charge up, and the energising of the relay is correspondingly delayed. Once energised, the change-over contacts are actuated, causing the capacitor to be disconnected from the relay coil and connected to another resistor, R2, through which it discharges. When the energising voltage is removed, the armature releases normally.

A relay circuit diagram is usually drawn in one of two ways, the choice being made according to the

complexity of the circuit and, to a small extent, with a view to the person who will be using it.

The method chosen for simple relay diagrams uses what is known as the "attached" circuit. An example of the "attached" circuit diagram is given in Fig. 12. As may be seen, this diagram shows all relay contacts as being in line with their energising coil. This type of circuit diagram is often used for simple arrangements, in which form it presents a circuit that is easy to visualise. It is often used in radio diagrams which include only one or two relays.

The other system is known as the "detached" circuit diagram. Using this interpretation, relay coils are represented as solid blocks, and their contact units are inserted in any convenient position in the diagram. In a complicated circuit, a relay contact unit may appear at the opposite end of the diagram from its coil. The detached circuit diagram is, perhaps, a little disconcerting at first to the uninitiated, but one soon gets used to it.

An example of a detached circuit diagram is shown in Fig. 13. It will be seen that each coil is designated with a letter and a figure, such as, for example,  $\frac{B}{2}$ .

The letter identifies the relay, whilst the figure indicates the number of contact units on that relay. The contact units spread around the diagram are then labelled with the letter of the relay, and their number. Thus  $\frac{B}{2}$  relay has two contact units—B1

and B2, these appearing in their appropriate places in the diagram. The contact units are usually numbered in the order in which they are mounted on the relay itself, No. 1 contact unit being that nearest the yoke. When two banks of contacts are fitted, contact unit No. 1 is that nearest the yoke on the left, No. 2 that nearest the yoke on the right, No. 3 the next out on the left, and so on. The left and right directions are obtained when looking at the underside of the relay with the core below the contacts.

## G.E.C. Radio Compass

THE G.E.C. radio compass, developed in close collaboration with the Royal Aircraft Establishment to a Ministry of Supply specification, is now available for civil aircraft. Designed especially for modern high speed aircraft and widely used in Service machines, it operates in conjunction with any ground transmitting station of known location operating in the frequency band 150-1,500 kc/s. It is used to determine the aircraft's position and course, and also for homing an aircraft on a transmitting station, the bearings being supplied by the instrument. The instrument also provides normal radio reception facilities in the medium waveband.

The complete equipment comprises a receiver, a loop assembly, a desiccator, two control boxes, a junction box, two indicators and a cathode follower unit, the total weight being about 74lb. One of the indicators incorporates a compass and is driven by a repeater from the gyro compass, enabling bearings to be related direct to North.

There are four facilities, all controlled from a service switch on the control boxes.

When the switch is tuned to "Nav.," A.V.C. is replaced by full-range manual control on both R.F.

It is important to remember that contacts illustrated in detached circuit diagrams are always shown in their de-energised positions. In the very occasional cases where this rule is not observed, the energised relays are named in a prominent place in the diagram.

A further simplification shown in Fig. 13 consists of the use of separate "sources of supply" and earth

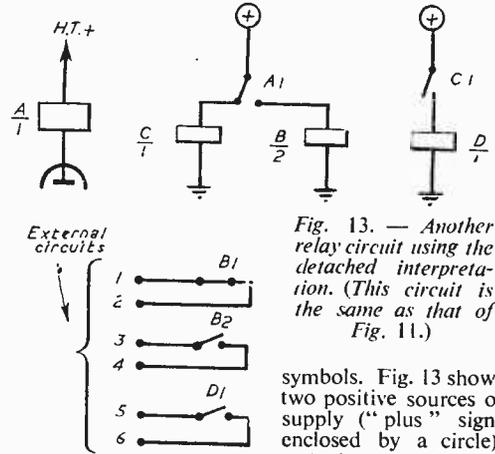


Fig. 13. — Another relay circuit using the detached interpretation. (This circuit is the same as that of Fig. 11.)

symbols. Fig. 13 shows two positive sources of supply ("plus" signs enclosed by a circle), and three earth symbols, these being used for two separate relay circuits. In practice, the positive sources of supply are obtained from the same point. Negative sources of supply may also be used.

It helps considerably, when studying a complex relay circuit, to try to visualise the action of each particular circuit by starting at its "source of supply" end and carrying through to the earth connection.

Up till now we have used the attached method of representation in these articles. Next month, when we show some circuits which are particularly applicable to radio, we shall commence to use detached circuit diagrams. (To be continued)

and I.F. amplifiers. This arrangement with the note filter switched in is provided specially for use with medium frequency ranges or track guides which are tone-modulated at approximately 1,000 c/s with polar diagram keying to give an equi-signal track with interlocking A—N off-course signals.

Turning the service switch to "A.D.F." brings into use the electronic loop switching circuits and servo mechanisms for automatic loop positioning, there being no ambiguity as to the sense of the bearings indicated. A.V.C. operates on this facility and a separate A.V.C. line is provided for the loop amplifier while manual volume control operates on the A.F. amplifier only. The compass provides reliable bearings on field strengths of 50 microvolt/metre, though in taking bearings on weak signals the receiver should always be carefully monitored by the telephones. A "No Signal" indicator is provided which confirms to the user that the signal on which he is homing is still being transmitted.

When the service switch is turned to "Loop" the sense aerial is eliminated and reception is on loop with full range R.F. manual volume control. Loop rotation is by variable speed reversible manual control and both note filter and heterodyne oscillator will be in use on weak signals.

# AMPLIFIER DESIGN

## 13.—TUNED AMPLIFIERS

By R. Hindle

(Concluded from page 146, March issue)

### Selectivity

**I**N addition to increasing the gain an increase in  $Q$  of a tuned circuit improves the selectivity as is shown in Fig. 52. The simplest way in which  $Q$  can be increased to take advantage of the increased gain and selectivity is by introducing positive feedback deliberately up to very near to the instability level. This is exactly what reaction is, and it is a very useful arrangement for a simple receiver giving quite appreciable R.F. gain, in effect. It will be seen, however, that bandwidth is severely restricted thereby, and it is hardly the measure to adopt for a quality receiver.

Similar results are achieved by using a number of tuned circuits in cascade, i.e., one after the other, and Fig. 53 gives curves for from one to four such circuits. It is assumed that the coupling used between successive circuits is in one direction only, such as is the case if there is a valve between circuits. Where circuits are coupled together inductively or by capacitance the operation is modified.

### Transformer with Tuned Primary and Secondary

The transformer as dealt with above was tuned at the secondary only, but a transformer can also be tuned both primary and secondary and on the face of it this could be looked upon as two separate tuned circuits in cascade (i.e. one following the other) but a moment's reflection will show that the coupling in the case of a transformer is not unidirectional as is required for circuits to be considered as working in cascade. It is necessary for cascaded tuned circuits that the energy be transferred from the first to the second circuits, but not in reverse from the second to the first, and the common method of coupling visualised for this method is via a valve.

*The Conclusion of A Series of Articles Dealing with the Theoretical Considerations of Amplifier Design, both R.F. and A.F.*

Inductive coupling in the transformer, however, is just as effective from second to first tuned circuit as in the forward direction and the cumulative effect shown in Fig. 53 cannot necessarily be applied.

The exact effect achieved by the tuning of both primary and secondary depends on the degree of coupling and where this is of a low order the shape of the secondary response curve is, in fact, very similar to that obtaining with one-way coupling between two such circuits, i.e. the selectivity is increased and the peak of the response narrowed and sharpened. The primary response, on the other hand, is much as though the secondary did not exist and the response is almost identical with that given by a single tuned circuit with similar  $Q$ . Curve 1 of Fig. 54 indicates the secondary circuit response for a low coefficient of coupling. As the coupling is increased the secondary current grows in amplitude and takes on a flattened peak and the degree of coupling at which the amplitude of current reaches its maximum and exhibits a maximum width of flat top is called the "critical coupling." This condition is given at curve 2 in Fig. 54. A further increase in coupling has no effect on the peak amplitude of the secondary current but is seen to result in the breaking up of the response into two separate peaks, and the greater the coupling above the critical value the wider apart are the peaks and the more pronounced the trough between. Curve 3 of Fig. 54 indicates the condition where  $k$  slightly exceeds the critical value and curve 4 where  $k$  is three times the critical value and it will be seen that the claim that peak amplitude does not change for over-coupling is verified.

### Reason for Double-peaking

This break-up into double peaks is due to the

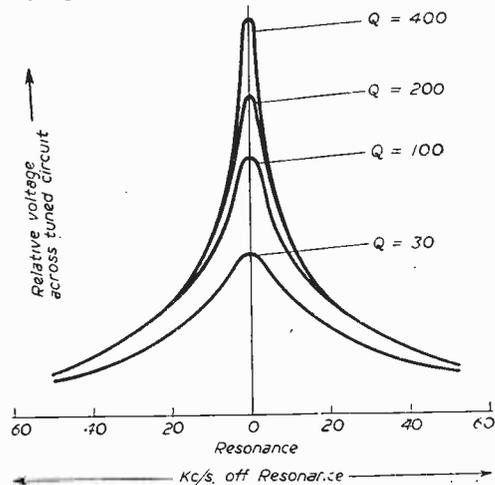


Fig. 52.—Effect of  $Q$  on selectivity.

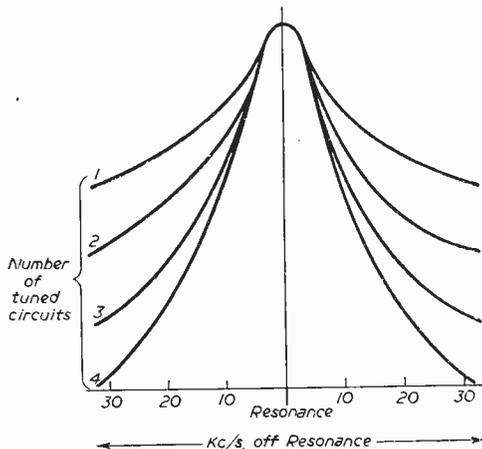
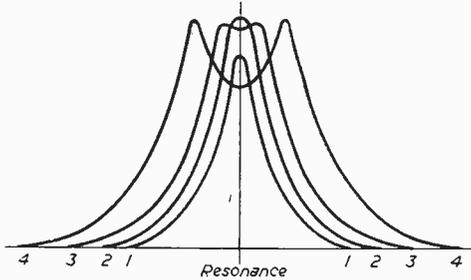


Fig. 53.—Effect of tuned circuits in cascade.

nature of the impedance coupled into the primary from the secondary. At resonance the reflected impedance is a pure resistance and this, being effectively in series with the primary impedance, reduces the Q of the primary and so reduces the response



Curve 1.... $K = 0.5 \times$  Critical value    Curve 2... $K =$  Critical value  
 Curve 3.  $K = 1.5 \times$  " "            Curve 4.  $K = 3 \times$  " "

Fig. 54.—Secondary response curve for various degrees of coupling ( $Q_p = Q_s$ ).

of the circuit at the exact frequency of resonance. This results also in a reduction in the voltage induced into the secondary at this frequency. The tighter the coupling the more effective is this damping of the primary by the secondary, and consequently the reduction of the secondary voltage at resonance is greater; hence the trough. To a frequency slightly above resonance, however, the secondary circuit capacitance has a reactance lower than that of the secondary inductance and therefore it draws the greater current. The secondary circuit as a whole, therefore, now exhibits the net characteristics of a capacitance, and it is a partially capacitive load that is reflected into the primary. Now in the primary the reflected secondary load appears as though it were in series with the primary components, and so the reflected capacitance appears there in series with the primary capacitance, effectively reducing it (two capacitances in series, the reader will remember,

are less than either capacitance alone). This produces in the secondary a resonance effect to a frequency higher than that to which the primary alone is tuned. Where the shift in frequency of response in this way is equal to the displacement of natural resonance (of the primary alone) of the frequency causing the effect, the primary response is greater, and the signal passed to the secondary is greater, than at the natural resonance of the individual circuits. This accounts for the displaced peak at a frequency above that to which the circuits are tuned.

By a similar argument the fed-back impedance at a frequency slightly lower than resonance is inductive and this, in series with the primary inductance, increases the effective inductance and lowers the primary frequency of response, causing a peak at the lower frequency.

The above discussion has been in terms of primary current whereas generally a voltage is required to drive the next stage but, of course, the current produces a voltage across the capacitance of the secondary, Ohm's Law determining the amplitude, and this voltage is thus proportional to the current flowing.

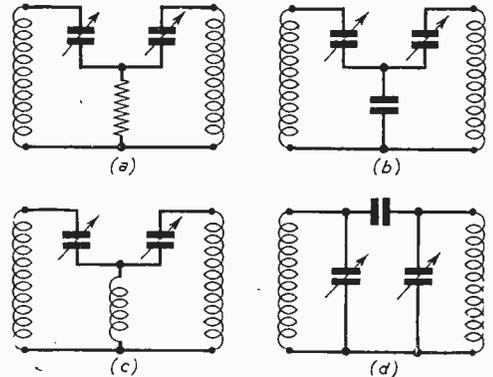


Fig. 55.—Alternative coupling methods.

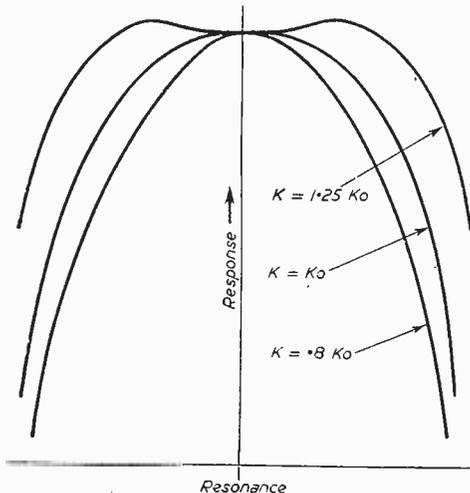


Fig. 56.—Response for K values centred round the critical value ( $K_0$ ).

**Critical Coupling**

The degree of coupling permissible without the break-up into double humps, i.e. the critical coupling, depends on the quality of the tuned circuits and is given by

$$\text{Critical coupling } (k_0) = \frac{1}{\sqrt{Q_p Q_s}}$$

where  $Q_p$  is the Q of the primary circuit,  $Q_s$  is the Q of the secondary circuit; when the two circuits have the same Q  $k_0$  becomes  $\frac{1}{Q}$ . The

similarity of tuned circuits used in the transformer is assumed when stating that double-humping occurs when the coupling exceeds the critical value as previously defined; if the Q's are different a somewhat greater degree of coupling is required to give the double hump.

**Staggered Tuning**

The frequency band passed by a transformer tuned at both primary and secondary can be increased by staggering the tuning so that one is tuned slightly above and the other slightly below the centre frequency required. The effect of this is, in practice,

equivalent to an increase in the coefficient of coupling and is (assuming equal Q's) as though  $k$  had been increased to a value equal to

$$\sqrt{k^2 + \left(\frac{\Delta}{f}\right)^2}$$

where  $k$  is the coefficient of coupling actually used ;  
 $f$  is the wanted middle frequency of the pass-band and so the frequency midway between the frequencies to which the tuned circuits are tuned.

and  $\Delta$  is the difference between the resonant frequencies of the two tuned circuits.

Generally, transformers used by the constructor have fixed coupling and so it is useful to know that the effect of tighter coupling can be simulated by staggering.

#### Methods of Coupling

Throughout the above discussion mutual inductance has been considered as the medium coupling the two circuits, but other methods are practicable. Fig. 55 gives various alternatives, indicating that any impedance common to the two circuits will serve as a

coupling impedance. The larger the impedance (i.e., the larger the resistance or inductance but the smaller the capacitance) the greater is the coupling. An alternative is "top-end" coupling by virtue of a capacitance connected from one circuit to another as shown in Fig. 55(d). Here, the larger the capacitance the greater the coupling.

#### Bandpass Filter

A circuit set up so as to give a reasonably level response over a range of frequencies whilst discriminating against frequencies outside that range is called a band-pass filter, and it has been shown that this condition is not fulfilled in all mutually coupled tuned circuits (which are often quite erroneously styled as band-pass circuits), but only in those cases where a suitable degree of coupling is found between circuits of suitable Q. In general, the band-pass characteristic is obtained with two circuits of equal Q coupled together when the Q of each circuit is within the range  $\frac{1}{k}$  to  $\frac{1.5}{k}$ . The amount of coupling that is permissible to give a suitably flat characteristic also depends on the associated circuits.

## New Electronic Organ Employs Osram Valves

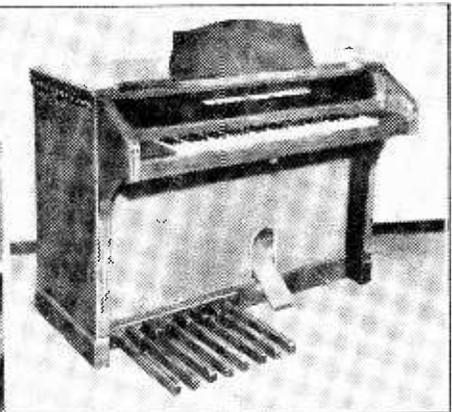
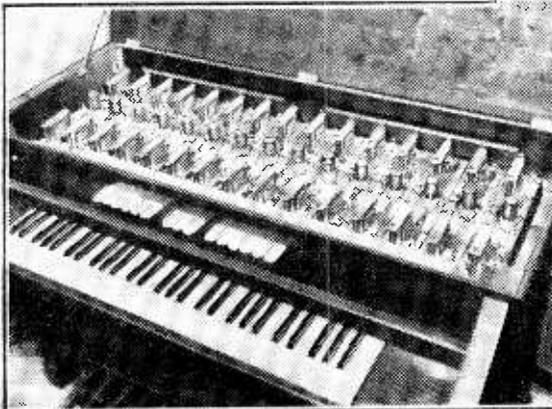
THE organ, which has been described as the most complex of all musical instruments, has tended in the past to be limited in its scope by the attendant expense. Henri Selmer, Ltd., of 114-116, Charing Cross Road, London, W.C.2, have recently, however, introduced a new electronically operated organ which markets at a much reduced price.

The Lincoln organ, as it is called, is the latest in a line of electronic musical instruments made by Henri Selmer, Ltd., and the experience derived from these is evident in the new instrument. It is silent in action, more responsive in speech than many pipe organs and free from mechanical complexities. Its performance is claimed to be acceptable even to the pipe organ purist and it measures only 4ft. by 2ft. 6in. by 3ft.

Each note can be tuned individually merely by rotating a knurled knob which varies the inductance in the oscillatory circuit, in which 15 Osram B65 valves are employed. Another B65 valve, in conjunction with an Osram L63 valve, forms the tremulant arrangement. A B309 valve acts as a shunt resonator,

an L63 as a bass oscillator. Two KT66 valves are used together with a Z729, a B65 and an L63 in the amplifier. Altogether 24 Osram valves supplied by the General Electric Co., Ltd., are employed in the organ circuit.

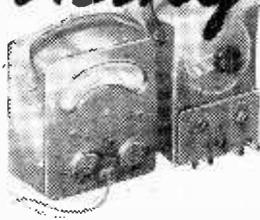
The organ has 15 stops in all, controlled by rocking-tablets. Six of these provide the main tone colours of the pipe organ which can be mixed to produce further tones. Three select the usual 4ft., 8ft. and 16ft. pitches, thus providing sub- and super-octave coupling. The remaining tablets control the bass and tremulant. Where extra volume is required the tremulant can be varied in both speed and depth. A solo stop is also provided which reduces the accompaniment and brings out the melody.



Two views of the Lincoln Organ.

Provision has been made for the addition of a tone chamber with its own booster amplifier (incorporating two Osram KT66 valves).

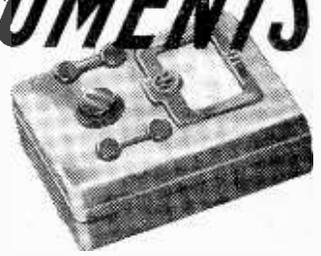
# Using TEST INSTRUMENTS



Part 4 of a New Series of Articles  
Dealing with the Practical Application  
of Standard Test Equipment

By Gordon J. King, A.M.I.P.R.E.

(Continued from page 186 March issue)



## Form Factor (8)

**C**URIOSLY, although our multi-range meter READS in R.M.S. values when it is used on A.C., it is not actually measuring R.M.S. voltages! We must remember, of course, that since a rectifier is used between the A.C. source and the meter, the meter will measure proportionally to the MEAN or average value of the RECTIFIED waveform, and not to the R.M.S. value of the source voltage.

Essentially, all universal multimeters employ a full-wave rectifier for A.C. measurements, which means that a sine waveform as in Fig. 12(a) will appear to the meter in the form of Fig. 12(b). It follows, then, that the meter needle will receive a push from zero to maximum when the A.C. is going positive, and a similar push when the A.C. is going negative—this is because the negative half-cycle appears to the meter as a positive pulse due to the action of the full-wave rectifier. Precisely the same effect occurs during the preceding A.C. cycles; so that for each full cycle of A.C., two positive half-cycles are applied to the meter.

Because each needle deflection due to the rectified A.C. begins gradually, builds up to a maximum, and then diminishes gradually, the meter will measure the mean value of the rectified waveform. Now it can be shown that the mean value of half a sine wave is  $2/\pi$ , or 0.6366 times its peak value. Therefore, a

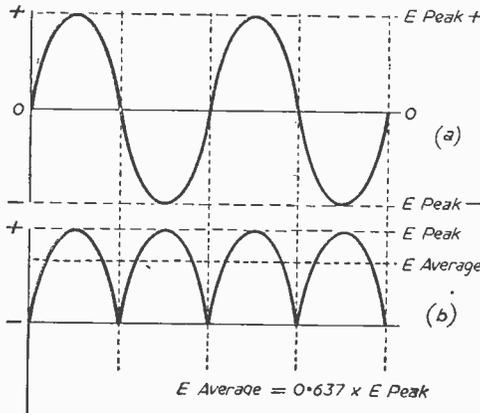


Fig. 12.—By reason of the full-wave rectifier in a universal multimeter the sine waveform at (a) will appear to the meter as in form (b). The meter will thus measure the average value of the rectified waveform.

meter connected through a full-wave rectifier to a sinusoidal A.C. source will measure 0.6366 times the peak value of the A.C., and not the R.M.S. value of the A.C., which, as we have already seen, is 0.707 times the peak value. Provided we are dealing with sine waves this discrepancy is of little consequence, for the meter is calibrated to READ the R.M.S. value, even though it is actually MEASURING in proportion to the mean value.

The ratio of the R.M.S. value to the mean value is termed the "form factor," and for SINE waveforms it is 1.11 (0.707/0.637). From this reasoning we can realise that a D.C. voltmeter connected through a full-wave rectifier to an A.C. supply would read 11 per cent. less than the R.M.S. value of the supply. This error is automatically catered for in universal multimeters by internal alteration of the circuitry on A.C. ranges—the switch does more than just bring in a full-wave rectifier, it adjusts the meter to READ 11 per cent. higher than the mean value, thereby corresponding to the R.M.S. value.

Although one may feel that all this theory is superfluous to the "Practical Application of Test Instruments," it is really necessary to understand as much as possible of it if we desire to interpret A.C. meter readings correctly, and if we expect our instruments to yield their utmost assistance.

The most important point to bear in mind is that on their A.C. ranges multi-range meters depend for their accuracy not only upon their initial calibration but also upon the maintenance of a sinusoidal waveform. They, therefore, READ R.M.S. values only on the assumption that the normal sine wave will be encountered. One should always recognise the possibility of some error when using distorted or non-sinusoidal waveforms where the form factor might deviate considerably from 1.11. For instance, squarish wave shapes incite high readings, and peaky ones low readings; a square wave, for example, has a form factor of 1, whilst a half-wave rectified triangular wave corresponds to a form factor of 1.63.

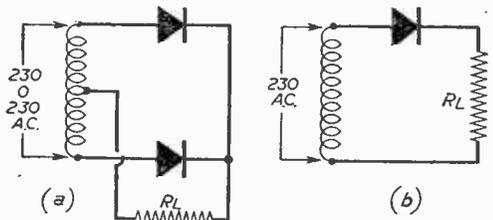


Fig. 13.—Simple full- and half-wave rectifier circuits at (a) and (b) respectively.

### Recognise the Effect of Unidirectional A.C. (9)

If we use a D.C. METER to measure the voltage existing across the output of a full-wave rectifier circuit (Fig. 13a), it is clear now, that the meter will measure the average value of the rectified waveform (Fig. 12b). Therefore, provided the rectifier is 100 per cent. efficient, and assuming the 230 volts R.M.S. is being applied to the rectifier, our D.C. meter connected across the rectifier load resistor RL will measure something like 207 volts— $(230 \times 1.414 \times 0.637)$ .

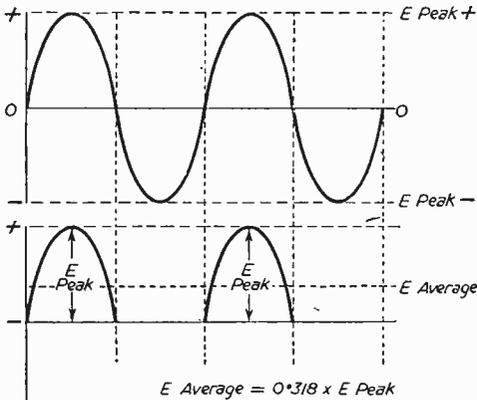


Fig. 14.—Showing that the average value of a half-cycle over the time of a whole cycle is half that of a full cycle.

Now let us consider a half-wave rectifier circuit (Fig. 13b). From this we know that the positive half-cycles of sine waveform drive current through the rectifier with little opposition, and thus give rise to half-cycle pulses of voltage across RL. On the negative half-cycles, however, the rectifier appears as a complete open circuit (assuming a perfect rectifier), so during these periods no output at all appears across RL: this effect is shown in Fig. 14.

We should have a good idea now that if we connect our D.C. voltmeter across RL of Fig. 13b, the rectifier of which also has a 230 volt R.M.S. input, our reading will deviate from that obtained across RL of Fig. 13a. Our meter is still going to measure the average value of the rectified waveform, but the average value of half a cycle over the time of a whole cycle is clearly half of 0.637, or 0.318. Thus, as compared with the 207 volts across RL of Fig. 13a, across RL of Fig. 13b will obtain a reading of something like 103.5 volts.

This explains, of course, why we get a remarkably low D.C. reading from the output of a power pack when the electrolytic reservoir capacitor becomes open-circuit.

### The Action of the Reservoir Capacitor (10)

As an example, let us consider a full-wave rectifier circuit complete with reservoir capacitor C (Fig. 15a). Reference to Fig. 15b shows that the voltage at C follows the line ABCD, the capacitor charging between A and B but discharging between B and C. The mean level of ABCD is, therefore, the effective direct voltage across C.

It is not here intended to explore deeply into the theory of rectification, though it is desirable to bear in mind that as the current taken by the rectifier circuit

is reduced (as the value of RL is increased), BC becomes more nearly horizontal and its level rises towards the peak value of the waveform until in the extreme case when RL is infinite the direct voltage across C will be equal to the peak voltage of the waveform.

We shall most likely correctly conclude that the actual value of the reservoir capacitor has a bearing on the output voltage when the rectifier is passing current. Also, with half-wave circuits, since the

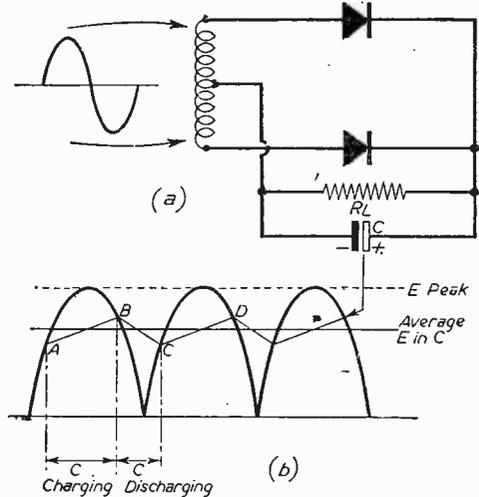


Fig. 15.—(a) A full-wave rectifier circuit complete with reservoir capacitor C. Diagram (b) illustrates how C charges during period AB and discharges during period BC. The average level of ABCD is, therefore, the effective direct voltage across C.

capacitor discharge time is greater and thus a longer time elapses before the capacitor is subjected to a recharging pulse, a larger value reservoir capacitor is demanded in order to maintain the required direct voltage output.

It is also interesting to note that the ripple voltage across C is determined by analysis of the shape of ABCD. Clearly, the greater the rate of change of voltage across C during the periods AB and BC, the greater will be the magnitude of ripple voltage. It follows, then, that as the circuit loading is increased the magnitude of the ripple voltage will also be increased.

### Resistance Measurement (11)

Now that we have successfully (we hope!) broken down the barrier so far as A.C. and our multimeter is

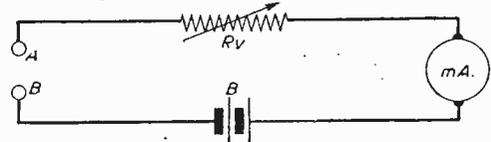


Fig. 16.—A simple ohmmeter circuit.

concerned, let us consider in some detail a feature of our instrument which is considerably less brain-taxing, namely the Ohms range.

(To be continued)



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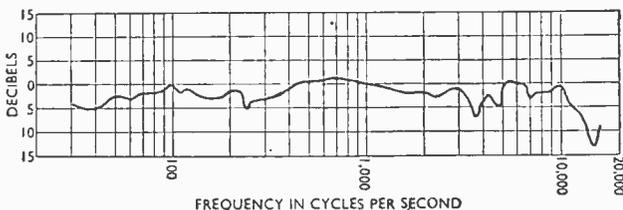
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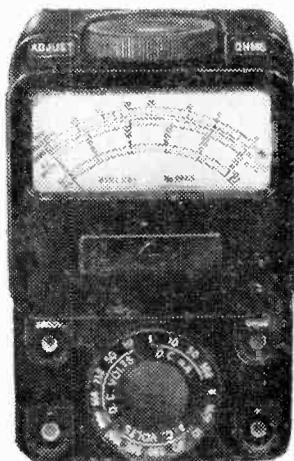
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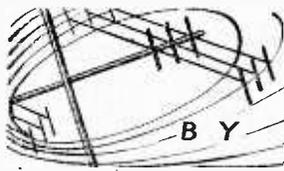
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# On Your Wavelength

BY THERMION

## New Electronic Devices

**T**HE Radio Corporation of America recently demonstrated some startling new electronic devices, including a music "synthesiser," a light amplifier (formerly considered impossible) and a magnetic tape recorder for television and motion pictures.

Brigadier-General Sarnoff, chairman of the R.C.A., who described the devices, declared that they opened up great promise for the future and explained that they were being revealed now in their experimental stage before they were ready commercially because he believed competition could be as stimulating in research as in manufacturing and merchandising.

Among the devices the magnetic tape recorder (first demonstrated in December, 1953, at the R.C.A. laboratories at Princeton, New Jersey) was of particular interest. According to General Sarnoff this can produce quickly and economically without any photographic developing or processing motion pictures in colour as well as in black and white, and an unlimited number of these tape recordings can be made.

## The R.A.I.B.C.

**I** HAVE received the following letter from Mr. J. Comber (E.I.S.L.), hon. treasurer of R.A.I.B.C. :

"With reference to correspondence between the secretary of the above club and yourself re balance sheet and your desire to have certified accounts, arrangements have been made for the accounts to be audited by Messrs. Ormsby & Rhodes, chartered accountants, 12, College Green, Dublin.

"The W.F.S.R.A. had a club from about the middle of 1951 to November, 1952, when it ceased to operate. On February 21st, 1953, the council of the society decided to close down that club. In May of that year I was asked to become treasurer.

"Owing to the differences that have arisen in W.F.S.R.A., I was not able to negotiate with the members now on our panel. R.A.I.B.C. was eventually formed on February 8th, 1954, and the balance in hand, as published in 'Skywire' (Jan.-Feb., 1954), is £6 4s. 1d., which may only be expended on the purposes for which it was donated."

## The I.S.W.L.

**M**Y comments on the International Short Wave League have brought forth a number of letters from members who state that they are entirely satisfied with the way in which the league is conducted. The following extracts from one received from Mr. J. D. Pearson, of Barrow-on-Humber, summarise the points made in many of the letters :

"It is said by some members that all they receive is a membership card and copies of a duplicated journal. That is all that the member of any radio society receives. The usefulness of any society is in the services it renders to members. The I.S.W.L. operates a Q.S.L. bureau. This service is genuine, as I have only to-day received a Q.S.L. card from CKCS, Sackville,

Canada, for a report which I forwarded through the I.S.W.L. broadcast bureau some time ago. There are also departments dealing with radio astronomy, broadcast, commercial and amateur station identification (this, too, is a very useful service), translation of foreign signal reception, and several others which I cannot remember without reference to membership data which are not to hand."

And here is another letter from Mr. J. E. Alban (G3JEA), of Bayswater :

"I was given to understand by the past organisers that the production of balance sheets was unnecessary. However, I lost no time in informing the present committee of the points you mentioned, and feel sure they will do something to rectify this error as soon as they are able.

"Annual general meetings have never been held. I agree with you that members should be notified even if the attendance is nil. If our national society can muster only 89 members out of some 10,000 odd at their A.G.M. it seems extremely doubtful that the I.S.W.L. could muster more than 10 !

"The production of an annual balance sheet has also been the subject of discussion at many committee meetings, but, as stated above, was always waived by the secretary on the information quoted above. Having been a member of the R.S.G.B. for the past 10 years and received an annual balance sheet, I thought such a sheet was a necessity.

"Committee members, treasurer and secretary have never been put up for re-election each year. The secretary has always accepted the task of collecting membership fees, keeping the books, counter-signing the cheques, and the complete running of the Q.S.L. bureau. He also handles most of the league's expenditure."

And, finally, here is a letter from Mr. J. H. Burrows, of Data Publications :

"The I.S.W.L. was formed in October, 1946, and sponsored by our short-wave journal. The founder members were : A. C. Gee (G2UK), C. W. C. Overland (G2ATV), and W. N. Stevens (G3AKA). In 1950 a committee of interested members was appointed by Amalgamated Short Wave Press, Ltd., to assist in the conduct and running of the League. The committee expressed the desire to run the League independently of any commercial organisation, and the League affairs were handed over to this committee as from December 1st, 1951. (There was no question of A.S.W.P., Ltd., being unable to afford to carry it on.) Announcements of all the above facts were prominently made in the sponsoring journal, no complaints were received, and the arrangements appeared to be popular with the League members. At no time up to December 1st, 1951, was there any association with the British Short Wave League. The British Short Wave League, a pre-war organisation, subsequent to the formation of the I.S.W.L., became associated with another periodical. We have not heard of any B.S.W.L. activity since the journal ceased publication.

# TRANSMITTING TOPICS



## TOPBAND AERIAL SYSTEMS

By O. J. Russell, B.Sc.(Hons.), G3BHJ

WHILE Topband activity is popular, and while many start their transmitting career on this band, it must not be thought that it is an "easy" band. While simple equipment may give first-class results, and while technical problems of the kind encountered upon higher frequencies, or the V.H.F. bands are not met with, yet the Topband has its own technical problems. These technical problems are not unconnected with obtaining excellent results, for DX upon 160 metres is definitely a very difficult feat. However, for some people obtaining other than purely local contacts, it may be difficult.

The question of aerial radiation is the secret of Topband operation, and it is not generally realised that the technical aspects are not as straightforward as might at first be supposed. Some of these aspects are well worth study, as it will be revealed that they give the clue to obtaining greatly improved efficiency.

Naturally, the fortunate few who are able to erect half-wave aerials at a height of 60 or more feet have little to worry about. However, only a few can erect a clear 250 odd feet span of wire, so that the majority are faced with the erection of the best possible compromise in the space at their disposal. City dwellers are, of course, particularly badly placed in this respect. Before considering aerial variations, however, there is one aspect generally overlooked in Topband working, and that is the great importance of the earth system. The earth system is important in all cases where a "Marconi against ground" aerial system is used. Naturally, the Marconi system is popular, as it enables short aerials to be loaded up for Topband use. One such system is shown in Fig. 1.

### An Example

In such systems, due to the relatively low impedance when series-tuned against ground, the aerial current is high. The ability to produce a given current in the aerial is not a very good indication by itself of efficiency. In fact, a high-impedance radiator drawing a much lower current would be considerably more efficient. To determine how various factors influence efficiency, Fig. 2 shows the "equivalent circuit" of a Marconi system aerial, that is, a length of wire shorter than a quarter wavelength. It is a capacity in series with a resistance. The resistance represents the radiation resistance, that is the value of resistance necessary to account for the power radiated. If the radiation resistance is 5 ohms, then an aerial current of 1 amp. corresponds to the radiation of 5 watts of R.F. The current is that measured at the base of the aerial, so the radiation resistance  $R_{rad}$  is referred to as the "base radiation resistance." It should be noted that in the Marconi tuning system, the aerial loading coil and condenser merely resonate the aerial capacity, so that the effective impedance becomes that of the aerial base resistance as shown in Fig. 3. This state of affairs would apply *only* if the earth

return were of zero resistance, and if the loading coil were of zero resistance. In practice, therefore, the radiation resistance has to compete with the earth resistance and with the coil resistance, so that efficiency is lowered. The real state of affairs is shown in Fig. 4, where only the radiation resistance does any useful work. Here, again, if the resistance representing coil losses were low, and if the earth resistance were low, no serious loss would result.

Unfortunately, this is generally not the case, as earth and coil losses may be much larger than the aerial resistance. Fig. 5 gives the Base Resistance curves for vertical wire aerials operated on Topband, and it will be seen that short wires have very low resistances. Thus the "8ft. whip" aerial employed for mobile Topband work has a radiation resistance of around one-tenth of an ohm! When it is considered that earth losses, even with a good earth, may be 10 ohms or more, it is clear that only 1 per cent. of the R.F. fed into such a system will be radiated. A loading coil to load up such a short aerial, even if of high Q construction, will itself have a resistance of over 10 ohms, so that as against the tenth of an ohm of the aerial we have some 20 ohms minimum

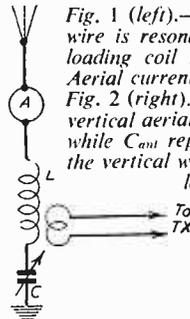
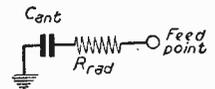


Fig. 1 (left).—The Marconi aerial. A vertical wire is resonated against ground by the aerial loading coil  $L$ , and the variable capacitor  $C$ . Aerial current is shown by the R.F. ammeter  $A$ . Fig. 2 (right).—The equivalent circuit of a short vertical aerial.  $R_{rad}$  is the radiation resistance, while  $C_{ant}$  represents the capacity to ground of the vertical wire. The feed point represents the lower end of the aerial.



loss in the earth and coil circuits. Accordingly, less than a half per cent. of the R.F. supplied to the aerial circuit will be radiated. Under these conditions it seems pointless to consume 10 watts in the transmitter to produce the radiation that would be given by a transistor coupled to a fully efficient aerial system!

### Earth Efficiency

This example serves to illustrate the extreme importance of the earth and loading coil efficiency. While an 8ft. vertical whip aerial is generally only used for mobile working, many amateurs in restricted locations are forced to use a short aerial for Topband. The curve of Fig. 5 shows that with short aerials even a few extra feet are worth having. Thus, a 16ft. vertical aerial has some four times the radiation efficiency under the same conditions as the 8ft. whip. Practically, the 16ft. aerial is even more

efficient, as a smaller coil is needed to resonate it as its capacity is higher. Consequently, coil resistance is lowered, and coil losses will be less. It is clear, however, that every foot of height counts on Topband, so that any possible extension in height is to be secured.

**The "L" Aerial**

In this connection the so-called "L" aerial as in Fig. 6, is used in order to get "as much wire" out as possible. Here again height is important. The effective height of the horizontal top portion is the

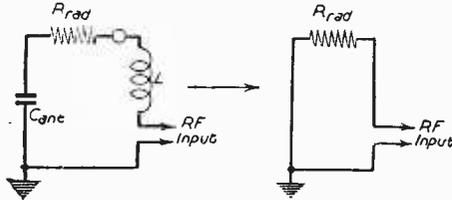


Fig. 3.—The effect of the usual Marconi series tuning circuit is to cancel the capacity of the aerial, so that the effective aerial resistance can be fed with R.F.

deciding factor. In the general case, where a resonant overall length of wire is not possible, the "L" aerial is actually operating as a "capacity top-loaded vertical." That is to say, the aerial is to be regarded as a vertical, loaded at the top by the effective capacity of the horizontal top portion. It will be found that a 30ft. high "L" aerial with only a short length of top is actually of higher base resistance than a 20ft. high "L" with a long top. This again illustrates the vital importance of height in securing an efficient radiator on the Topband. In fact, "top capacity loading" is one way of improving aerial efficiency, so that after attaching the aerial to the highest possible point, an additional horizontal length adds to the attainable efficiency. In commercial practice, capacity top loading may be effected by flat metallic or mesh discs at the top of the radiator. This is

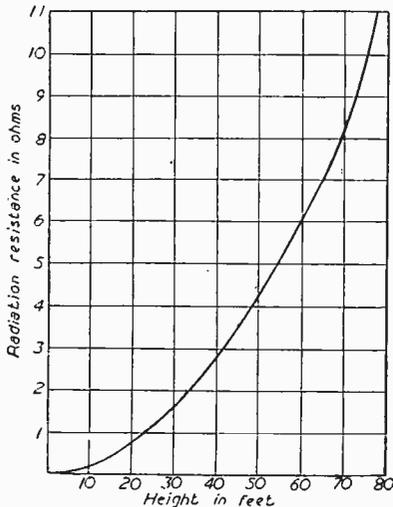
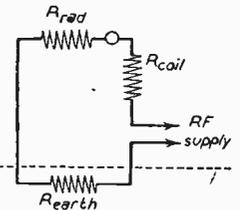


Fig. 5.—Radiation resistance of short vertical aeriels on Topband.

generally beyond the possibility of amateur practice, as discs of some feet diameter are necessary. However, a fan top of several wires may be used where feasible. The practice of using the feeders and top of a centrefed dipole cut for an H.F. band, as in Fig. 7, is one method of achieving a capacity-top-loaded aerial. In fact, a two-metre beam array, propped at the top of a high mast, could be used in the same way by tying the feeders together and using it as a "capacity-loaded vertical" for Topband use!

In this respect, one rather unusual family of centre-fed aeriels may be employed for Topband use. These are operated like conventional dipole systems, although the top lengths may be considerably shorter than an 80-metre dipole. It should be noted that the feeders are tapped on to either side of the centre of a parallel-tuned circuit for Topband use. The advantage of these aeriels is that the top is symmetrical and does not have to rely upon a ground system. Thus the difficulty of providing a low-resistance ground is avoided. While the effect of the earth below the aerial will still have some bearing on efficiency, this will not be as marked as when a physical earth is part of the R.F. circulating system. As will be seen, the shorter the top is made the longer become the feeders, as the feeders are an integral part of the system. This feature enables the use of an earth to be replaced by a feeder of low resistance. It may be regarded either as an abbre-

Fig. 4.—In a practical Marconi system, the radiation resistance has to compete with the effective earth resistance and the resistance losses in the tuning coil. Unless great care is taken, earth and coil losses may very greatly reduce the radiated R.F.



viated dipole, or as a radiator with an elevated counterpoise. It should be noted that these aeriels may be used on higher frequency bands as well as on Topband, so that a single aerial gives an efficient "all-band" aerial system. It should be noted that height is still important, even though the effect of earth losses are reduced.

**Aerial Radiation**

One important effect of aerial height lies in the radiation from the aerial. The vertical Marconi systems radiated a vertically polarised wave at low angle, as shown in Fig. 8. If the ground were of perfect conductivity, the maximum radiation would be at zero angle. However, the effect of ground resistance is to reduce the radiation at extreme low angles, so that Fig. 8 gives a good idea of the radiation pattern at average locations. In effect the vertical aerial radiates a strong "ground wave," with very little radiation at the higher angles. The practical result of this is that a strong local signal up to some hundred miles or so will be radiated.

In contrast to this type of radiation pattern, the horizontal aerial will radiate most of its energy upwards, unless extreme height, say two hundred feet or so, is available for supporting the aerial wire. In most amateur cases the aerial is supported much nearer the earth, so that the available radiation is largely skywards. In fact, the coverage on Topband is almost all due to the skywave being reflected down-

wards again, and so covering all distances by single or multiple hops. Except under extreme conditions enough ionisation exists for the reflection of Topband frequencies, so that generally night working over all distances is possible by skywave. In daylight ranges may be greatly restricted under some conditions.

In practice therefore, the user of a vertically polarised aerial system therefore can expect consistent operation without marked fading over perhaps one hundred miles, and perhaps good results on extreme DX, but with rather inconsistent results on ranges of a few hundred miles on Topband. The user of a horizontally polarised system will similarly obtain results perhaps a little worse over the first hundred miles than with a vertical aerial. Over longer distances of up to three hundred miles or so, considerable night fading will often be experienced, but signal strengths will often be higher than with a vertical aerial system.

Needless to say, unless losses have been reduced by attention to aerial efficiency, long ranges will not be achieved easily, despite the fact that even low-power transistor transmitters have achieved considerable ranges, well over the hundred mile mark. As pointed out earlier, the losses of a makeshift aerial system may be so large as to put the 10-watt station on a par with a transistor station as regards actual radiated R.F. power. In this case the power limit upon Topband operation does not enable the



Fig. 8.—With the usual heights obtainable on Topband, the vertical aerial will radiate mainly horizontally, while the horizontal aerials will radiate mainly upwards.

operator to step-up power in order to overcome the limitations of the aerial system. Conversely, where results have been disappointing on Topband operation, the attention to both aerial and earth system efficiency may make a startling improvement in results. While an illegal increase of power to, say, 100 watts would seem an extreme step, it is possible than an equivalent increase in signal strength might arise by retaining 10 watts input and improving the aerial efficiency.

**Aerial Loading Coil**

While a tenfold increase in radiation efficiency may seem exaggerated, this can be seen to be quite a feasible state of affairs when Marconi systems are used. A glance at Fig. 5 will show that unless a very high aerial is in use, and unless a very efficient low-loss earth system and a low-loss aerial loading coil are in use, the aerial efficiency may be only a few per cent. Thus, for example, a single earth driven into the garden soil will seldom be below some 20 ohms resistance, even if a 10ft. earth rod is driven down into the soil. In fact, for the user of a Marconi tuned aerial, one earth connection should never be relied upon. At least three earth rods should be driven into the soil at widely spaced intervals, and the three rods paralleled with heavy cable brought to the shack. It should be noted that the effect of adding extra earth connections in the Marconi system can be observed as an increase in the aerial current

meter, and also by a corresponding increase in signal strength as reported by local stations. Therefore, if additional earth connections can be arranged, their efficiency can be gauged by checks on aerial current and on signal strength reports. In all cases where a single earth or a makeshift earth has been employed, an improvement will be noted by using efficient earths, and multiple earth connections.

Finally, it is useless to improve aerial and earth efficiency if the aerial loading coil is inefficient. While a Topband loading coil may need a sizeable

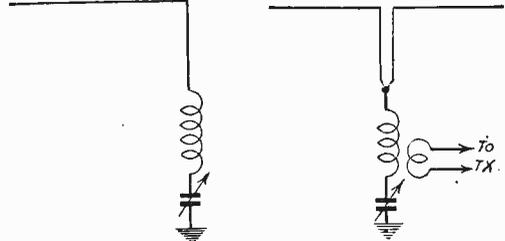


Fig. 6 (left).—Adding a horizontal top section increases the efficiency of a vertical radiator. The effect is to increase the radiation resistance so that a greater fraction of R.F. is radiated. However, length of the top portion is not a substitute for height, so that a high aerial with a short top is better than a low aerial with a long top. Fig. 7 (right).—A dipole aerial used for the higher frequency bands may be used as a capacity top-loaded Marconi system by paralleling the feeders and loading against ground in the usual Marconi fashion.

amount of inductance, it is a poor policy to wind many turns of thin wire on a cardboard former and expect good results. Such a coil may be useful in deciding the size of coil required, but is not suitable for efficient operation. The permanent loading coil should be wound with thick wire on low-loss ceramic formers, or air-spaced. An efficient low-loss aerial tuning coil will make a further contribution to overall aerial system efficiency for topband operation.

While the above features apply with special force to Topband operation, they also apply to other bands as well. Whilst, generally, it is possible to

Table of feeder lengths and top lengths for centre-fed Topband aerials, using spaced twin feeders. For every 2ft. reduction in overall top length, increase feeders by 1ft.

Full top, length in feet.	Feeder, length in feet.
100	38
98	39
96	40
94	41
92	42
90	43
88	44
86	45

obtain efficient radiation on the higher frequency bands without difficulty, many people are in such restricted spaces, that even 80-metre or 40-metre operation presents a problem. Where only short aerials are possible, therefore, application of Marconi or similar loaded systems may enable efficient operation to be carried out.

# Relay-controlled Directional Aerial

A SIMPLE INDOOR SHORT-WAVE IDEA FOR ALL-ROUND USE

By A. W. Mann

ONE hears but little nowadays concerning the transposed doublet type of receiving aerial once so popular with the short-wave fraternity. No doubt quite a number are still in use throughout the world, but on the whole it may be regarded as out of favour so far as the majority are concerned.

To erect an aerial of this type to textbook recommendations requires a considerable amount of space. That in many instances entirely rules out this type of aerial, especially in industrial areas.

Like other types the transposed doublet possesses certain advantages, but also certain disadvantages.

When one cannot follow conventional methods outdoors, it is sometimes possible to adopt unconventional ones indoors, and use roof space to full advantage in order to achieve the desired results.

In this instance the result is an efficient aerial system which will prove to be an asset to the DX enthusiast.

The design of a relay-controlled doublet aerial, using twisted wire feeders to be described, if carefully matched to the receiver which is to be used in conjunction with it, will provide world-wide coverage, with a really good signal-to-noise ratio.

The author is fully aware as to the functioning of this type of aerial, in relation to resonant frequency and theoretical considerations.

## Early Tests

The first tests were carried out with two 10-ft. flat tops, separated with a two-terminal spacing insulator. Plastic-covered lighting flex was used as the feeders. Candidly this was only a test to gauge the possibilities. Not much was expected, but the results even when the feeders were directly coupled to the aerial and earth terminals of a R1116A

were sufficiently promising to warrant going ahead.

In order to increase aerial signal pick up, 10ft. of wire was added to each flat top section, and the run of wiring arranged as shown at Fig. 1, which we will discuss in detail later. The second test proved even more satisfactory, and the second aerial was made up in a like manner and the feeders run down to the receiver position.

A six-terminal strip was screwed into position along the edge of a shelf about 3ft. above the receiver. The twisted feeders were fitted to the two outside pairs of terminals, and the common feeder pair to the centre pair of terminals. Thus, in order to use the N-S aerial the bridging wires were switched over from the E-W terminals. A double-pole double-throw switch would have been better, but we had other ideas, and the arrangement outlined served during the test period which covered some weeks.

## General Arrangement

Fig. 1 shows the general arrangement. Here we have two divided aeriels. For example, the N-S aerial from L to K to J is one continuous wire, G to H to I being likewise. The same applies exactly to the E-W aerial. Thus, our bent, flat tops are each 20ft. long. The dividing insulators can be cut from spare insulating material, plastic or the like, and the terminals should be 2in. apart. If desired they could be made in one piece. Separate insulators, however, enable the height of the aeriels to be adjusted to suit local circumstances. In my case the E-W one is 1ft. higher than the other. This enables the bent arms A-B, etc., to be arranged one above the other, 1ft. apart.

## Materials

Fig. 2 shows the dimensions of the dividing insulator, two of which are required. The total length of wire required is 80ft. Any good make of insulated aerial wire will be suitable. The twin feeder used for the original aeriels is plastic-covered, twin-lighting flex, at 4½d. per yard. The lengths required will

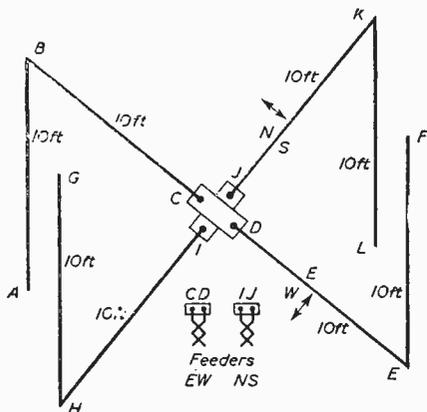
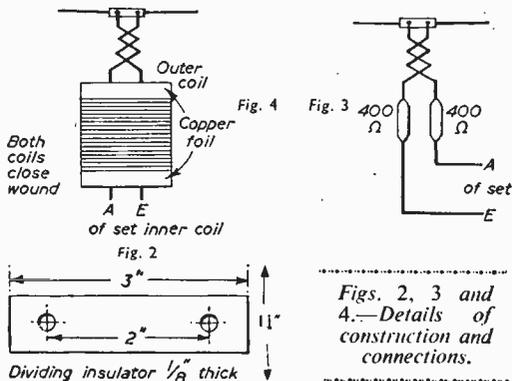


Fig. 1.—General arrangement of indoor doublet aeriels:

- A to B=10ft. Total length, 20ft.
- B to C=10ft. Total length, 20ft.
- D to E=10ft. Total length, 20ft.
- E to F=10ft. Total length, 20ft.
- G to H=10ft. Total length, 20ft.
- H to I=10ft. Total length, 20ft.
- J to K=10ft. Total length, 20ft.
- K to L=10ft. Total length, 20ft.



Figs. 2, 3 and 4.—Details of construction and connections.

depend on the distance between the aerial spans and the receiver location. Providing that insulated aerial wire is used the reader may use other methods than stand-off insulators to support the spans.

### Matching

Assuming the receiver to be an R1116 double superhet, a 400 ohms resistor in series with each feeder

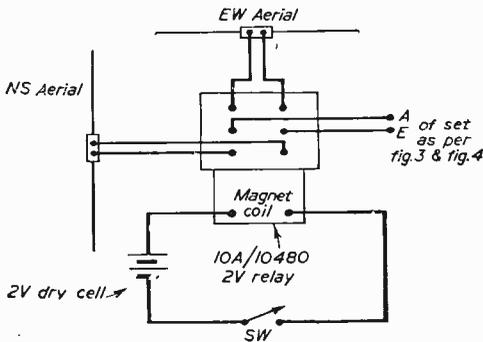


Fig. 5.—Wiring of the complete aerial arrangement.

and the aerial and earth terminals of the set will provide a good match. A resistance of the same value placed in series with the feeder going to the earth terminal of the set will, in certain instances, give a better match and a little extra gain.

An alternative method is to wind a coupler on an inch diameter paxolin former, consisting of 14 turns copper enamelled wire, cover with a strip of copper foil, leaving a  $\frac{1}{4}$  in. space between foil ends, and then cover the foil with a paper strip. Follow this by very carefully winding another 14 turns coil over the insulating paper. The latter is a precaution against shorted turns to foil in case of wire insulation defects.

Note: an earth connection (i.e., earthing of chassis) should not be used. The coupler may be used with the foil screen earthed or without. Try both. This electrostatic form of coupler provides a very good match and a good signal-to-noise ratio. See Fig. 3 and Fig. 4. This coupler is somewhat different from anti-electrical-interference types, and is simply a matching device. Use 26 s.w.g. enamelled wire.

### Changeover Relay

Fig. 5 shows how by the use of a magnetic relay which require but two volts to operate it, the doublets can be switched. This is the type 10A/10480 as used in the ex-R.A.F. TR9 transmitters and obtainable from advertisers in this journal. The switch used should be of the push-pull type, which allows an almost instantaneous comparison by a fractional movement. Once checked, the switch should be fully engaged or disengaged. A QMB switch can, of course, be used if preferred. At the end of listening periods always leave the switch in open position with no current flowing in relay coil.

Always check that relay is working correctly at the start of a listening period, and that both spring contacts are engaging properly with their opposite numbers. Relays sometimes stick and in this case the result is apt to be misleading.

### Directional Properties

While the writer has been able to cover the world

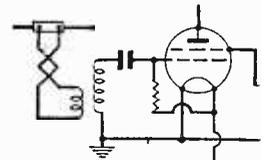
with a rotary aerial, and thus obtain maximum signal strength on all signals according to prevailing reception conditions, the blind spot with other aerials has always been South Africa. This does not mean that South African transmissions were not receivable on end-fed aerials, but that due to location difficulties, such aerials could not be erected so that full advantage could be taken of their directional properties.

The broadside directivity of N-S aerial main span, plus the SE-SW directivity of the legs, resulted in the reception of VQ7DT on twenty metres phone at 6.30 p.m. B.S.T. The broadside directivity of the E-W aerial is equally effective in those directions.

This aerial system is not effective so far as the reduction of electrical interference is concerned, because the flat top sections must perforce come within the interference zone at my location.

Details have been given in this article concerning the use of this aerial system in conjunction with the R1116A double superhet receiver. It can, of course, be used with T.R.F. receivers as shown at Fig. 6, and with straight regenerative types in which six-pin plug-in coils are used, by coupling the feeders directly to the aperiodic coil. I would be most interested to hear of the results obtained by users of modern

Fig. 6.—Details of the aerial input arrangement for T.R.F. receivers.



communication receivers in which provision is made for doublet coupling.

The sole idea behind these experiments was to utilise doublet principles to the best advantage indoors and within a very limited space. Due to the fact that the R1116A has a most excellent AVC system the signal strength and noise ratio compare more than favourably with other aerials which have been used with this receiver. The coupler, like the aerial system, may appear unusual, but the results have been such that they will remain in constant use for some time to come.

To obtain full advantage of relay change-over, the relay switch should be mounted on the table edge as close to the receiver as possible.

### Operating Procedure

It sometimes happens, and especially on the 20 metre amateur band, that nothing is to be heard. I have found this so when tuning for American amateur phones using the E-W aerial. Changing over to the N-S aerial, however, has brought in transmissions from other parts of the world when the band appeared to be entirely closed.

To me this is not surprising, as when using the rotary aerial one only needs to rotate the full circle to hear some amateur, somewhere, unless receiving conditions are extremely bad. Therefore, when tuning, make full use of the change-over switch, always making sure that the relay is working, and enter in the log which aerial was in use against each entry. Within a few months you will have a good idea as to coverage, and in all probability log quite a number of countries from which you had never received either amateur or broadcast transmissions before, and a greater interest in DX.

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# OSCILLATORS FOR VIBRATO

THE USE OF OSCILLATORS FOR VARYING THE PITCH IN ELECTRONIC MUSICAL INSTRUMENTS

By W. J. Delaney

THE recent series of articles on oscillators dealt with the subject in a general way as applicable to ordinary radio receivers, but there is a further branch of electronics in which the oscillator plays a very important part, and in which circuits different from those which have been described are used.

Most experimenters will be aware of the types of oscillator used in modern television equipment—thyratrons, blocking oscillator, multi-vibrators, etc., and certain of these are used also in some musical instruments, notably the electronic organ. In these instruments the note which is produced is made to vary slightly to give what is familiarly known as the vibrato or tremolo, an effect produced on ordinary wind-blown organs under the more familiar term of "vox humana." It is an effect which is often overdone by the immature singer and, in fact, by the popular type of cinema organist, but it is a valuable effect exemplified in the better playing of some violin pieces.

In the electronic organ the vibrato is obtained by means of an oscillator operating at an extremely low frequency—usually from 5 to 10 cycles per second, and there are several suitable circuits for this low periodicity, as well as the means of applying it to the remainder of the circuitry.

### Circuits

The most popular type of low-frequency oscillator is the multi-vibrator or variations of it (Fig. 1), the ordinary feed-back triode (Fig. 2) and the phase-shift (Fig. 3). These are perfectly standard circuits, the

values of certain components being selected to provide the low periodicity.

In the multi-vibrator a double-triode is usually employed although separate triodes may be used. The cathodes are strapped and a common biasing resistor is used for both sections, and one anode has a slightly lower value load resistor than the other. In one form, one grid is strapped to earth, and the anode of this section is coupled to the following grid in the usual manner with R.C. coupling. The second grid is taken to earth through an R.C. combination, and the value chosen for the R.C. components controls the speed of oscillation. Those indicated on the diagram will produce a speed of about 6 or 7 c.p.s. the 1 MΩ variable enabling the speed to be adjusted over quite a wide range. As is usual with this type of oscillator, either the capacitor or the resistor may be varied to produce variations in speed. In this particular circuit the anode current of each section rises and falls alternately. This feature is made use of in one application of the oscillations to the remainder of the circuit, as will be described later. The ordinary feed-back by means of a low-frequency transformer is shown in Fig. 2. Here the transformer must be connected the right way round, and almost any triode (or one half of a double-triode) may be used. There is the usual anode resistor in series with the transformer, and to this is also connected a resistor to earth. As a result the anode current causes a voltage drop through the resistor and again this is employed to regulate the intensity of the oscillation—not the pitch or frequency. The latter is controlled by the grid components, and in this particular circuit the

vibrato oscillations are taken out from the grid connection as shown. The remaining circuit to be described is the phase-shift oscillator, and although this also calls for a double-triode it is an extremely reliable oscillator and has many points of similarity with the arrangement shown in Fig. 1. Here again either the capacitors or the resistors in the first grid circuit may be modified for the purposes of controlling the frequency of oscillation.

### Applying the Oscillation

Those readers who remember the circuit of the PRACTICAL WIRELESS Electronic Organ will recognise in Fig. 1 and Fig. 3 the two main oscillators which were used, the former for the purpose of applying vibrato, and the latter as the standard note

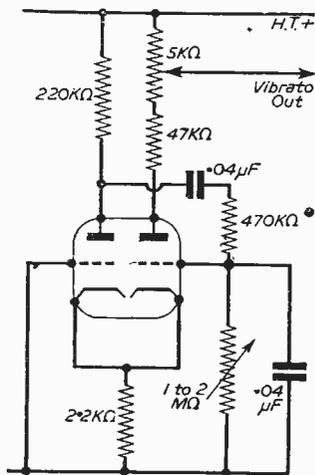


Fig. 1.—Multi-vibrator circuit, utilising variation in anode current as control.

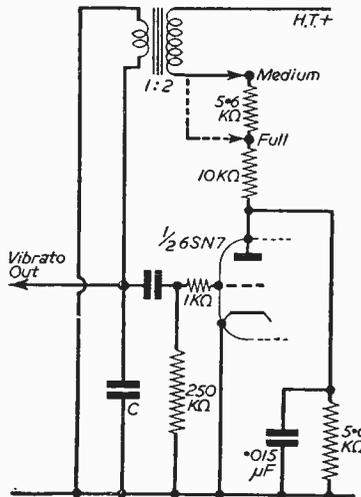


Fig. 2.—Transformer-coupled oscillator with variation of anode load.

generators. In the latter circuit, however, it is essential to use the type of triode having high gain such as the ECC83 or 12AX7—6SN7's or similar triodes not functioning satisfactorily—even if oscillation can be obtained. The important feature in the

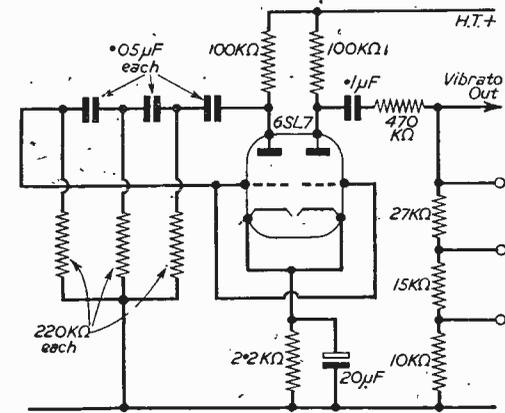


Fig. 3.—The phase-shift oscillator.

oscillatory circuit is the H.T. applied to the anode, and as a rule if this varies the frequency of oscillation will also vary. Advantage is taken of this feature to use the oscillator in Fig. 1 to apply the vibrato to the oscillator used to generate the notes as in the PRACTICAL WIRELESS Organ. The anode resistor of the first triode in Fig. 3 is then joined to the slider of the 5 kΩ potentiometer of Fig. 1 and as already mentioned, the fluctuating anode current will result in the H.T. at the slider varying—the amount of variation being dependent upon the value of resistance between H.T. and the slider point. With the oscillator described this will result in several volts variation in the H.T. applied to the note generator or oscillator, and as a result the frequency of the latter will vary, resulting in a nice smooth vibrato effect. In the arrangement of Fig. 2 the oscillation is not quite so strong and it may be amplified with a standard triode amplifier and the variation in anode current of the latter may be employed in a similar manner to that already described, or alternatively the oscillations may be injected into the grid circuit of any other form of note generator.

**Separate Vibrato**

In the circuits so far described, and, in fact, in the majority of vibrato or tremolo arrangements, the oscillations vary those produced by a note generator and thus are not applicable to straightforward amplifiers such as may be used to amplify guitars or other musical instruments in which a microphone or pick-up is used to pick up the sounds and feed them into an ordinary amplifier. Here, a novel circuit is available for adding a tremolo effect, and is depicted in broad outline in Fig. 4. The signals from the pick-up are fed into a pre-amplifier as shown at (a), and this is arranged as a normal phase-splitter, outputs being taken from anode and cathode. These are applied to the two grids of a standard double-triode. The two parts of the signal are out of phase and re-united at the anodes and taken to the remainder of the amplifier in the usual way. Two separate stages are employed to provide the vibrato effect, one being a

standard low-frequency oscillator such as the phase shift arrangement already mentioned or any other arrangement, and the oscillations are fed into a further phase-splitter. The anode and cathode of this latter stage are joined to the two grids of the double-valve previously mentioned, as shown at A and B, and the effect of these out-of-phase signals is to give the signal in its passage through the amplifier a fluctuating effect which forms a very pleasing vibrato. It is essential to use certain filters, etc., in the circuits

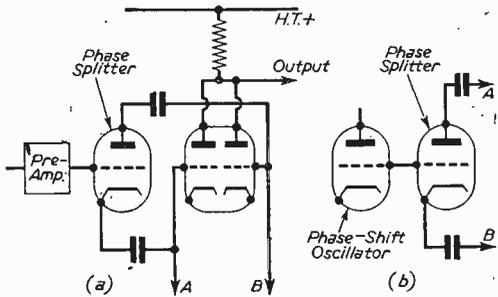


Fig. 4.—Injecting an oscillator into a normal amplifier arrangement.

according to the particular frequencies which are likely to be covered by the apparatus, and the arrangement calls for a certain amount of experiment in order to obtain the maximum vibrato effect, with a minimum of distortion of the actual signal passing through.

**Portuguese Radio Lighthouses**

FOR some years past the lighthouse service along the rocky and precipitous coast of Portugal has been augmented by the use of Marconi Radio Beacons, which have proved of particular value in foggy weather.

In compliance with regulations laid down at the 1951 Conference for the Re-organisation of Maritime Radio Beacons, the Portuguese Lighthouse Department are to duplicate their existing radio beacons. To this end they have now placed an order with Marconi's Wireless Telegraph Company, Ltd., for four duplicate equipments of the latest design.

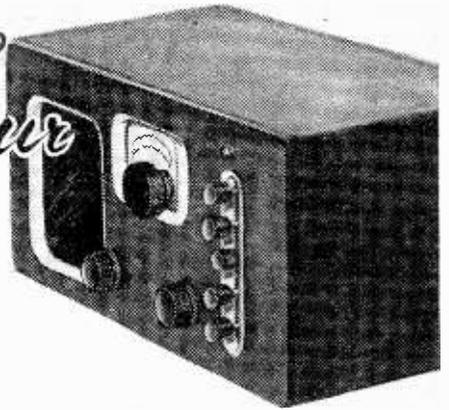
The equipments on order are 20-watt M.F. beacon transmitters, Type RB.109. They will be installed at the lighthouses at Montedor, on the northern part of the Portuguese coast, Cabo Espichel near Lisbon, Cabo Sines, and Vila Real de Santo Antonio, which lies in the extreme south close to the Spanish frontier. The single Marconi beacons at these points are being moved to other lighthouses along the Portuguese coast to provide duplicate equipments there also.

The Type RB.109 Radio Beacon is designed for automatic working, and has a normal range of about 50 to 75 miles. The entirely automatic nature of the equipment means that the installation requires no attention other than for normal periodic servicing and for the adjustment of the time period to meet local conditions.

Radio beacons are in many respects equivalent to lighthouses, but instead of a beam of light they transmit wireless signals (generally consisting of a repetitive call sign for station identification followed by a long dash for direction finding purposes).

# Making a Bedside Push-Button Four

A SIMPLE THREE-VALVE PLUS RECTIFIER T.R.F. RECEIVER FOR A.C./D.C. MAINS OPERATION, WITH PRE-SET OR MANUAL TUNING



THE use of forms of automatic station-selection seems to be regaining popularity, and such arrangements do have a convenience not found with manual tuning alone, as a number of stations can be selected instantly and accurately. In order that other stations need not be missed, the receiver described here also has a manual tuning control, used to select stations not provided for by the push-buttons. As a five-button unit is used, four pre-set or "button selected" stations are arranged for, one being on long waves. The unit also acts as wavechange switch, allowing manual tuning on both medium and long waves when required.

Dimensions have been kept down as far as is practicable without using midget components, and the receiver is very compact. The popular series of .3 amp. octal valves has been employed because these are efficient, robust and readily obtainable, both new and ex-service, from almost any valve supplier.

The circuit is shown in Fig. 1, and the method of operation will become apparent from this. When the top button is depressed, the coils are tuned by the 2-gang condenser in the usual way. As all other buttons are out, none of the pre-set condensers is

in circuit, and the coils are both switched to medium waves. For manual tuning on long waves, both top and bottom buttons are depressed. If the second button from the top is depressed, C1 and C2 are brought into circuit, the coils switched to medium waves, and the gang condenser disconnected. This provides for one pre-set medium-wave station. The centre button, with C3 and C4, is for the second M.W. station, and the fourth button, with C5 and C6, for the third M.W. station. When the lower button alone is depressed, C7 and C8 are brought into circuit, the coils switched to long waves. This allows one L.W. station (e.g., Light Programme) to be selected.

The remainder of the circuit is quite straightforward. Volume control is provided by the 100 K. cathode potentiometer. A further potentiometer of 25 K. acts in a simple tone-control circuit. A valve rectifier is employed in preference to the metal type since hum is usually at a much lower level,

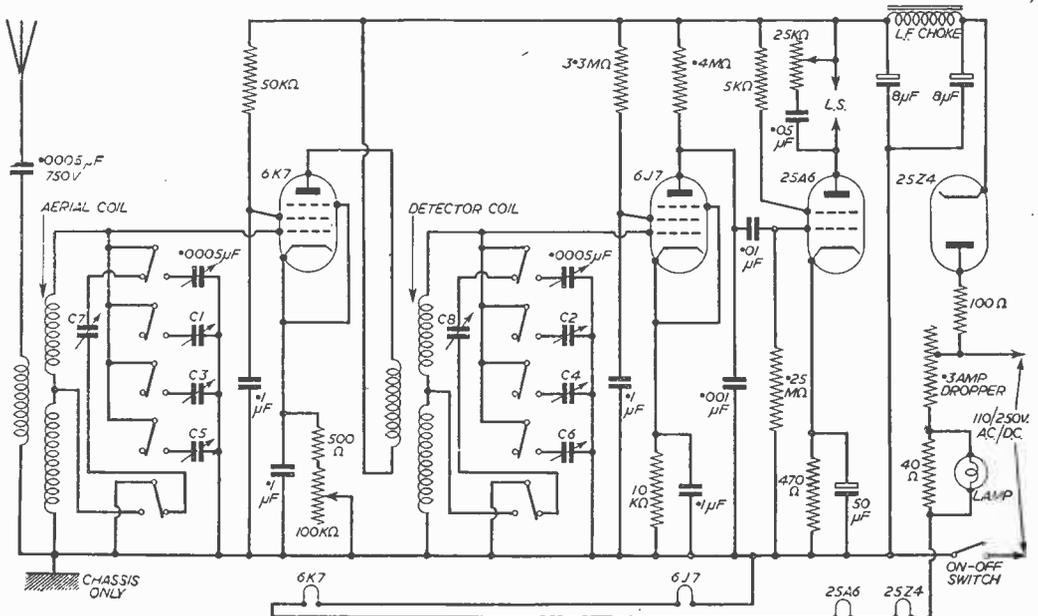
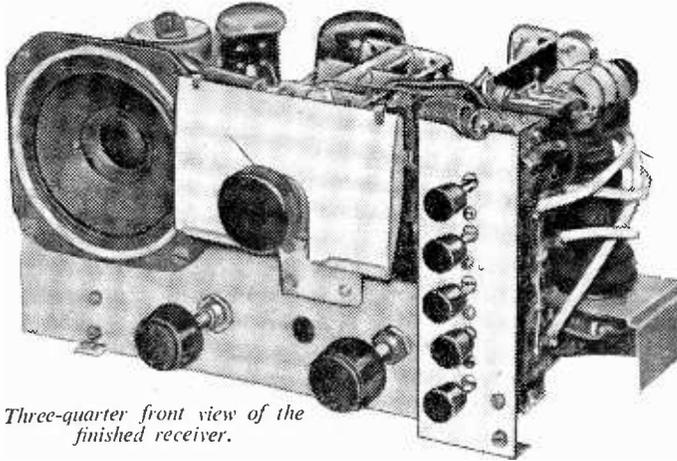


Fig. 1.—Theoretical circuit of the receiver.

with a given capacitance of smoothing condenser, with a valve in this position.

**Constructional Points**

The chassis is "stepped" at the back to reduce the overall height of the cabinet ; except for reducing height, this is not essential, and there is no reason why the usual flat chassis should not be used. The



Three-quarter front view of the finished receiver.

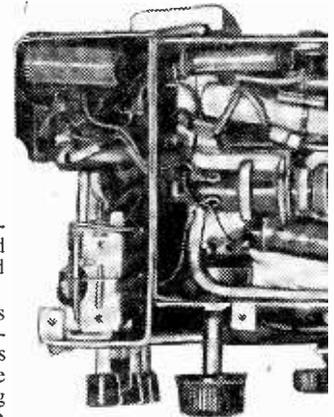
chassis is 4in. wide, 7½ in. long, and 2in. deep, descending to 1½ in. deep at the back, where the valveholders are fitted. A screen supporting the push-button switch is bolted to the right of the chassis. This screen is 5in. high, 4½ in. from back to front, and has a flange 1½ in. wide, turned, as shown, to support the switch. Fairly stout metal, such as 16 s.w.g. aluminium, is desirable here. Finally, a small box-shaped extension, 2in. by 2in. by 1½ in. deep, is bolted against the screen to hold the 6K7 valveholder. This will become apparent from the diagrams. Three double pre-set condensers are bolted to the back edge of the vertical screen. For long waves these may be

.0005 μF. This capacity is also suitable for stations above about 350 metres in the M.W. band. For stations of lower wavelength, .0002 μF pre-sets may be used, with small postage-stamp 50 or 100 pF pre-sets, supported directly in the wiring, for stations of very low wavelength. (The large-capacity pre-sets cannot be used to tune low in either waveband, because their minimum capacity is very much greater than the minimum capacity of the usual gang condenser.)

The layout of the larger parts is clear from the illustrations, and they should be positioned carefully before drilling mounting holes, as there is not a great deal of free space.

**Wiring Details**

Wiring under the chassis is shown in Fig. 5, the four .1 μF condensers being lifted out of position to show valveholder wiring. When wiring is



complete, these condensers are pushed over the 6K7 and 6J7 holders.

All connections should be well insulated, and points marked "M.C." are taken to soldering tags bolted to the chassis. Work will be simplified if the coils and push-button switch are left off until all other wiring has been completed. Insulated sleeving should be slipped over the wire ends of condensers and resistors, to avoid possible short circuits.

Connections to the push-button unit are shown in Fig. 2.

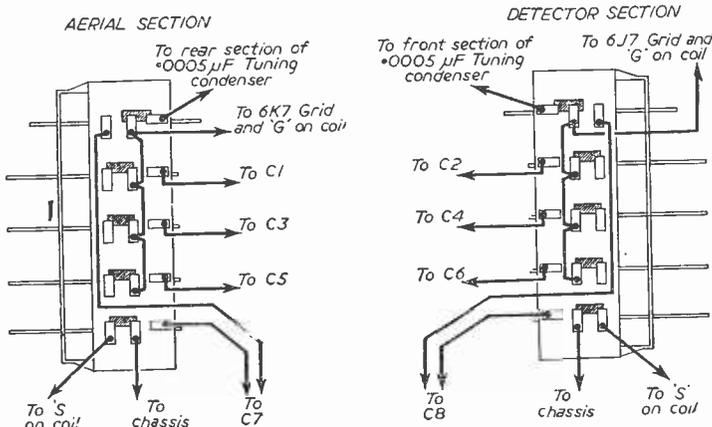


Fig. 2.—Details of the push-button connections.

**RESISTORS :—**

- 500 ohm
- 5 KΩ
- 10 KΩ
- 50 KΩ
- .25 megohm
- .4 megohm
- 3.3 megohm
- 470 ohm
- 100 ohm
- 40 ohm, 2 watts.
- .3 amp, 600 ohm mains dropper.
- 100 KΩ pot. with switch.
- 25 KΩ pot.

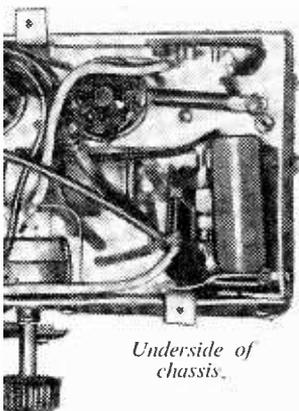
} ½ watt.  
} 1 watt.

When the switch is mounted, the aerial section lies outside, and is fully visible. The detector section, however, is adjacent to the vertical screen. Leads should therefore be soldered to this side of the switch before the latter is bolted into place. If desired, these leads may be identified by using coloured sleeving. Wires which are required to go to the detector (6J7) or associated circuits pass directly through the vertical screen. They must not be brought round near connections in the R.F. stage, or instability may arise, especially when the volume control is turned to maximum.

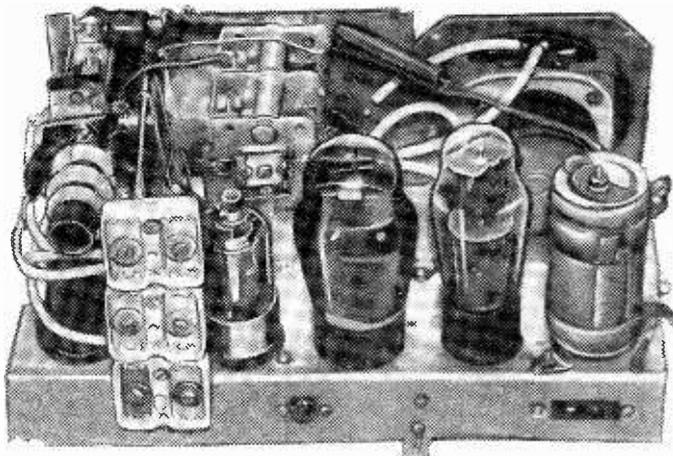
It will be seen that both sides of the switch are wired up in exactly the same way. Leads to the outer, or aerial section, can be put on after the switch is mounted.

**Coils**

Coil connections are given in Fig.



Underside of chassis.



A rear view which shows the compact layout.

3, but only apply to the specified coils. If other coils are used, then the maker's instructions must be followed as the tags may be placed differently, or connections from windings to tags, inside the coil, may not be the same. The coils specified have a thick projecting loop, for earth and mounting, and this is bolted to the vertical screen near the top, in the case of the aerial coil, which lies above the 6K7 valve. The Astral coils which were used in the original version of this receiver were made by Astral Radio Products of 138, The Ridgeway, Woodingdean, Brighton 7.

**Adjustments**

The mains dropper should be adjusted so that the valves receive the correct heater voltage—6.3 volts for 6K7 and 6J7, and 25 volts for 25A6 and 25Z4. An A.C. meter is best for assuring this is so. If no meter is available, the dropper clip should be so placed that the valves gain full operating temperature in about 45 secs., when switching on from

cold. Both excessive and insufficient heater voltage can cause premature deterioration of the valves.

The anode and screen grid voltages of the 25A6 should not exceed 160 and 135 volts respectively. The exact voltage will depend on the resistance of the speaker transformer and choke, the condition of the rectifier, and the mains voltage, and will usually be around these figures. But with 250 volts mains, the voltages may be a trifle high. If so, the value of the 100 ohm resistor should be increased, or this resistor taken to a tapping clip on the dropper, instead of directly to the one main lead.

The receiver should perform in the usual way when the manual control is operated, the top button being depressed. If the gang condenser does not have

**COMPONENT LIST**

- y 2-pole 2-throw push-tion switch.
- ycle drive. 3 knobs.
- tal valveholders.
- A smoothing choke.
- l ohm/2-3 ohm mains out- valve transformer, ratio prox. 45 : 1.
- hm, 3½in. P.M. speaker al lamp and holder, etc.
- es—6K7, 6J7/GT, 25A6G, Z4G.

**CONDENSERS**

- 4 of .1  $\mu$ F, 350 volts.
- .001  $\mu$ F, 350 volts.
- .05  $\mu$ F, 350 volts.
- .01  $\mu$ F, mica.
- .0005  $\mu$ F, 500-750 volts.
- 8 plus 8  $\mu$ F, 350 volts.
- 50  $\mu$ F, 50 volts.
- 2-gang .0005  $\mu$ F tuning condenser.
- Trimmers and pre-sets, see text.
- Pair "Astral" dual-range coils.

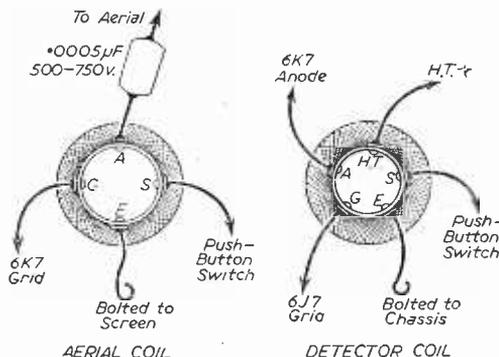
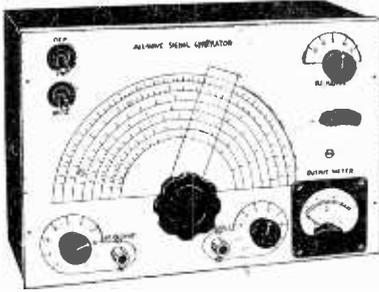


Fig. 3.—Coil connections.





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**Drop thro'** 230-0-230, 200 mA., 6 v. 5 amps., 5 v. 3 amps., 27/6. Heater Transformer. Pri. 230-250 v. 6 v. 1 1/2 amp. 6/- ; 2 v. 2 1/2 amp. 5/-.

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500-0-500 120 mA. 4 v. C.T. 4 a. 4 v. C.T. 4 a. 4 v. C.T. 2.5 a., 27/6. 500-0-500 250 mA. 4 v. C.T. 5 a. 4 v. C.T. 5 a. 4 v. C.T. 4 a., 39/6. P. & P. on the above transformers 3/-.

**PATTERN GENERATOR** 40-70 Mc/s. direct calibration, catches frame and line time base. Frequency and linearity, vision channel alignment, sound channel and sound rejection circuits, and vision channel band width. Silver plated coils, black crackle finished case, 10 x 6 1/4 x 4 1/4 in. and white front panel. A.C. mains 230-250 volts. This instrument will align any TV. receiver. Cash price. £3.19.6 or £1.9.0 deposit and 3 monthly payments of £1. Post and packing 4/- extra.

**TV. CONVERTER** for the new commercial stations, complete with 2 valves. Frequency - can be set to any channel within the 186-195 Mc/s. band. I.F. - will work into any existing TV. receiver, designed to work between 42-68 Mc/s. Sensitivity 10 Muiv. with any normal TV. set. Input - arranged for 300 ohm feeder. 80 ohm feeder can be used with slight reduction in R.F. gain. Circuit EF80 as local oscillator, ECC81 as R.F. amplifier and mixer. The gain of the first stage, grounded grid R.F. amplifier, 10 db. Requires power supply of 200 v. D.C. at 25 mA., 6.3 v. A.C. at 0.6 amp. Input filter ensuring complete freedom from unwanted signals. 2 simple adjustments only. £2.10.0. Post and packing 2/6.

**Volume Controls**. Long spindle less switch, 50 K., 500 K., 1 meg. 2/6 each. P. & P. 3d. each.

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**MEDIUM & LONG-WAVE A.C. MAINS 230/250 2-VALVE PLUS METAL RECTIFIER, 22/6.**

Comprising chassis 10 1/2 x 4 1/2 x 1 1/2 in., 2 waveband scale, tuning condenser, wavechange switch, volume-control, heater trans., metal rectifier, 2 valves and v'holders, smoothing and bias condensers, resistors and small condensers, and medium- and long-wave coil, litz wound. Circuit and point-to-point, 1/3. Post and packing, 2/6 extra.

**Volume Controls**. Long spindle and switch, 1, 1.1 and 2 meg., 4/- each; 10 K. and 50 K., 3/6 each. 1 and 1 meg., long spindle, double-plate switch, miniature, 5/-.

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**Constructor's parcel**, comprising chassis 12 1/2 x 8 x 2 1/2 in., cad. plated, 18 gauge, v.h. IF and trans. cut-outs, back-plate, 2 supporting brackets, 3-waveband scale, new wavelength stations names, Size of scale 11 1/2 x 4 1/4 in., drive sp. drum, 2 pulley's pointer, 2 bulb holders, 5 part 1.0. v.h. 4 knobs and set of 465 I.F.s. twin gang, 16 x 16 mfd. 350 wkg., mains trans. 250-0-250 60 mA. 6.3 v. 2 amp., 5 v. 2 amp. and 6 1/2 in. M.E. speaker with O.P. trans. P. & P. 3/6. 39/6.

*Terms of business* : Cash with order. Despatch of goods within three days from receipt of order. Where post and packing charge is not stated, please add 1/6 up to 10/-, 2/- up to £1 and 2/6 up to £2. All enquiries S.A.E. Lists 5d. each.



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**Used A.C. Mains**, 5 valve, 3 wavebands, Superhet chassis, 11 1/2 in. x 8 1/2 in. x 3 1/2 in. Complete with 3 waveband scale, 10 1/2 in. x 5 1/2 in. Pair 465, K.C.I.P., tuning condenser, main transformer, volume control with switch, Tone Control, 3 waveband coil pack. (This is a completely detachable unit on small chassis.) Various small condensers and resistors biasing condensers. 19/6. P. & P. 3/6. As above 2 wavebands 15/- P. & P. 3/6.

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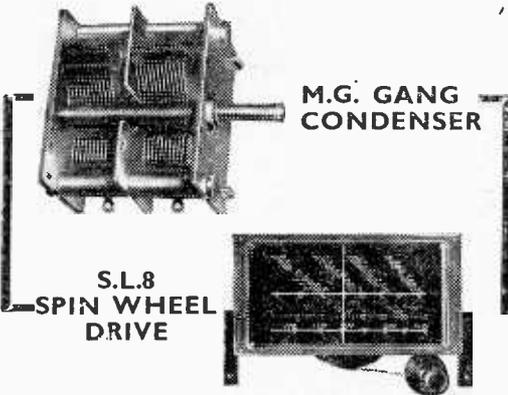
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8 mfd., 350 v. wkg., tag ends ...	1/6	250 v. 350 mA. 6.3 v. 4 a. twice 2 v. 2 a. ...	19/6
50 mfd., 25 v. wkg., wire ends ...	1/9	Auto-trans., input 200/250 HT 500 v. 250 mA. 6 v. 4 a. twice 2 v. 2 a. ...	19/6
100 mfd., 350 wkg. ...	3/6	250-0-250 60 mA. 6.3 v. 1.5 a. 0-5-8.3 v. 1.5 a. ...	10/6
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Low loss non-hygroscopic insulation.

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Fig. 4, and that the cross-screens have been made in accordance with Fig. 5 and the notes given in the text. A system of assembly is called for, especially in regard to the coils and screens and the tuning condenser, otherwise it will be difficult to mount certain parts.

### Switch and Screens

Assemble first of all the switch and the cross-screens as a separate unit. The spacing pieces which fit over the side struts of the Oak switch should be cut to provide two  $\frac{3}{4}$  in., eight  $\frac{1}{2}$  in., and six  $1\frac{1}{2}$  in. After ensuring that the positions of the stops in the front plate allow the wafers to move over their ranges of positions correctly, assemble the switch and cross-screens as shown in Fig. 6. The main switch spindle passes through the screen  $\frac{3}{4}$  in. holes, and the screens are clamped in position finally by the pressure of the spacing pieces biting against them. When the assembly is tightly bolted up, check that the whole line is straight and that there is no twist in either the switch struts or the screens. The latter should now sit squarely on the chassis when placed in position with the front bush locked through the front chassis hole. Now mark out the fixing feet positions on the rear screen so that the assembly can be firmly bolted down to the chassis.

The padders can now be fixed to their bracket and

bolted on the end of the back screen in the position shown.

When the switch and screens are properly positioned and turning properly, the tuning condenser and J.B. drive assembly should be marked out. The drive is two-hole fixing to the front side of the chassis, but the exact height must be decided by the height at which the tuning condenser spindle comes when this is resting on its feet on the chassis top, centrally placed. Allow the spindle to enter the coupling on the dial drive, therefore, and then mark off the two necessary fixing holes for the dial, ensuring that the flywheel position coincides approximately with the 1 in. hole in the chassis front. The flywheel is, of course, removed during this operation, being finally replaced behind the chassis front. The oblong cut-out permits its rotation when it comes a little high.

With the drive assembly fitted, mark off the four fixing holes for the gang condenser. Bolt this down temporarily, and then lock the spindle to the dial coupling by means of the grub screws provided. Check that the drive runs freely and that the gang opens and closes smoothly.

Now remove the gang and solder three flexible leads to its lowermost tags. These should be left fairly long, and they will later pass through the three holes in the chassis into their respective coil compart-

(Continued on page 233)

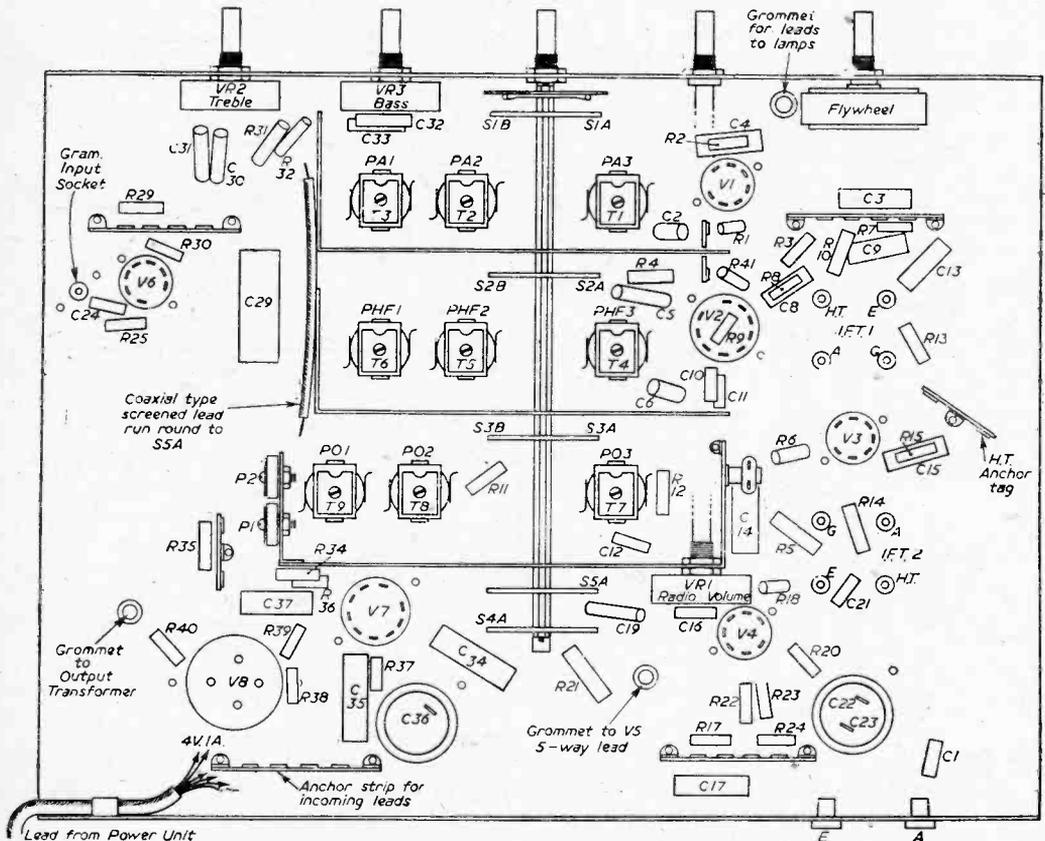


Fig. 3.—Details of principal components below chassis.

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WIRE-WOUND POTS. 3 WATT. FAMOUS MAKE. Pre-set Min. T.V. Type. 1 standard size Pots. 2 1/2 in. Knurled Slotted Knob. Spindle. High Grade. All values 25 ohms to 30 K. 3/- or cap. 50 K. 4/-.

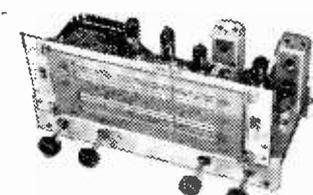
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L.F. COILS 10 h. 65 ma., 5/-, 20/25 h. 100/150 ma., 12/8. 3 h. 250 ma., 15/-, 13 h. 100 ma., 10/8.

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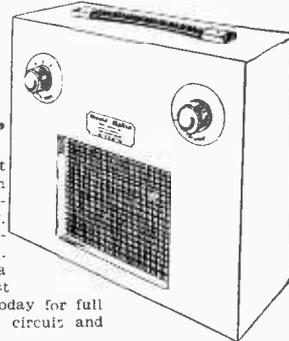
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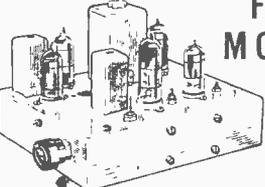
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(Continued from page 230)

ments. Grommets are not necessary provided the hole edges are not ragged.

The Wearite coils should now be prepared for mounting. These coils are one-hole fixing and present no difficulty from this point of view, their fixing holes being already drilled in the chassis compartments.

The trimmers are wired directly across the long tags of these coils, these being bent down for the

purpose. A side view of a coil will be shown later to illustrate the best way of doing this. The tag with a red marker is the hot end of the main (secondary) winding, and the fixed plates of the trimmers should be wired to this tag. All the coils have 60 pF trimmers except the long-wave set (PA1, PHF1 and PO1) which have 100 pF.

Before bolting the coils down in the positions indicated in Fig. 3, several other things have to be

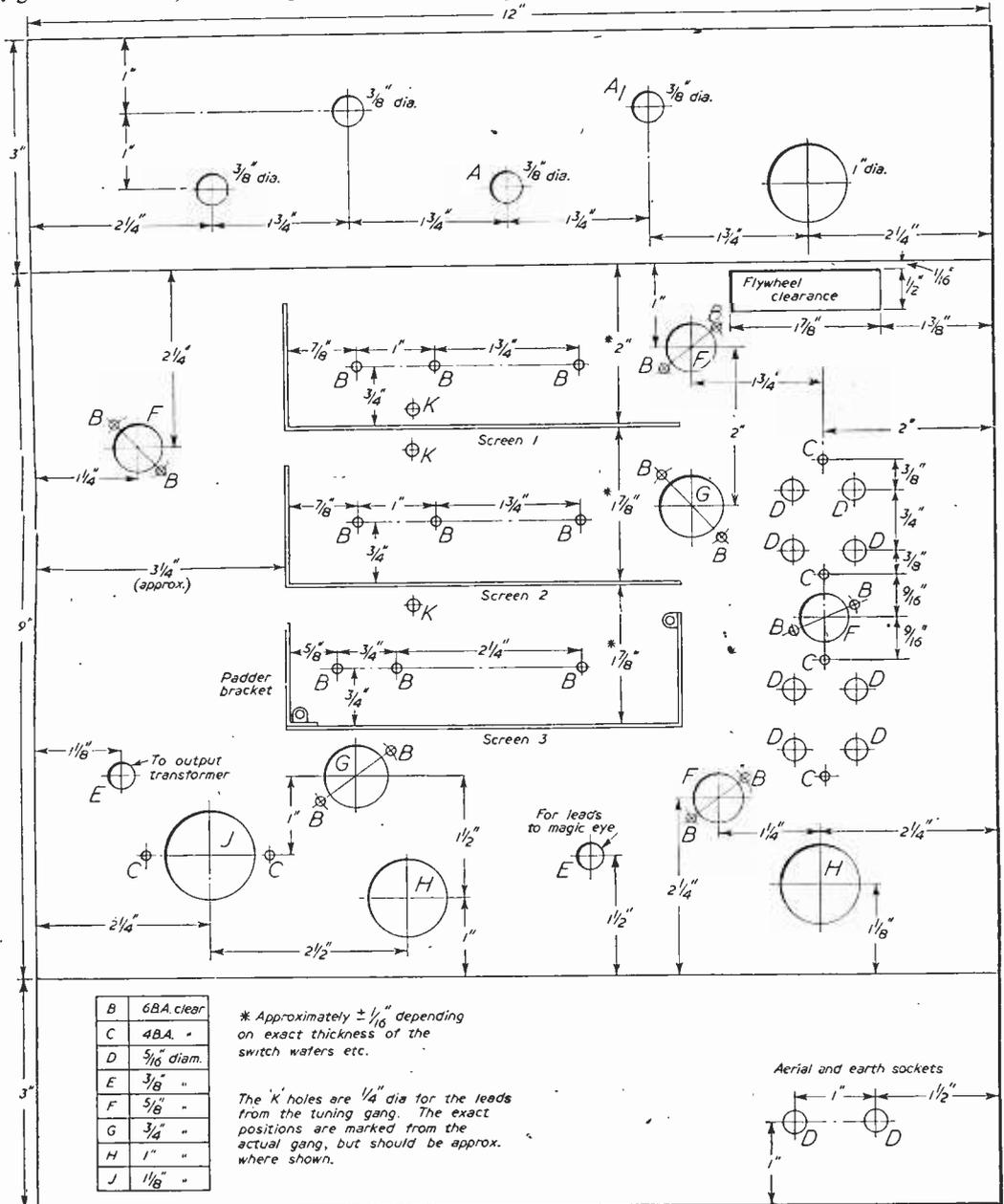


Fig. 4.—Details of chassis drilling and bending.

done. The lowermost tags of the switch banks inside the cross-screens should have leads soldered to them, as it is difficult to get to these once the coils are mounted. Then it should be checked to see whether any coil fixing screw head comes under the position of the three-gang condenser; this coil or coils should be fixed before the gang, using countersunk screws.

**Remaining Assembly**

The remainder of the assembly is quite simple and there is no particular order in which it need be carried out. The valveholders should be fitted with the pin orientation as shown in Fig. 3, tags being bolted under each fixing nut for earthing points, though all of these may not be used. The tag strip mountings are clearly shown on the diagram, as are the I.F. transformer orientations. In these latter the tag with the red marker is "Grid," and the other tags are then disposed, as shown. A piece of sleeving may be slipped over each tag outlet of these transformers to avoid possible contact with the chassis where they pass through the holes provided.

The first transformer is supplied with a flying lead at the top of the can. This lead is not required in this set as the I.F. amplifier valve is single-ended. The lead should therefore be removed or snipped off very close to the can itself. It is necessary to ensure that the bare end does not short-circuit to the can if it is cut off in this way.

The volume-control (radio) VR1 is mounted on the rear cross-screen so as to be as close to the second detector V4 as possible. A long extension spindle passes through the other two screens and a bush (which can be obtained from an old volume-control) bolted to the front of the chassis. An 8 in. length of 1/4 in. brass or steel rod may be used for this spindle, and it is joined to the control by a normal coupling unit.

The output transformer is mounted above chassis between V6 and V8, 4 B.A. bolts passing through the four holes provided. The tag strip supporting R35 uses one of these bolts for its fixing, as does the fixing of C29 which, being a large condenser, is clipped down to the chassis.

A pair of one-way tags are fixed to the first cross-screen to act as anchors for R1C2 and R4R41 respectively as shown, and a further single tag is fixed to the rear screen as anchor for the junction of R5, R6 and C7.

R16 is mounted on the base of the magic-eye indicator itself, not on the chassis.

**Wiring**

It is best to wire up in 22 s.w.g. tinned copper wire and 1 mm. PVC sleeving, the colour code used being

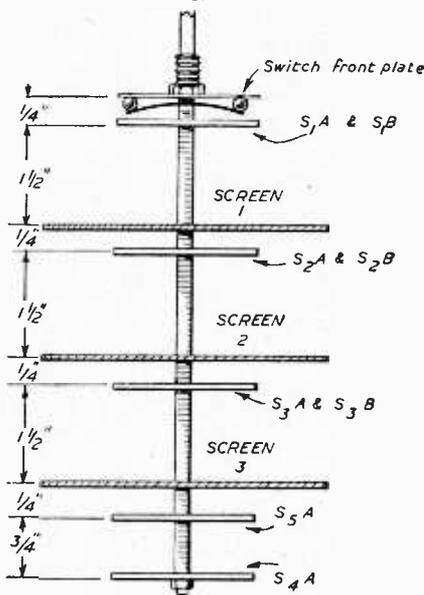


Fig. 6.—Details of the switch assembly.

left to the individual. The heater run (all valves excepting V8) is best wired first, this being carried out in twisted pair; the order from the anchor strip input is: V7, then to V6 and V4, from V4 to V3, to V2, to V1, then through the grommet to the dial lamps on the scale. Note very carefully that both poles of these lamps must be insulated from the frame of the dial assembly (chassis), otherwise half the heater winding will be shorted out.

The "trickiest" part of the wiring (if it may be called that) is associated with the coil and switch bank connections inside the screened departments.

Basically, each compartment is a duplicate of the other, and a diagram showing in more detail the layout of the R.F. section will be given later. To match the "S.M.L. Gram." markings on the specified knob, the wafers should be wired as drawn here, the "Gram." position being most anti-clockwise looking from the front of the set. It is necessary to ensure that the oscillator coils are properly wired, otherwise there may be no oscillation; the "hot" tags go to the switch contacts in all cases.

The adjustable padders are wired in the earthy ends of the main windings of the medium- and long-wave oscillator coils, the short-wave having a fixed 0.005 µF padder. P1 (600 pF) is the medium-wave padder, with P2 (250 pF) for long-waves.

(To be continued)

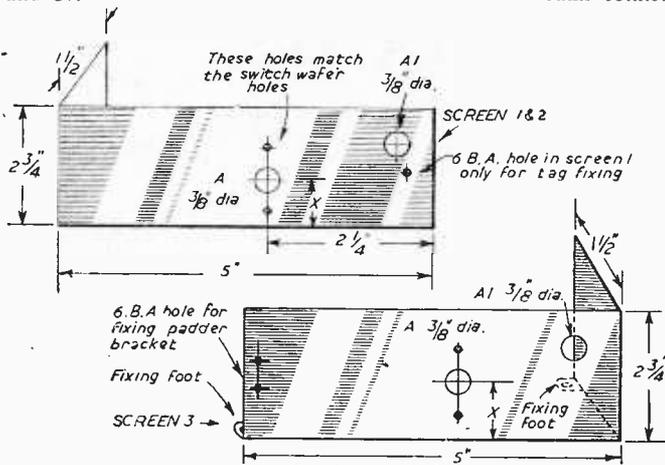
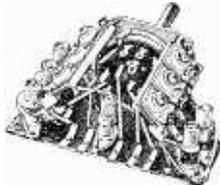


Fig. 5.—Details of the switch screens.



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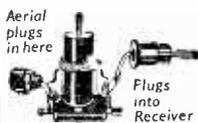
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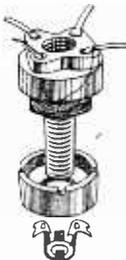
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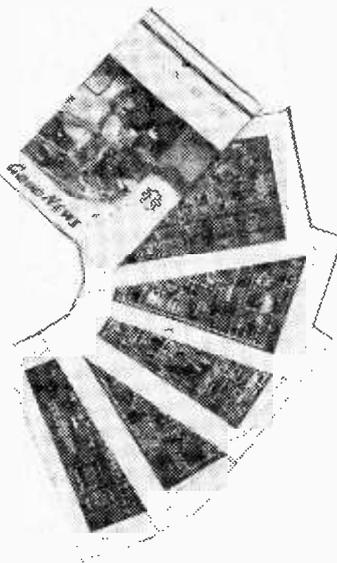
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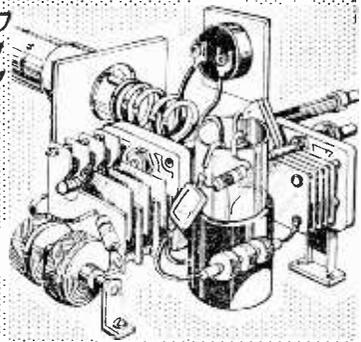
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# SHORT-WAVE SECTION

## BUILDING COMMUNICATIONS RECEIVERS

### 5.—THE A.V.C. SYSTEM

(Continued from page 153 March issue)



**T**HOUGH the A.V.C. circuit of a communications receiver may in several respects be similar to that of a standard broadcast band superhet, modifications and improvements are frequently present, especially in equipment of advanced type. In general, the highest possible efficiency will be required from the A.V.C. system, so that weak signals of considerably varying strength may be dealt with, and provide a reasonably stable A.F. output.

The efficiency of the A.V.C. system depends largely on the number of controlled stages. In the usual four-valve superhet circuit, only two controlled stages will be present—the F.C. and I.F. valves. In a communications receiver, four controlled stages are quite usual, due to the addition of one valve in the R.F. position, and a further as 2nd I.F. amplifier. In larger receivers even more stages will be present, and A.V.C. may be introduced into the A.F. amplifier. The degree of A.V.C. action obtained from such arrangements is very great, compared with that achieved with the simple broadcast band superhet.

#### Typical A.V.C. Circuit

The circuit in Fig. 1 is the basis of more complex arrangements, and one largely used. One diode of the double-diode or D.D.T. valve acts as detector, 100 pF condensers and 50 K resistor providing R.F. filtering for the A.F. output circuit. The A.V.C. diode is fed from the final I.F. anode, or from the secondary of the transformer, as indicated by the dotted line. The I.F. stage receives a minimum amount of bias from the voltage drop across R1, which will usually be from 250 to 500 ohms.

With no signal present, the stage is operating at minimum bias, or maximum gain. When a signal becomes apparent, rectification at the A.V.C. diode results in the A.V.C. line becoming negative, the negative voltage increasing as the signal strength rises. This negative voltage is applied to the control

grids of the controlled valves (e.g., R.F., F.C. and I.F. stages), thereby reducing gain. As a result amplification is reduced when signal strength is good, and at maximum with low signal strengths, thereby maintaining a more stable output level from the detector.

With several controlled stages, this circuit can be very satisfactory. It is apparent, however, that the signal reaching the A.V.C. diode cannot be maintained exactly the same in all circumstances, since it is by changes in signal strength here that the A.V.C. operates. The circuit will hold powerful stations down to reasonable volume, however.

A further disadvantage arises from the fact that any signal will cause some A.V.C. voltage to be developed, so that the receiver can never be at maximum gain when a station, however weak, is tuned in. This may be overcome by using a delay voltage.

#### Single Diode

In compact equipment, or battery-operated receivers, only one diode may be available. This is particularly so in battery equipment where the type

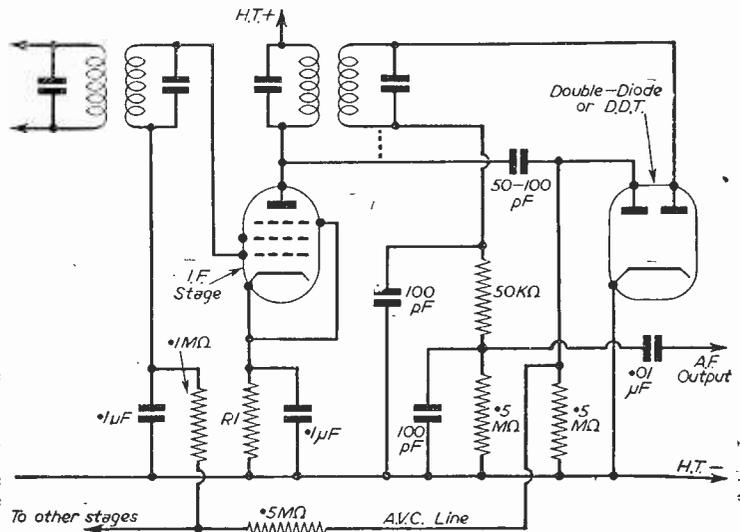


Fig. 1.—A typical A.V.C. circuit.

of valve used has only a single diode. In mains equipment, the second diode normally present may serve some other purpose, such as noise suppression. When a single diode is available, the circuit in Fig. 2 will provide detection and A.V.C. Here, a battery type valve is shown, but the circuit is the

When the A.V.C. action of a receiver is insufficiently sensitive to deal with very weak signals, due to a small number of A.V.C. operated stages, it is most satisfactory to delay the operation of the A.V.C. in this manner. The receiver will thus be at maximum gain with all signal levels below that provided for, though no A.V.C. action will be obtained with such signals. Only when ample gain, with three or four controlled stages is available does the successful control of very low signal levels become feasible.

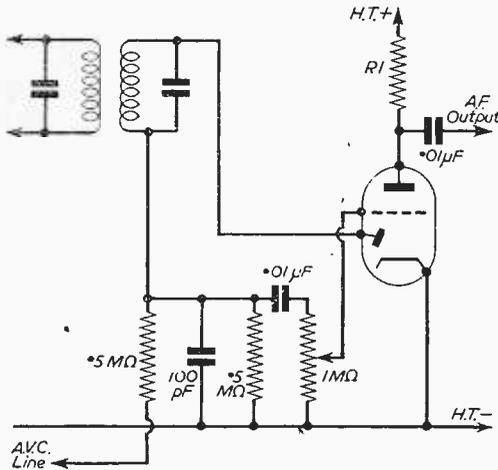


Fig. 2.—Circuit for single diode.

same for mains types. One .5 megohm resistor serves to decouple the A.V.C. line, while the second is the diode load. The potentiometer is for A.F. gain or volume control purposes. The operation of this circuit is basically the same as that in Fig. 1.

**Delay Voltage Circuits**

When the double diode cathode is at the same potential as the H.T. negative circuit, as in Fig. 1, an A.V.C. voltage will appear when any signal is present, however weak. This may be avoided by applying a positive voltage to the cathode. No A.V.C. action will then commence until the signal strength exceeds the delay voltage.

Fig. 3 shows a circuit of this kind. R1 will be the bias resistor for the triode section of the valve, allowing the triode grid to be negative, with respect to the cathode, to the required extent. The diode detector circuit is returned to the cathode, so that no potential difference exists between the cathode and this diode. The A.V.C. diode, however, is returned to the H.T. negative line, and the cathode will thus be positive, relative to it, by the extent of the combined voltage drop across R1 and R2. R1 and R2 will usually be in the neighbourhood of 1 K to 3 K each, according to the type of valve and amount of pre-detector gain.

It will be observed that some delay voltage will always be obtained with a double-diode-triode, when the cathode circuit has a bias resistor to permit proper operation of the triode section. Such a delay voltage will not be present when a diode alone is used, or when the cathode is returned directly to the H.T. negative line.

**Effect of Other Circuits**

With a given A.V.C. system, maximum efficiency will only be obtained when each A.V.C. operated stage is suitably arranged. An example of the effects of changes in circuit design will become apparent from Fig. 4. At "A" the screen grid voltage is obtained by means of a dropper resistor. As the valve control grid becomes more negative, due to the A.V.C. action on tuning in a station, the anode and S.G. currents will fall. The voltage drop in R1 will thus fall, increasing the S.G. voltage. This will, to some extent, oppose the reduction in gain brought about by the A.V.C. system, thereby reducing its efficiency.

At "B" the S.G. is supplied from a divider network R1 and R2. These resistors are of comparatively low value (10 K to 25 K) and the current passing through them is relatively large, compared with the valve S.G. current. As a result, the S.G. voltage will remain reasonably stable, irrespective of the S.G. current. The A.V.C. system can thus work at full efficiency.

A similar effect arises with cathode resistors, but is small when their value is low. If, however, a variable cathode control is used for manual purposes, the A.V.C. action on the valve will be much reduced especially as gain is diminished by means of the manual control. This is a defect largely inherent in such circuits, but can be somewhat offset by adding a resistor from cathode to H.T. positive so that the voltage drop across the control potentiometer is stabilised.

(Continued on page 241)

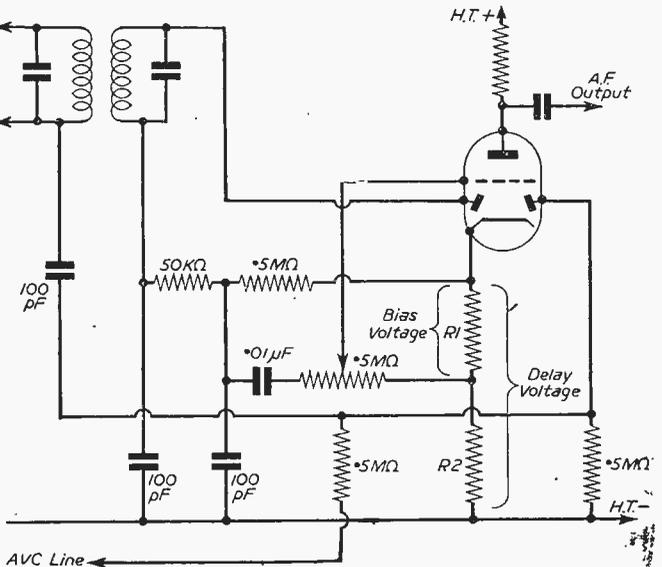


Fig. 3.—Delay voltage circuit.

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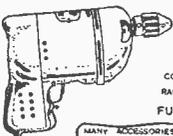
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In home-built equipment the bias resistors recommended by the valve makers should not be omitted, and will usually be of 250 to 500 ohms. Gain will usually be at maximum with the correct value, as the control grid will then not become positive with

latter may be used for detector and A.V.C. purposes, with the pentode section as A.F. amplifier. With a H.T. voltage of 180 to 300 this valve requires an anode load of .25 megohm, with the S.G. retained at 75 to 125 volts, or fed through a 1.2 megohm series resistor. For this valve R1 would be 1,800 ohms.

Because of the manner of operation some distortion arises when large A.V.C. voltages are applied to an A.F. stage. In equipment of the type in view this is not such a disadvantage as in broadcast band receivers where high quality is required. If the A.V.C. circuit gives a large A.V.C. voltage on maximum signal it may be necessary to feed the A.F. stage from a potential divider so that excessive voltage (with resultant distortion) is avoided here. This may be done by dividing the normal diode load resistor into two components, feeding the A.F. circuit from the junction of the resistors thus used.

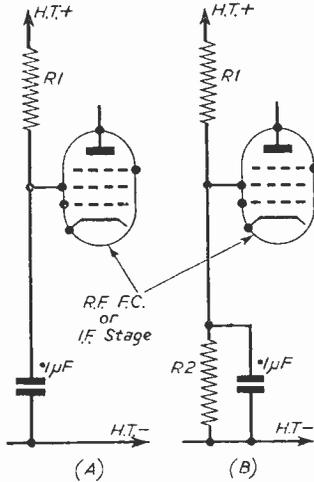


Fig. 4. — These two diagrams show the feeding of voltage to the screen grid through a series resistor and by means of a potential divider.

respect to the cathode under normal circuit conditions, as can arise when no bias is applied. Valve life will also be increased. If such resistors are omitted, the gain of the stage may be increased when a low A.V.C. voltage arises, which is exactly the reverse of the effect desired.

Controlling the A.F. Amplifier

Since a variation in signal strength must always be present at the A.V.C. diode, to control the A.V.C. system itself, complete control by means of pre-detector stages alone is impossible. To overcome this, one or more valves in the A.F. amplifier may be controlled by the A.V.C. system, a circuit such as that shown in Fig. 5 being employed.

Here, R1 provides the normal operating bias for the valve, while additional negative bias is applied to the control grid, via the .5 megohm resistors, under conditions of increasing signal strength. The gain of the stage is thus reduced when volume is high.

A suitable valve for this application is the 6B8G, which is an I.F./A.F. pentode with two diodes. The

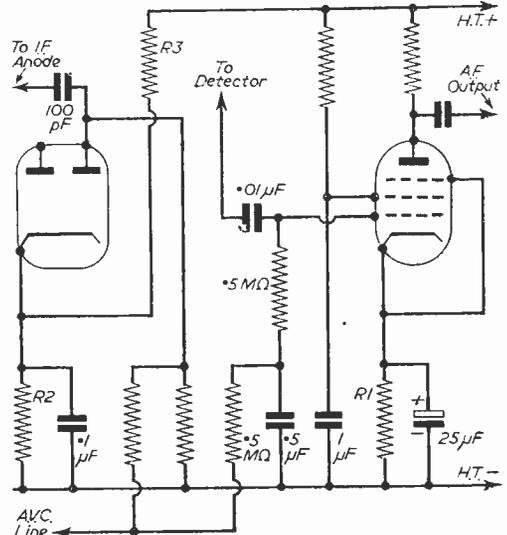


Fig. 5.—An A.V.C. operated A.F. stage.

Variable-Mu type valves are required for A.V.C. circuits, and this should not be overlooked when choosing a type for an A.F. amplifier. Low anode voltages should be avoided with such a stage, as increasing the possibility of distortion or overloading.

Grid Circuits

The A.V.C. voltage may be applied to the control grids of R.F., F.C. or I.F. stages by means of the coil or I.F. transformer winding, as shown at "A," in Fig. 6. The by-pass capacitor is required to complete the R.F. path to earth and, in conjunction with the resistor, prevents coupling through the A.V.C. line, which could otherwise cause instability. The condenser and resistor should be wired near the coil or transformer.

With some coil designs bottom-end coupling is used, the aerial being connected to the point marked "X." With such circuits the condenser forms part of the coupling circuit, and the value specified by the coil maker must be used. This condenser value may be much smaller than that shown, and a .1 microfarad component coupling would be signal strength much reduced.

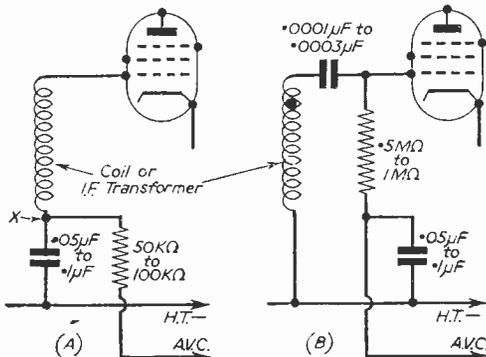


Fig. 6.—Controlled valve grid circuits.

With some types of switching or coils it is impossible or inconvenient to use the winding in this way, and the circuit at "B" can then be employed. The condenser and leak should be near the grid of the valve in question. If bottom-end or tuned anode coupling is used between R.F. and F.C. stages, the tuning

it is thus necessary to render the A.V.C. system inoperative. This can be done by wiring an on/off switch between the A.V.C. line and H.T. negative. When open, the switch will be set for R.T. reception, with the A.V.C. operating. When closed, it will be in the position for I.C.W. reception, with receiver at maximum gain. It is sometimes necessary to use such a switch with R.T. signals, when the proximity of a powerful I.C.W. station renders the A.V.C. system erratic.

To avoid undue time delay in the operation of the A.V.C. system, the time constant of the whole circuit should be kept low. This requires the use of by-pass condensers of moderate value, and the avoidance of extremely high values of load or decoupling resistors. Without attention to this, the A.V.C. system may become very sluggish and unable to deal with fading of a rapid nature.

Finally, Fig. 5 also shows how a delay voltage may be introduced with a double diode, the cathode voltage here depending upon the relative values of R2 and R3.

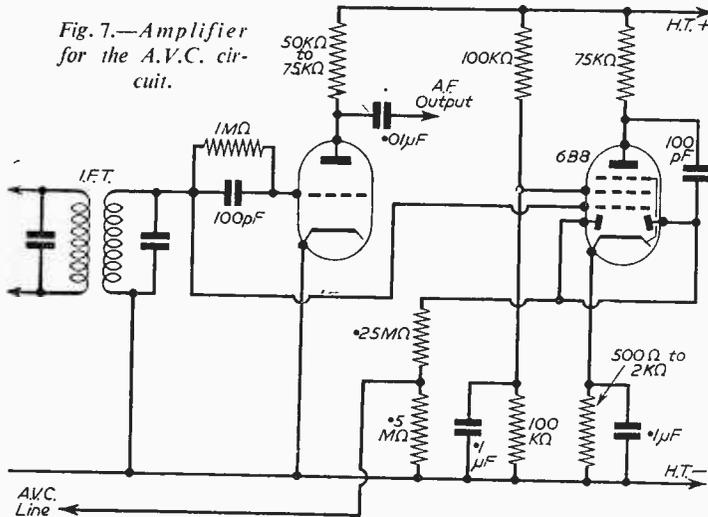


Fig. 7.—Amplifier for the A.V.C. circuit.

coil is at the same potential as H.T. positive, and the grid circuit at "B" then becomes essential. In such cases the insulation of the coupling condenser (.0001 to .0003  $\mu$ F) must be of high quality, or positive voltages will reach the control grid.

#### Amplified Circuit

The effectiveness of the A.V.C. system may be further increased by employing a valve to amplify the carrier available from the final I.F. stage. A circuit of this type is shown in Fig. 7. The carrier is applied to the control grid, the pentode section of the valve acting as a straight amplifier, so that the amplitude of the signal applied to the diodes is much increased. A.V.C. is taken from the diodes in the normal way.

When a grid detector is used, in the interests of high sensitivity, an A.V.C. stage of this type is very suitable, as no means of obtaining A.V.C. from the detector exist. With the grid leak type of detector, efficient pre-detector gain control, either by means of the A.V.C. system or a manual control (or both) is essential, as the advantage of high sensitivity to weak signals is offset by the ease with which such a detector may be overloaded. It is, of course, possible to use a separate valve for amplification, with this circuit.

#### R.T./I.C.W. Switching

With speech or music, the carrier level does not depend on the audio component, but upon the power of the station, and conditions such as distance and fading, which influence the signal strength at the receiver. It is to obtain a stable output under widely varying signal strengths that A.V.C. is employed.

But with I.C.W. Morse, no carrier is radiated during "silent" periods. To prevent erratic operation

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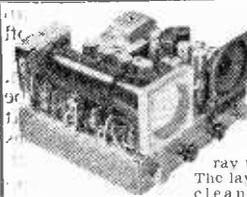
"RADIO" earphones which have no trailing wires and are not plugged into a point are manufactured by the Magnetic Broadcasting Co., Ltd., of Suffolk Hall, 1, Upper Richmond Road, S.W.15. Known as Stethophones—since they resemble doctors' stethoscopes—they give the wearer complete freedom of movement.

The 'phones are of purely mechanical construction. They have no valves, batteries, wire or cords. There is a volume control at each earpiece. Each pair weighs less than two ounces.

Hospital-type Stethophones have short extensions which are made to revolve so that the pole pieces may always remain in a vertical position even when the wearer is lying down. This also controls the power of each earpiece. Standard Stethophones have instead a knurled wheel on the back of each earpiece to control the volume.

When they are used in conjunction with a domestic radio the output of the set is fed into a step-down transformer to match a loop of wire (approximately 14 s.w.g.). The wire is laid round a skirting board, picture rail or outside wall. The loudspeaker can then be fitted with a potentiometer to control the volume without affecting the loop.

This induction radio system was invented by Victor A. Foot, F.Inst.P.I., A.M.Inst.B.E., who for many years has been a manufacturer of hearing aids. Retail price of Stethophones (both standard and hospital types) is £2 2s. a pair, and of forgnette-type 'phones £3 3s. each. Matching auto-transformers for domestic radios are 12s. 6d. each. Instructions for fitting the 'phones are provided with each pair.



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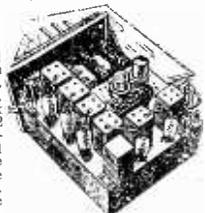
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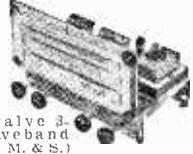
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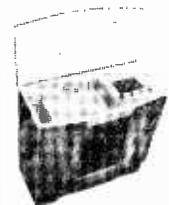
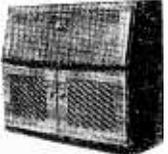
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**RECEIVER R155**

**BRAND NEW. AERIAL TESTED**  
In maker's original transit case. Now is the chance to get one from the best delivery we have had from the Ministry.

£11-19-6. Carr. 10/6  
Send S.A.E. for further details or 1/3 for publication giving circuit diagrams, etc. Others available from £9.10.0 according to condition.

**HEADPHONES.**—High Resistance Type CHR. New. 12/6 pair, post 1/6. **MICROAMMETERS.**—250 F.S.D. 3 1/4in. Flush Model 537. Specially scaled for test meters. Knife edge pointers, magnetic shield. Brand New. 55/-, 45 Mc/s **PYE IF STRIP.** These vision units are brand new and complete with 6 EF50 valves and EA50. Our price only 65/-, Post 2/6. **ROYALTY CONVERTERS.** Input 12 volts D.C. output 230 volts A.C. 50 cycles, 100 watt, 92/6 each. Also available with 24 volt input, carr. 7/6.

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**THE FIDELIA MAJOR 10**

Hand built high quality radiogram chassis at economic price. 10 valve, model illustrated, £32-8-4. De-luxe 9 valve model £25-5-0. 7 valve £21-12-0. 8 valve £24-18-4. F. M. Tuner £13-10-0. Technical data sheets free. Electro Acoustic Developments, 2, Amhurst Road, Telcombe Cliffs, Sussex.

**STAN WILLETTS**

43, Spon Lane, West Bromwich, Staffs. Tel.: WES. 2392.

- PACKARD BELL P.R.F. AMPLIFIER.**—Brand new, boxed, complete with valves 6SL7, 2BD7 and circuit. 12/6 p. & p. 9d.
- "ACOS" CRYSTAL PICK-UP (GP10).**—Brand new, boxed. 24/6 (list price 44/-), p. & p. 1/-.
- MALORY VIBRATORS.**—12 volt; 4-pin, brand new. 9/9 p. & p. 6d.
- "CYLDON."**—5-channel switched tele-tuners, complete with 2 valves. EP80, EOCB1. Brand new, boxed. 28/6 p. & p. 1/-.
- GERMANIUM XTAL DIODES.**—G.E.C. Brand new. 1/-, 10/9 doz., p. & p. 3d.
- VALVES.**—Brand new. Every one guaranteed. 6K7G, 4/6; 6K7 (metal), 5/-; EL32, 5/-; N77, 5/-; 6V6GT, 6/3; 6X5GT, 6/9; 6SN7, 6SL7, 7/6; 6J50, 4/9; 6SC7 (metal), 4/9; 6X4, 6/6; 6K8G, 8/6; RK34, 2C34, 1/9; AT4, 3/6; EA50, 1/9; 4D1, 8D2, 1/9; 8D2, 15D2, 3/6; EY51, 11/6; PCP80, PCC84, 9/9; R17, 7/6; 1T4, 8/6; 1S5, 6/9; 1S4, 6/9; 354, 6/9; Z77, 6/6. P. & P. 6d.

**WANTED—Valves.** Best price offered.

**ANNAKIN**

Condenser Bargains.—1 mfd. 2 Kv. Blocks 11d., 1 mfd., 350 v. blocks, 2d., 0.05 mfd. 1.5 Kv. tubulars, 6d., 50 mfd. 25 v. tubulars, 6d., 1.2 mfd. 600 v. blocks, 6d., 500 pf. silver mica, 3d., 30 pf. ceramic, 3d., 0.1 mfd. 150 v. tubulars, 3d., .002 mfd. or .004 mfd. mica, 2d. Hiss Filter Chokes 10/- post free. 0004 mfd. variables 1/3. Please send plenty of postage, surplus is refunded. C.W.O. only. Money Back Guarantee. Free Lists.

25, Ashfield Place, Otley, Yorks.

**TESTSCOPE Mains Tester**

For high and low voltage testing 1/- to 30 and 100-350 volts A.C. or D.C. Write for interesting leaflet 29F 16 page manual (how to make 50 electrical tests) 1/- post free.

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# News from the Trade

## Potted Iron-dust Aerial Coils

SOME newly introduced Osmor iron-core coils are available in two types: type P.M. for the medium waveband and P.L. for the long waveband. They are for use unscreened in normal superhet circuits where high gain is required with standard oscillator coils. The pots or cups provide efficient magnetic inductive screen. A range of these aerial coils is available and these standard production coils give the following "Q" readings at the frequency stated (Marconi "Q" meter).

Frequency (Kc/s)	Capacity	"Q"
1,200	100	160
980	150	185
852	200	198
695	300	205
600	400	205
545	475	200

Price 6s. each (retail). Osmor Radio Products, Ltd., 418, Brighton Road, South Croydon.

## 15in. Permanent Magnet Loudspeakers

A RECENT addition to the Plessey range of loudspeakers is a general purpose 15in. permanent magnet unit suitable for use in cinema and public address installations, or as the bass reproducer in dual loudspeaker systems, in which full use can be made of its low fundamental resonance and smooth response.

This loudspeaker is notable for its robust construction and the elaborate precautions which have been taken to ensure consistent results under the most adverse climatic conditions.

The chassis, which is cast in aluminium to give great mechanical stability and is finished in an attractive crackle black enamel, holds a felted cone driven by a 2in. speech coil. This is wound on an aluminium former and protected against atmospheric action by a baked varnish impregnation. Additional protection is given by the outside suspension and moulded speech-coil dome, which excludes all dust.

The coil moves in a gap having a field strength of 15,000 gauss, energised by a permanent magnet giving a total flux of 228,000 lines. The bass resonance can be arranged to occur at any frequency between 30 and 60 c.p.s. to suit individual requirements, while the useful high frequency response extends to 8 Kc/s.

The speaker can also be supplied, at slight extra cost, with a velour surround to the cone in place of the paper corrugations. This results in reducing the resonance to 25 c.p.s. and a somewhat smoother response characteristic.—Plessey Co., Ltd., Ilford, Essex.

## Heathkits

FOR some time now enquiries have been made concerning the special kits of parts for various types of equipment which are advertised in American publications under the trade name "Heathkit." These are test instruments, amplifiers and similar apparatus which have been supplied in complete sets of parts with blueprints, etc., for home construction, and they have hitherto not been available in this country.

With the easing of the dollar restrictions these kits are now being imported against specific orders, and

may be obtained from Rocke International, Ltd., of 59, Union Street, S.E.1.

It should be pointed out that the mains apparatus is for 110/120 volt operation, but a 220 volt step-down transformer may be used, and a supply of these at various wattage ratings is supplied by the same firm. In some cases the apparatus may be obtained without the American transformer, and thus a standard English transformer may be fitted. Full details of the apparatus available may be obtained on application to the above firm.

## Permabit Soldering Iron

AFTER spending a considerable amount of time on research and tests, Light Soldering Developments, Ltd., have evolved a permanent bit for soldering irons which is registered under the trade mark "Permabit." It is claimed that this bit lasts indefinitely, does not become pitted or lose its face, and requires no re-shaping, filing or maintenance. They are available in a fixed bit range of instruments and also as bits for replaceable types in all sizes.

	Complete		Spare
	Bit-Element Unit		
	£	s.	d.
½in. Fixed Permabit Iron ...	1	1	6
3/16in. " " " " ...	1	4	0
¼in. " " " " ...	1	5	6
⅜in. " " " " ...	1	8	6

Replaceable Permabit Bits		
Bit Diameter	Shank Diameter	Price each
		s. d.
½in.	3/32in.	2 10
3/16in.	9/64in.	3 3
3/16in.	3/16in.	3 6
¼in.	3/16in.	3 9
5/16in.	5/16in.	4 6
⅜in.	5/16in.	4 10

Light Soldering Developments, Ltd., 106, George Street, Croydon, Surrey.

## The Philips "Recordergram"

PHILIPS ELECTRICAL LIMITED announce the introduction of their new, lightweight, portable tape recorder Model AG.8105—to be known as the "Recordergram"—at the attractive price of 35 gns.

The accessories included in this price are a Philips crystal microphone, a 600ft. reel of high quality tape and a spare 5in. diameter take-up reel. The instrument is, therefore, completely ready for service without the purchase of additional equipment.

The "Recordergram" is housed in a neat grey case, measuring 13½in. by 10in. by 7in.; the total weight is only 21 lb. All the accessories are finished in cream and can conveniently be stowed away in the lid of the case when not in use. This compact tape recorder can also be used, in conjunction with the Philips "Disc-Jockey" or other record player, as an ordinary gramophone amplifier.

There is only one main control knob which can be turned to different positions—marked by clear symbols—to perform the following operations:—Recorder off; Amplifier on; Fast Wind; Fast Rewind (80 seconds for 600ft. tape); Playback; Record.

Philips Electrical Ltd., Century House, Shaftesbury Avenue, W.C.2.

# Programme Pointers



## This London of Ours

**T**RIPS round and about London are always pleasant to follow and listen to. There is so much we know and with which we have grown up. They recall some of our happiest memories and there is often much to be proud of, and feel affection for, the scenes visited and described. A well-conducted tour, as with the "Scrapbooks," is always a welcome item.

"Greenwich Palace" was no exception. Although it is a little off the "beaten track" of most of us, we have nevertheless been there. The historical details given us must either have renewed our interest in this very lovely building and its imperishable story or, if strangers to it, made us resolve to take that trip down the river and see it for ourselves at an early opportunity.

## "In All Directions"

A new series of Peter Ustinov's and Peter Jones's "In All Directions" has started. This very witty and sophisticated commentary on manners and customs, rather than on men and things, is often subtle to a degree. It makes fascinating listening as it chatters along, often skating over thin ice and occasionally running up against a boulder. That its quality varies from time to time is perhaps understandable and excusable. It is none the less a brilliant contribution to recent broadcasting.

"Programme Parade" has long seemed to me a superfluous intrusion into the otherwise even flow of programmes. Apart from being a concession to this very repetitious age we live in, it takes tunes, jokes, opinions, sentiments, etc., right out of their context and presents them to us in their least attractive light. Have we not *all* got our *Radio Times*, or our daily paper, at our elbow? Can a snippet from the "Goon Show" or the "Tschaikovsky Concerto" at 8.10 a.m. possibly whet anybody's appetite for the whole thing 12 hours later? It seems hardly possible, even if we remember it all that while.

## "Ghastly" Music

Mentioning "The Goon Show," compels me to say it is usually extremely funny if easily the noisiest and most obstreperous show on the air. Its signing-off tune is the second most horrible one in present-day radio. The "musical figure" half way through "What Do You Know?" is an easy winner. Ghastly and quite inexcusable.

Three interesting and worthwhile programmes were "A Cup To Be Filled," "Gold in the Street" and "The Tragic Clown." The first, written and produced by Eileen Capel and narrated by Duncan McIntyre, was all about those over sixty. "Gold in the Street," written and produced by Robert Pocock and narrated by Felix Felton and Frank Duncan, was the story of Hatton Garden, whilst

## Our Critic, Maurice Reeve, Reviews Some Recent Programmes

"The Tragic Clown" that ubiquitous and lovable character, speaks for itself. This was an anthology, excellently compiled and delivered by Richard Findlaker, assisted by James Langham, Eric Philipps and Harold Scott.

## Drama

There have been more interesting and entertaining plays. I liked "Waiting for Julia," which was not a play really, but a dramatisation by Peggy Wells of Nigel Balchin's novel "A Way through the Wood." Goozie Withers is such a fascinating person that even to only hear her is good enough return for staying home on a Saturday evening. When you can see her as well, then you have had your money's worth. (I essayed a film the other day and saw her for a fleeting moment in an advertisement for a washing soap. I shall always use that soap in future.) John McCallum, Hubert Gregg and others helped to vivify the story of what not to do if you knock someone over when driving your car, especially if that someone is "the other guy."

Sonia Dresdel chose Rattigan's "Love in Idleness" for her contribution to the *Stars in their Choices* series. This charming actress played the rôle of the woman who chose her son in preference to a stepfather for him—whom he hated for various reasons—with the greatest sympathy and conviction. Whether the subsequent marriage and happy ending make it one of Mr. Rattigan's best plays leaves me in some doubt. For myself, I rather fancy that either the renunciation of the son for a second husband or the sacrifice of him and all his wealth and luxury for the boy should have been the answer, not a hashed-up situation which removes insuperable barriers and makes the harmonious existence of all three under the same roof possible.

Christopher Marlowe's massive portrayal of that sinister period in our history, Edward the Second, was strong meat, and made excellent listening. The story of the ineffective King and his infatuation for the impostor and adventurer Gaveston, with consequences so grievous to the nation, was one which no Elizabethan dramatist would be expected to overlook. The adaptation and production of R. D. Smith were admirable, as were Richard Hurndall as Gaveston, Paul Schofield as Edward and a long and radio-ly-distinguished cast.

"The Duke in Darkness" and "Marie Lafarge" were fair to average. "The Warberg Wire Job" eloquently recounted the amazing wartime escape. Suitably glowing tributes were paid to that very great Nobel Prize winner, Albert Schweitzer.

### R.S.C. A4 HI-FIDELITY 25 WATT AMPLIFIER

A new design for 1955. "Push-Pull" output. "Built-in" Tone Control. Pre-amp stages. Increased sensitivity. Even further improved performance figures. Includes 7 valves, specially designed sectionally wound output transformer, block paper reservoir condenser and reliable small condensers of current manufacture. TWO SEPARATE INPUTS CONTROLLED BY SEPARATE VOLUME-CONTROLS allow simultaneous use of "Mike" and Gram, or Tape and Radio, etc., etc. INDIVIDUAL CONTROLS FOR BASS AND TREBLE. "Lift" and "Cut". Frequency response  $\pm 3$  db. 30-30,000 c/c. Six negative feedback loops. Hum level 66 db. down. ONLY 20 millivolts INPUT required for FULL OUTPUT. Certified harmonic distortion only 0.3% measured at 10 watts. Comparable with the very best designs.

ENTIRELY SUITABLE FOR SMALL HOMES OR LARGE HALLS, CLUBS, GARDEN PARTIES, DANCE HALLS, etc. etc. For ELECTRONIC ORGAN or GUITAR. For STANDARD RECORDS or LONG-PLAYING RECORDS. FOR ANY "MIKE" or PICK-UP.

**9 GNS.**



Size approx. 12-2 1/2 in. For A.C. mains 200-250 v. 50 c/s. Outputs for 3- and 15-ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Unapproachable value at 9 Gns. or ready for use, 50/- extra. If required, cover as illustrated can be supplied for 17/6. H.P. TERMS AVAILABLE.

**BATTERY SET CONVERTER KIT.** All parts for converting any type of Battery receiver to All Mains. 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v., 90 v. or 80 v. at up to 40 mA. and fully smoothed L.T. or 2v. at 0.4 to 1 a. Price, complete with circuit, wiring diagrams and instructions, only 43/9. Or ready to use, 8/9 extra.

**PERSONAL SET BATTERY SUPERSEDER KIT.** A complete set of parts for construction of a Unit (housed in metal case) to replace Batteries where A.C. Mains supply is available. Input 200-250 v. 50 c/s. For 4 valve receivers requiring 90 v. 10/20 mA. and 1.4 v. 250 mA., fully smoothed. Price complete with circuit. Only 35/9. Or ready to use, 42/6. Size of unit, 5 1/4 x 4 1/4 in.

**BATTERY CHARGER KITS**  
For mains 200-250 v. 50 c/s.  
To charge 6 v. acc. at 2 a., 25/6.  
To charge 6 or 12 v. acc. at 2 a., 31/6.  
To charge 6 or 12 v. acc. at 4 a., 49/9.  
Above consist of transformer, full wave rectifier, fuses, fuseholders and steel case. Any type assembled and tested, 6/9 extra.

**THE SKY CHIEF T.R.F. RECEIVER.** A design of a 4-stage, 3-valve 200-250 v. A.C. Mains receiver with selenium rectifier. It consists of a variable Mu high gain H.F. stage followed by a low distortion grid detector triode. The next stage is a further triode amplifier with tone correction by negative feedback. Finally comes the output stage consisting of a parallel connected double triode giving ample output at an extraordinarily low level of distortion. Point to point wiring diagrams, instructions, and parts list, 2/6. This receiver can be built for a maximum of 44/19/6 including attractive Brown or Cream Bakelite or Walnut veneered wood cabinet 12 x 6 1/2 x 5 1/2 in.

**VOLUME CONTROLS** with lons (1/2 in.) spindles, all values, less switch, 2/6, with S.P. switch, 3/9. D.P. sw., 4/9.

**ELECTROLYTICS** (Current production-Not ex-Govt.)

<b>Tubular Types</b>		8uF 500 v.	2/6
8uF 350 v.	1/9	16uF 450 v.	2/9
8uF 450 v.	1/11	24uF 350 v.	2/11
8uF 500 v.	2/11	32uF 350 v.	2/11
16uF 350 v.	2/3	32 mfd. 450 v.	4/9
16uF 450 v.	2/9	40uF 450 v.	4/11
24uF 350 v.	3/6	64uF 450 v.	3/9
32uF 350 v.	3/6	8-8uF 350 v.	3/9
25uF 25 v.	1/9	8-8uF 450 v.	3/9
50uF 12 v.	1/3	8-16 mfd. 450 v.	2/11
50uF 50 v.	2/3	8-16uF 450 v.	3/11
<b>Can Types</b>		16-16uF 450 v.	4/11
8 mfd. 350 v.	1/3	16-32uF 350 v.	5/3
8uF 450 v.	2/3	32-32uF 450 v.	5/11

Terms: C.W.O. or C.O.D. NO C.O.D. under £1. Post 1/- extra under £10; 1/6 extra under £1; 2/6 extra under £3. Open 9 to 5.30; Sats. until 1 p.m. List 6d., Trade List 5d. S.A.E. with all enquiries.

# RADIO SUPPLY CO. 32, THE CALLS, LEEDS, 2

### R.S.C. 10 WATT "PUSH-PULL" HIGH-FIDELITY AMPLIFIER A3

Ideal for the quality enthusiast in the home or small hall. Two different inputs can be simultaneously applied and controlled by separate volume controls. Any kind of Pick-up is suitable and most microphones. Tone controls give full Long Playing record equalisation. For uncorrected Pick-ups sensitivity is very high. Only 130 millivolts required for full output. H.T. and L.T. available for Radio Feeder unit.

Complete with integral Pre-amp. Tone control stage (as A4 amplifier), using negative feedback, giving humproof individual bass and treble lift and cut tone control. Six Negative Feedback Loops. Completely negligible hum and distortion. Frequency response  $\pm 3$  db. 30-20,000 c.p.s. Six valves. A.C. mains 200-250 v. input only. Outputs for 3 and 15 ohm speakers. Kit of parts complete in every detail. 7 Gns. plus 5/- carriage or ready for use, 45/- extra. Illustrated leaflet 6d. Cover as for A4 is suitable.

**H.M.V. LONG PLAYING RECORD TURNABLE WITH CRYSTAL PICK-UP** (Sapphire Stylus). Speed 33 1/3 r.p.m. For A.C. mains 200-250 v. Limited supply. Brand New Cartonned. Perfect. Only £3/19/6. Plus carr. 5/- (Normal price £3 approx.).

**A PUSH-PULL 3-4 watt HIGH-GAIN AMPLIFIER FOR £3/7/6.** For mains input 200-250 v. 50 c/s. Complete kit of parts including circuit, point to point wiring diagram and instructions. Amplifier can be used with any type of Feeder Unit or Pick-up. This is not A.C./D.C. with "live" chassis, but A.C. only with 400-0-400 v. trans. (Output is for 2-3 ohm speaker.) Supplied ready for use for 25/- extra. Carr. 2/6. Descriptive leaflet, 7d.

**FOUR STAGE RADIO FEEDER UNIT.** Design of a High Fidelity Toner Unit. L. & M. Wave. Full decoupling. Self-contained heater supply. Detailed wiring diagrams, parts list, and illustration, 2/6. Total building cost, £3/15/-.

**P.M. SPEAKERS.** All 2-3 ohms. 6 1/2 in. Plessey, 16/9. 8 in. Plessey, 16/9. 10 in. Plessey 19 6. 10 in. R.A. 26/9. 10 in. Rola with trans. 29/6. 10 in. W.B. "Stentorian" 3 or 15 ohm type HF1012 10 watts. Highly recommended for use with any of our amplifiers, £3/13/6.

**MICROPHONES.** Crystal type, good quality. Recommended for use with our amplifiers. Hand type, 50/-; Stand type, with adjustable stand, £6/19/6.

**COAXIAL CABLE.** 75 ohms. 1 in., 7d. yard. Twin Screened Feeder, 9d. yard. **M.T.E. SPEAKERS:** All 2-3 ohms. 8 in. R.A. Field 500 ohms, 12/9. 10 in. R.A. Field 1,000 or 1,500 ohms, £3/9.

SELENIUM RECTIFIERS		H.T. Types H.W.	
L.T. Types		150 v. 40 mA	3/9
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F.W. Bridge Type		250 v. 80 mA	7/9
6/12 v. 1 a.	4/9	RMA 250 v. 250 mA	11/9
6/12 v. 1.5 a.	7/6		
6/12 v. 2 a.	8/9		

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

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

TOP SHROUDED DROP THROUGH	
250-0-250 v. 70 mA. 6.3 v. 2.5 a.	12/11
260-0-260 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.	23/9
0-4-5 v. 3 a.	23/9
350-0-350 v. 150 mA. 6.3 v. 4 a. 5 v. 3 a.	28/9
350-0-350 v. 150 mA. 6.3 v. 2 a. 6.3 v. 2 a.	31/6
5 v. 3 a.	

**FILAMENT TRANSFORMERS**  
All with 200-250 v. 50 c/s primaries 6.3 v.

1.5 a. 5/9; 1.63 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 2.4 v. 1.5 a. 17/6

**FULLY SHROUDED UPRIGHT**

250-0-250 v. 60 mA. 6.3 v. 2 a. 5 v. 2 a.	17/6
Midget type 21-31n.	
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 v.	21/9
C.T. 0-4-5 v. 3 a.	27/9
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For R1355 conversion	
300-0-300 v. 100 mA. 6.3 v. 4 v. 4 v.	27/9
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350-0-350 v. 100 mA. 6.3 v. 4 a. 5 v. 3 a.	27/9
350-0-350 v. 100 mA. 6.3 v. 4 v. 4 v.	27/9
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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	
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5 v. 3 a.	

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All with 200-250 v. 50 c/s Primaries:  
0-9-15 v. 1 a. 11/9; 0-9-15 v. 3 a. 16/9;  
0-9-15 v. 5 a. 19/9; 0-9-15 v. 6 a. 22/9.

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250 mA 3-5 H 100 ohms	11/9
150 mA 7-10 H 250 ohms	11/9
100 mA 10 H 175 ohms Potted	8/9
80 mA 10 H 350 ohms	6/6
60 mA 10 H 800 ohms	4/11

**E.H.T. TRANSFORMERS**  
2,500 v. 5 mA. 2-0-2 v. 1.1 a. 2-0-2 v.  
1.1 a. for VCR57, VCR517, etc. 36/6

**OUTPUT TRANSFORMERS**  
Midget Battery Pentode 66: 1 for 354, etc.

Small Pentode, 5,000 $\Omega$ to 30 $\Omega$	3/9
Standard Pentode, 5,000 $\Omega$ to 30 $\Omega$	4/9
Standard Pentode, 7,000 $\Omega$ to 30 $\Omega$	4/9
Standard Pentode, 10,000 $\Omega$ to 30 $\Omega$	4/9
Multi-ratio, 10 mA. 30:1, 45:1, 60:1, 90:1, Class B Push-Pull	5/6
Push-Pull 10-12 watts 6V7e to 3n or 15 $\Omega$	15/9
Push-Pull 10-12 watts to match 6V6 to 3-5-3 or 15 $\Omega$	16/9
Push-Pull 20 watts, sectionally wound 6L6, KT66, etc., to 3 or 15 $\Omega$	47/9
Williamson type exact to spec.	85/-

(LEEDS) LTD.



# Open to Discussion



## Economy Quality Receiver

**SIR**,—I don't think much of Mr. Stevens's idea of connecting the screen directly to the oscillator anode in his "Economical Quality Receiver." The screen is floating at R.F. and at the oscillator frequency, and it is unlikely that the circuit will perform at its best under these conditions.

I should think it would be better to feed the oscillator anode in series with the coupling L3, taking the screen from the earthy and decoupled end of this coil. This simply means the use of a 0.1  $\mu$ F condenser (or thereabouts), and with C13 not now required, no change in the number of components is necessary.—S. A. KNIGHT (Chelmsford).

## Ex-R.A.F. Receivers

**SIR**,—Here is some data about certain ex-R.A.F. receivers which may be of interest to readers:

R1132A.—I.F. 12 Mc/s (about), not 22 Mc/s as is popularly believed. The 6J5 output valve will operate a 5in. speaker connected to the phone jack. In many sets the 25  $\mu$ F electrolytic capacitor is dry and useless.

The A.G.C. delay voltage is large and a very strong signal is necessary to make the needle of the tuning meter move back.

If the set be converted for "144" or some frequency higher than about 130 Mc/s, the mica 0.001  $\mu$ F condensers in the R.F. unit should be replaced by ceramics.

R1147A & B.—The 1147A has acorn valves both in the R.F. unit and the two I.F. stages. They are four of 954 and one of 955. The 1147B has in the R.F. unit two EF54's (VR136) and one EC52 (VR137) as in the R.F. 26 and 27 units. The I.F. valves are EF50's. The I.F. is about 70 Mc/s. The BFO is an audio-oscillator because a stable 70 Mc/s single-valve oscillator is extremely difficult to construct.

Both sets tune around 200 Mc/s and will therefore convert to Band III if required (170 Mc/s to 216 Mc/s). The fibre insulation in the R.F. unit is very fragile in most sets due to age.

Type 25/73 set (from TR1196).—I.F. 460 kc/s. The two 2 K resistors in the I.F. cans are R13 and R16, and are anode stoppers. On conversion these resistors need not be removed. The socket board on the R.F. unit is for crystals (quartz, not germanium).

The BFO is permanently "on," and cannot be disconnected unless the A.G.C. coupling to the second diode of the EBC33 is reconnected to the anode of the EF39 I.F. amplifier. This may, however, give too low an A.G.C. voltage (about 25 volts is required) and some other means must then be devised. R18 is very useful as an R.F. gain control. The EBC33 will not work a loudspeaker satisfactorily.—T. WOODGATE (Chislehurst).

## I.F. Adjustment

**SIR**,—I was recently informed that the latest practice is to "peak" I.F. at 470 kc/s instead of the more usual 465 kc/s, this being done to help overcome the increasing interference on the M.W. I would be interested to hear any PRACTICAL WIRELESS readers' comments on this.—R. BAYLY (Edgware).

## Universal Push-button 4

**SIR**,—I was very interested in the design published in the August issue as it appeared to offer scope for what I had in mind. At the risk of boring you, I would like to say that I studied the circuit and then proceeded to adapt it to my needs. At once you will say that I did wrong and that one should never try and make a new design from an old one, but what I thought was that I did

not need to buy a push-button unit, and I had four valves on hand. In place of the buttons I used three on/off switches, a line cord which I had available, and with trimmers and other parts from my spares box I built the set. Total cost was 5s. for two resistors and a new valveholder, plus a small sheet of plywood. When I switched on the set was perfectly stable and the local was soon tuned in. I have a job to know what setting to use for the selector switches as I get so many stations, but have settled on three to give me adequate reception.

I might mention that I am over sixty and that this was the first set I have constructed since pre-war days.

Thanks again for a good design.—G. FRANKS (Edgware).

## Licence Legality

**SIR**,—In "Comments of the Month" in your February issue, you state that "thousands of people have been fined and their convictions recorded for the non-payment of wireless licence fees which, as it now turns out, were illegally demanded. The proposed retrospective legislation should contain a clause ordering these convictions to be expunged from the records and the fines refunded."

In fact, the people to whom you refer were convicted and fined for operating a wireless receiver without a licence. The Attorney General stated in the House of Commons on December 10th, 1954 (Hansard Col.1256), that "the (Validation of Charges) Bill relates to charges for licences. It does not relate to the necessity to hold a licence for a wireless receiving set. No question arises as to convictions of those who have had wireless sets without licences."—T. A. O'BRIEN, Public Relations Officer, G.P.O., E.C.1.

*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 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 New Formula?"

SIR,—I was interested in H. Dobson's letter on a new formula he had discovered (March issue).

Although I have never seen it written in a text book, I have used it a lot at the technical college. In actual fact, it is just the numerical part of the standard equation:  $x_c = \frac{10^8}{\omega C}$  after it has been equated.

From  $x_c = \frac{10^8}{\omega C}$  where C is in  $\mu F$  we get

$$x_c = \frac{10^8}{2\pi} \times \frac{1}{fC}$$

$$\text{Equating } \frac{10^8}{2\pi} = 159,200 \approx 160,000$$

∴ it can be said that

$$\frac{160,000}{fC} \approx x_c$$

which Mr. H. Dobson says is well within 1 per cent.

As a matter of fact, when using this equation to solve various problems I usually set my slide rule to just below 160,000, which cuts down errors later on in the problems.—MICHAEL J. S. PEAK (Willerby).

SIR,—In reply to Mr. Dobson's query in connection with the equation  $X_c = \frac{160,000}{fC}$  for calculating capacitive reactance, the explanation relies upon assuming a value of 6.25 or  $\frac{25}{4}$  for  $2\pi$  in place of the more accurate value of 6.28.

The normal equation for determining the reactance of a capacitor is written  $X_c = \frac{10^8}{2\pi fC}$  where  $X_c$  is expressed in ohms,  $f$  in c/s and  $C$  in microfarads.

This equation can be rewritten  $X_c = \frac{10^2}{2\pi} \times \frac{10^4}{fC}$

Substituting  $\frac{25}{4}$  for  $2\pi$  we immediately reach the

$$\text{form } X_c = \frac{4 \times 100}{25} \times \frac{10^4}{fC} = \frac{16 \times 10^4}{fC} = \frac{160,000}{fC} \text{ ohms.}$$

The percentage error incurred in approximating  $2\pi$  as 6.25 in place of 6.28 is calculated as follows:

$$\frac{6.28 - 6.25}{6.28} \times 100 = \frac{.03 \times 100}{6.28} = \frac{3}{6.28}$$

or less than .5 per cent.

It is indeed a useful mathematical "dodge."—N. CRAIG (West Cumberland).

## News from the Clubs

### AMATEUR TAPE RECORDING SOCIETY

Hon. Sec. : P. N. Hollis, 143, Lymington Avenue, Leigh-on-Sea, Essex.

ALL correspondence concerning membership of the above Society should be addressed to the assistant secretary, Mr. G. A. Widdup, 92, Halifax Road, Rochdale.

The Society was founded in 1952, the idea being to personally contact other members through the medium of recording tape. Members usually use the small 600ft. reels, double track, and at a speed of 7 1/2 in. per second; this gives a half-hour's recording. This type of reel usually costs 4d. or 5d. through the post and, as one can realise, all manner of subjects can be recorded to each other, musical items, etc. There is no subscription, the only rules being as follows:

1. Members are requested to handle with particular care other members' tape and to return same, with recorded reply, within 10 days.

2. Members are asked to carefully pack tape reels and always secure parcel with string.

3. Members should first contact other members by letter, advising tape speed, size of reel to be used, and whether single or double track recording contemplated.

We have at the moment only 12 active members, but, as many more people are either constructing recorders or purchasing commercial ones, no doubt membership will increase.

### SOUTHEND & DISTRICT RADIO SOCIETY

Hon. Sec. : J. H. Barrance, M.B.E., 49, Swanage Road, Southend-on-Sea, Essex.

INSTEAD of the ordinary meeting on Friday, February 4th, a visit to the power station at Barking was arranged for members of the Society through the good offices of Mr. E. V. C. Habgood, a committee member, and organised by the newly appointed social secretary, Mr. C. G. Collop.

The party was met at the entrance by Mr. R. M. Sephton, one of the station engineers. After signing the visitors book, the party was conducted over this gigantic steam generating station, the largest in Europe.

### HAWKING RADIO SOCIETY

Hon. Sec. : Geo. Shankie, 17, Etrick Terrace, Hawick.

AT the last two fortnightly meetings Mr. Vinnicombe, GM8RY, gave a talk on "Ohms Law in Radio" and Mr. Horne a talk on "Capacitance and Inductance in Radio."

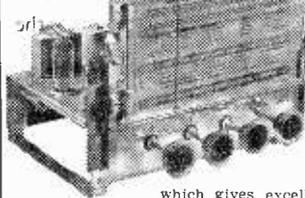
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The three receivers are for operation on A.C. mains, and employ the very latest miniature valves. They are designed to the most modern specification, great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both gram, and radio, making them the ideal replacement chassis for that "old Radiogram," etc.

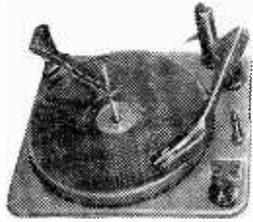
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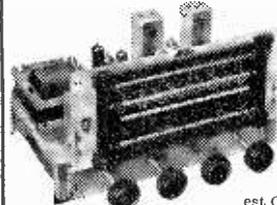
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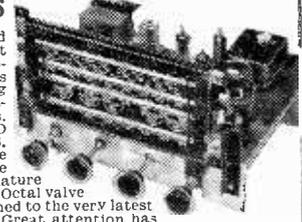
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- (b) LEAK model T.L.40, together with Pre-Amplifier Tone Control Unit.
- (c) OSRAM "12" AMPLIFIER available as an assembled amplifier.
- (d) MULLARD AMPLIFIER, also available completely assembled.
- (e) STERN'S PRE-AMP./TONE CONTROL UNIT. Can be used with any amplifier.
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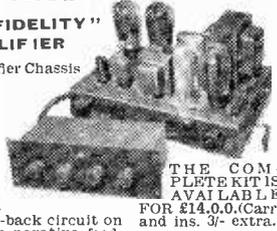


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PRICE OF COMPLETE KIT, INCLUDING VALVES AND DRILLED CHASSIS **£7.10.0.** (Plus 2/6 carr. and ins.) **WE WILL SUPPLY IT COMPLETELY BUILT FOR £9.10.0.** (Plus 5/- carr. and ins.) Designed for high quality reproduction up to an output level of 10 watts, having 6V6s in Push-Pull and incorporating negative feedback. Suitable for use with all types of Pick-ups and most types of microphones and the output transformer provides for use of 3 and 15 ohm speakers. **BRIEF FEATURES:**

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**WINWOOD FOR VALUE.**—Baker 12in. P.M. list 5 gns. 82/6; Elac 8in. P.M. list 29/-, 23/6; Coilpacks, L.M. and S. 23/6; Fil/trans. 207-240v. 6.3v at 1.5A. 5/9; O/trans. Mid-geat, 4/3; Miniature, 4/6; Stnd Pent. 4/9; M/ratio-P/ull, 6/-; Card/tub. 8 mf-500v. 2/3; 500K V/Cntrls. 1/-; X/tal Diodes, 1/6; Circuit and data for 3-stage Amplifier, AC or AC/DC, 1/3; 5-valve P/ull Amplifier, 1/6; 1d. stamp for full list. WINWOOD, 12, Carnarvon Rd., Leyton, E.10. (Mail only.)

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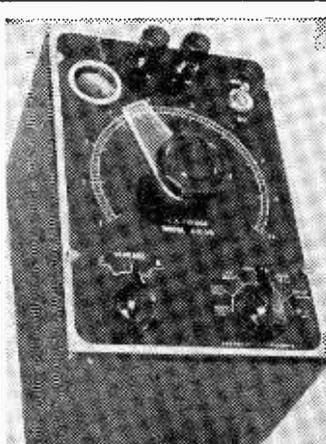
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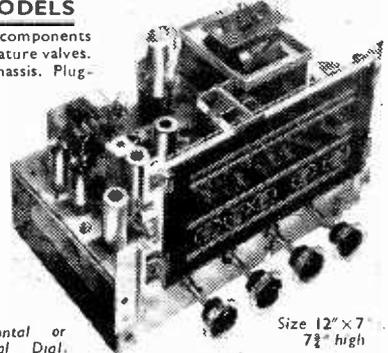
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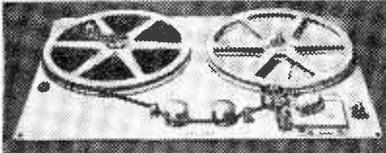
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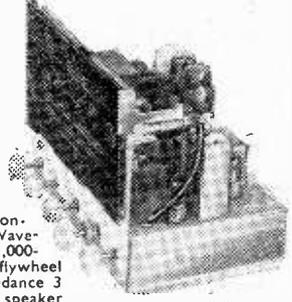
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## AMATEUR WIRELESS AND WIRELESS MAGAZINE

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### SPECIAL NOTE

THESE blueprints are drawn full size. The issues containing descriptions of these sets are now out of print, but an asterisk denotes that constructional details are available, free with the blueprint.

The index letters which precede the Blueprint Number indicate the periodical in which the description appears. Thus P.W. refers to PRACTICAL WIRELESS, A.W. to Amateur Wireless, W.M. to Wireless Magazine.

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

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#### Mains Operated

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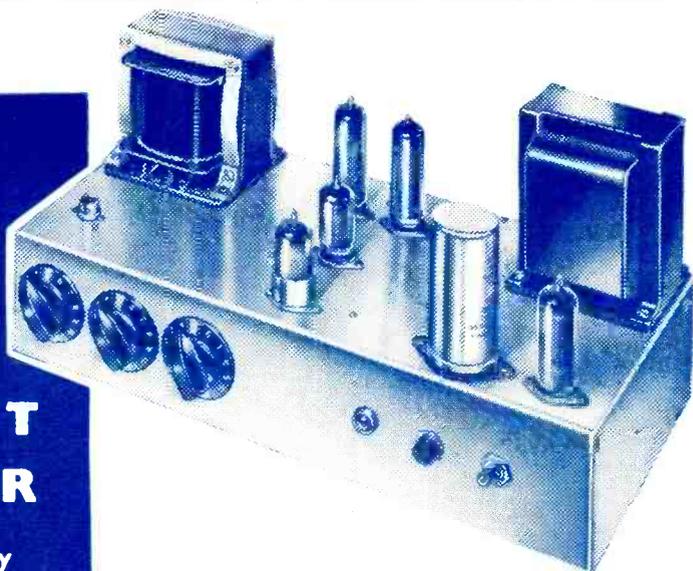
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