A PUSH-PULL GRAMOPHONE AMPLIFIER

PRACTICAL WIRELESS

1/3

DECEMBER 1957

EDITOR: F. J. CAMM

CONTENTS

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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 µF.	Peak Wkg. Volts	Surge Volts	Dimns. in Ins.		Type No.	List Price Each
			Length	Diam.		
50	12	15	1 5/8	13/32	CE87B	2/9
25	50	60	1 11/16	15/32	CE88DE	3/-
1	350	400	1 5/8	3/8	CE86L	2/6
8	350	400	1 13/16	17/32	CE99LE	3/3
16	350	400	2 5/16	13/32	CE91LE	4/-
32	350	400	2 5/16	1 1/16	CE90LE	6/-
4	450	550	1 13/16	17/32	CE99PE	3/3
8	450	550	1 13/16	13/16	CE90PE	3/6
16	450	550	1 13/16	1 1/16	CE92PE	5/-
32	450	550	2 13/16	1 1/16	CE94PE	7/6

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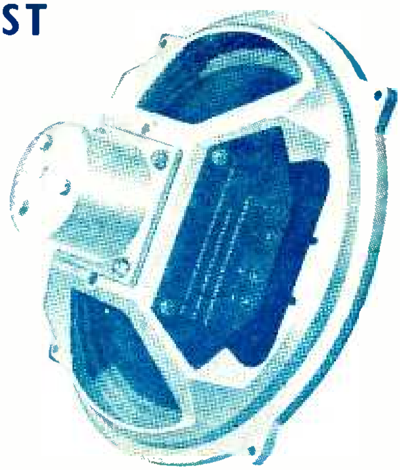

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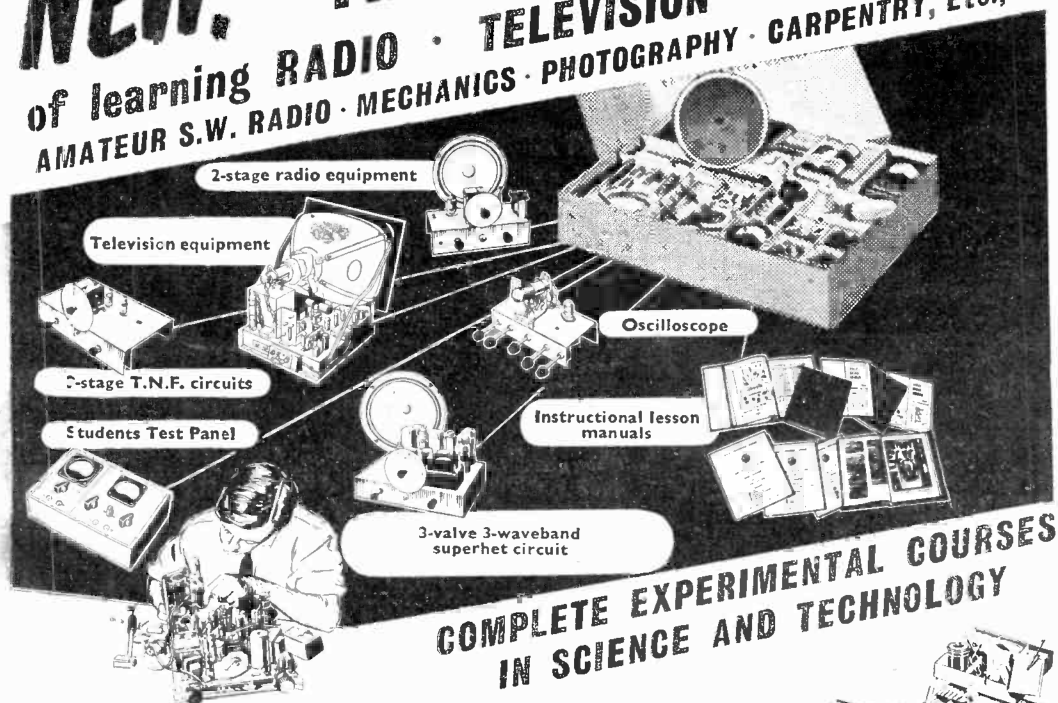

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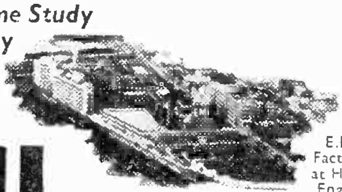

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R.S.C. BATTERY CHARGING EQUIPMENT

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

ASSEMBLED CHARGERS

6 v. 1 amp. ... 19 9
6 v. or 12 v. 1 amp. ... 27 9
6 v. 2 amps. ... 29 9
6 v. or 12 v. 2 amps. ... 38 9
6 v. or 12 v. 4 amps. ... 59 9
Above ready for use. Carr. 3/6. With mains and output leads.

SELENIUM RECTIFIERS

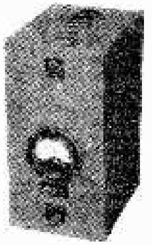
6/12 v. 1 a. 4 11	L.T. Types H.W.	6-12 v. ½ a. H.W.	2 9
6/12 v. 2 a. 8 9	H.T. Types H.W.		
6/12 v. 3 a. 11/9			
6/12 v. 4 a. 14 9	150 v. 40 mA.		3 9
6/12 v. 6 a. 19/9	250 v. 50 mA.		5 9
6/12 v. 10 a. 25/9	250 v. 80 mA.		7 9
6/12 v. 15 a. 35/9	250 v. 150 mA.		9 9
	250 v. 250 mA.		11 9

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

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

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

ASSEMBLED CHARGER 6 v. or 12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use. With mains and output leads. Double Fused. Only **47/9** Carr. 3/9.



Assembled 6 v. or 12 v. 4 amps. Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Louvred steel case with stoved blue hammer finish. Fused and ready for use with mains and output leads. **75/-** Carr. 3/9.

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

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

TOP SHROUDED DROP THROUGH

250-0-250 v. 70 mA. 6.3 v. 2 a. 5 v. 2 a. 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 v. 4 a. C.T. 0-4-5 v. 3 a. ... 23 9
350-0-350 v. 150 mA. 6.3 v. 4 a. 5 v. 3 a. 29 9

FULLY SHROUDED UPRIGHT

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

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

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

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

CHARGER TRANSFORMERS All with 200-230-250 v. 50 c/s Primaries: 0-9-15 v. 1½ a. 11 9; 0-9-15 v. 3 a. 16 9; 0-3-5-9-17 v. 3 a. 17 9; 0-9-15 v. 5 a. 19 9; 0-9-15 v. 6 a. 23/9.

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

OUTPUT TRANSFORMERS
Midget Battery Pentode 66:1 for 3S4, etc. ... 3 9
Small Pentode 5,000Ω to 3Ω ... 3 9
Small Pentode 7/8,000Ω to 3Ω ... 3 9
Standard Pentode 5,000Ω to 3Ω ... 4 9
Standard Pentode 7/8,000Ω to 3Ω ... 4 9
10,000Ω to 3Ω ... 4 9
Push-Pull 10-12 watts 6V6 to 3Ω or 15Ω ... 15 9
Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω ... 16 9
Push-Pull EL84 to 3 or 15Ω ... 16 9
Push-Pull 15-18 watts, 6L6, KT66 ... 22 9
Push-Pull 20 watts, sectionally wound 6L6, KT66, etc., to 3 or 15Ω 47 9

MAINS TRANSFORMERS Manufacturers' surplus. Primaries 200-250 v. 50 c/s. 250-0-250 v. 70 mA. 6.3 v. 2.5 a. Drop through type, 11 9. 375-0-375 v. 150 mA. 6.3 v. 4 a. C.T. 6.3 v. 1 a. Fully shrouded, 22 9. Postage 2/9 on either type.

SPECIAL OFFERS: Electrolytics. 32-32-32 mfd. 250 v. Dubilier small can. 2/9 ea. 150 mfd. 450 v., 3 9. Small .0005 mfd. 2-gang, 4 9 ea. Westinghouse Rectifiers 250 v. 250 mA. 7 9. **CO-AXIAL CABLE.** 75 ohm. ¼in. 8d. yd. Twin-Screened Feeder 11d. yd.

EX-GOVT. SMOOTHING CHOKES
300 mA. 20 H 200 ohms ... 19 9
250 mA. 5 H 50 ohms ... 12 9
150 mA. 10 H 100 ohms ... 11 9
150 mA. 6-10 H 150 ohms Trop. ... 6 9
120 mA. 12 H 100 ohms ... 9 9
100 mA. 5 H 100 ohms ... 3 11
80 mA. 10 H 150 ohms ... 3 11

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

THE SKYFOUR T.R.F. RECEIVER. A design of a 3-valve Long and Medium wave 230-250 v. A.C. Mains receiver with selenium rectifier. It consists of a variable Mu high-gain H.F. stage followed by a low distortion anode bend detector. Power pentode output is used. Valve line-up being 6K7, SP61, 6V6G. Selectivity and quality are well up to standard, and simplicity of construction is a special feature. Point-to-point wiring diagrams, instructions and parts lists, 1 9. This receiver can be built for a maximum of £4 19/6, including attractive Brown or Cream Bakelite or Walnut veneered wood cabinet 12 x 6½ x 5½in.

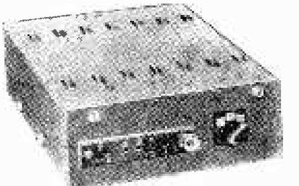
EX-GOVT. DOUBLE WOUND STEP UP STEP DOWN TRANSFORMERS. 10-0-100-200-220-240 v. to 5-0-75-115-135 v. or REVERSE. 80-100 watts. Only 11 9, plus 2 9 post. 10-0-100-200-220-240 v. to 9-0-110-122-136-148 v. or REVERSE. 200 watts, 35/9, plus 7 6 carr. Both 50 c.p.s.

EX-GOVT. MAINS TRANSFORMER. Primary 0-110-120-200-210-220-230-240-250 v. 50 c.p.s. Secs. 275-0-275 v. 100 mA. 6.3 v. 7a. 5 v. 3 a. Govt. rating, 18 9. Following with 230-250 v. primaries. 400-0-400 v. 200 mA. 5 v. 3 a. 5 v. 2 a. 19 9; 230-0-230 v. 100 mA. 12.6 v. 1.5 a. 5 v. 2 a., 11 9; 12.6 v. 3 a. 5 v. 3 a., 9/9. Postage 2 9 on any type.

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

R.S.C. BATTERY TO MAINS CONVERSION UNITS

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



Type BM2. Size 8 x 5½ x 2½in. Supplies 120 v. 90 v. and 60 v., 40 mA. and 2 v. 0.4 a to 1 amp. fully smoothed. Thereby **completely replacing both H.T. batteries and L.T. 2 v. accumulators.** When connected to A.C. mains supply 200-250 v. 50 c/s. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulator.

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

Complete kit of parts with diagrams and instructions, 49 9, or ready for use, 59/6

JUNCTION TRANSISTORS. Red Spot Audio Type only 7 6 each. R.F. Type 17 6.

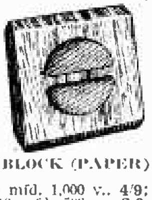
VOLUME CONTROLS with long (¼in. diam.) spindle, all values less switch, 2 9; with S.P. switch, 3 9; with D.P. switch, 4 6.

MINIATURE MOTORS, 24/28 v. D.C. or A.C. made by Hoover Ltd., Canada. Size only 2½ x 1½in. Spindle 1½in. long, ⅛in. diam. Brand New, 9 9.

HEADPHONES. Brand new. Low resistance, 7/9 pr. High Resistance, 15/9 pr.

EXTENSION SPEAKERS

Ready for use in walnut veneered cabinet.
8in. 2-3 ohms. 35 9.
Very limited number.



EX-GOVT. METAL BLOCK (PAPER) CONDENSERS
4 mfd. 350 v., 2 9; 4 mfd. 1,000 v., 4/9; 8 mfd. 500 v., 4 9; 10 mfd. 500 v., 3/9.

EX-GOVT. VALVES (NEW)

1T4	7 9	EF39	5 9	EF80	7 9
1S5	7 9	6V6G	7 9	EB91	4 9
3S4	8 9	6X4	6 9	EF36	4 9
5Y3G	8 9	6X5GT	8 9	EL32	3 9
5U4G	8 9	6L6G	11 9	EL91	5 9
5Z4G	9 9	807	7 9	EL91	5 9
6K7G	5 9	12A6	7 9	KT44	8 9
6SJ7GT	6 9	15D2	4 9	EZ80	6 9
6SL7GT	8 9	35Z4GT	9 9	EL84	10 6
6SN7GT	8 9	MH4	4 9	SP61	2 9
6AT6	7 9	ECC83	9 9	35Z4	8 9
6J6	4 9	ECC81	4 9		

ELECTROLYTICS (current production) NOT EX-GOVT.

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

Many others in stock.

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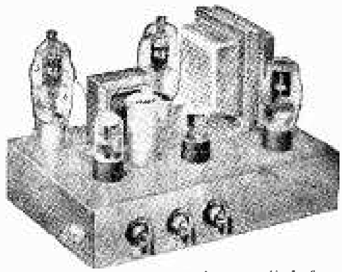
R.S.C. A8 ULTRA LINEAR 12 WATT AMPLIFIER

High-Fidelity Push-Pull Amplifier with "Built-in" Tone Control. Pre-amp stages. High sensitivity. Includes 5 valves (807 outputs). High Quality sectionally wound output transformer, specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response 3db., 30-30,000 c/cs. Six negative feed-back loops. Hum level 71 db. down. ONLY 70 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and practically all microphones. Comparable with the very best designs. For **STANDARD** or **LONG-PLAYING RECORDS**, For **MUSICAL INSTRUMENTS** such as **STRING BASS, GUITARS**, etc. **OUTPUT SOCKET** with plug provides 300 v. 20 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT**. Size approx. 12-9-7in. For A.C. mains 200-230-250 v. 50 c/cs. 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 **£7 15/-** or factory built **45/-** extra. Carriage 10/-.

£7-15-0



If required louvred metal cover with 2 carrying handles can be supplied for **18/9**. Additional input socket with associate Vol. control so that two different inputs such as Gram and 'Mike' or Tape and Radio can be mixed, can be provided for **13/-** extra. Guaranteed 12 months.

TERMS on assembled two input model: **DEPOSIT 25/6** and nine monthly payments **23/4**.

HIGH-FIDELITY MICROPHONES and **SPEAKERS** in stock. Keen cash prices or H.P. terms if supplied with amplifier.

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

A highly sensitive Push-Pull high output unit with self-contained Pre-amp. Tone Control Stages. Certified performance figures compare equally with most expensive amplifiers available. Hum level 70 db. down. Frequency response 3 db. 30-30,000 c/cs. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All components are chosen for reliability. Six valves are used. EF86, EF86, ECC83, 807, 807, GZ33. Separate Bass and Treble Controls are provided. Minimum input required for full output is only 12 millivolts so that **ANY KIND OF MICROPHONE OR PICK-UP IS SUITABLE**. The unit is designed for **CLUBS, SCHOOLS, THEATRES, DANCE HALLS or OUTDOOR FUNCTIONS**, etc. For use with Electronic **ORGAN, GUITAR, STRING BASS**, etc. For standard or long-playing records. **OUTPUT SOCKET PROVIDES** L.T. and H.T. for a **RADIO FEEDER UNIT**. An extra input with associated vol. control is provided so that two separate inputs such as Gram and 'Mike' can be mixed. Amplifier operates on 200-250 v. 50 c/cs. A.C. Mains and has outputs for 3 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. If required cover as for A8 can be supplied for **18/9**. The amplifier can be supplied, factory built with 12 months' guarantee, for **£12 19/6**.

ONLY 10 GNS. Carr. 10/-

TERMS: DEPOSIT 35/9 and 9 monthly payments of **28/11**.

COLLARO RC54 3-SPEED AUTO-CHANGERS with Studio Pick-up. Brand new. For 110 v. 50 c.p.s. A.C. mains. Price with 110 v. to 200-250 v. Auto Trans. only **7 Gns.** Carr. 5/6.

COLLARO RC/457 4-SPEED AUTO-CHANGERS with high fidelity Studio Pick-up. Latest model. Brand new. Cartoned. For 200-250 v. 50 c.p.s. A.C. mains. Our price **£8/19/6.** carr. 5/6. Credit Terms. Deposit **3 gns.** and 6 monthly payments of **21/6** or with another credit purchase same deposit and 9 monthly payments **14/6**.

LG3 MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with above or any other single or auto-change units. Output for 2-3 ohm speaker. For 200-250 v. 50 c.p.s. A.C. mains. Overall size 6¼ x 4½ x 2¼in. Controls: Vol. and Tone with switch. Guaranteed 12 months. Only **49/9**.

PORTABLE CABINETS. Exceptionally attractive appearance. Size inside 17¼ x 12¼ x 8½ in. Will take above amplifier and any modern 3 or 4 speed auto-changer or single player. **59/6.** Carr. 4/6.

SUPERHET FEEDER UNIT. Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). Delayed A.V.C. employed. The W.Ch. Sw. incorporates Gram position. Controls are Tuning, W.Ch. and Vol. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Simple alignment procedure. Point-to-point wiring diagrams, instruction and priced parts list with illustration, **2/6.** Total building cost, **£4 15/-**. For descriptive leaflet send S.A.E.

LINEAR L45 MINIATURE 4/5 WATT QUALITY AMPLIFIER. Suitable for use with Collaro, B.S.R. or any other record-playing unit, and most microphones. Negative feed-back 12 db. Separate Bass and Treble Controls. For A.C. mains input of 200-250 v. 50 c/cs. Output for 2/3 ohm speaker. Three miniature Mullard valves used. Size of unit only 6-5-5¾in. high. Output for 2-3 ohm speaker. Guaranteed for 12 months. Only **£5 19/6.** Send S.A.E. for illustrated leaflet. Credit Terms. Deposit **22/6** and 5 monthly payments of **22/6**.

LINEAR 'DIATONIC' 10 WATT HIGH FIDELITY PUSH-PULL ULTRA LINEAR AMPLIFIER. For 200-230-250 v. 50 c/cs. A.C. mains. Valve line-up ECC83, ECC83, EL84, EL84, EZ81 miniature Mullard. The unit has self-contained Pre-amplifier Tone Control stages and separate Bass and Treble Controls. Independent 'Mike' and Gram input sockets are provided. Size is only 9-7-6in. Output Matchings for 3 and 15 ohm speakers. Only **12 GNS.**; or Deposit **26/9** plus 10/- carr. and 9 monthly payments of **26/9.** Send S.A.E. for leaflet.

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

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

B.S.C. TA1 HIGH QUALITY TAPE DECK AMPLIFIER. For Tape Decks with High or Low Impedance, Playback and Erase Heads, such as Lane, Truvox, Aspden, Collaro, Brennell etc. For A.C. Mains 230-250 v. 50 c/cs. Carriage 7/6.

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Positive compensated identification for recording level by Magic Eye. Recording facilities for 15, 7½ or 3¾in. per sec. Automatic equalisation at the turn of a knob. **Linear frequency response of** 3 db., 50-11,000 c/cs. Negative feed-back equalisation. Minimum microphony and hum. High output with completely effective erasure and distortionless reproduction. Sensitivity is 15 millivolts so that any kind of crystal microphone is suitable. Only 2 millivolts output required from Recording head. Provision is made for feeding a P.A. amplifier.

Illustrated leaflet 6d. Special price can be quoted for Amplifier and a Deck. When ordering please state make of Deck to be used.

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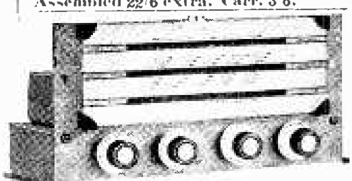

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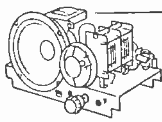

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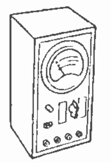

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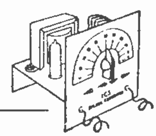

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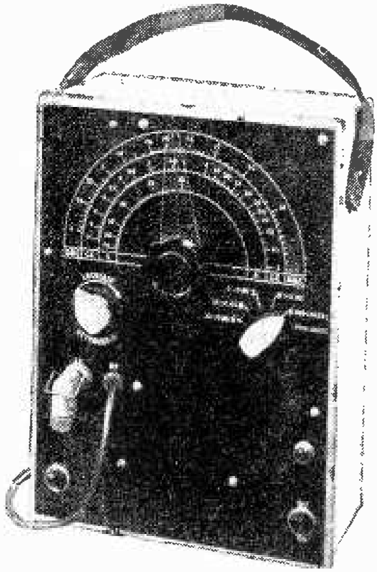

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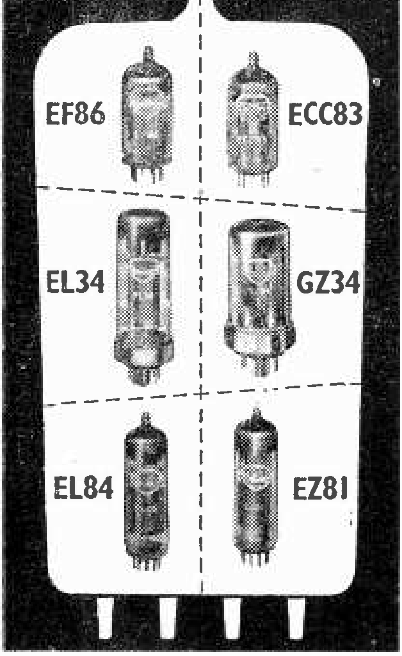

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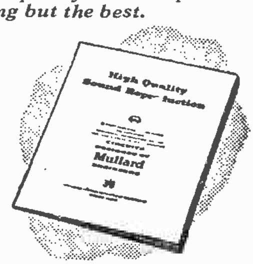

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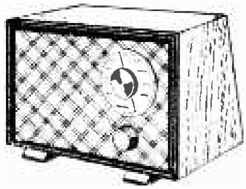


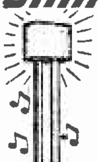
THE SKYSEARCHER

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

ALL-MAINS AMPLIFIER

Powerful three-valve Mains amplifier ideal for dances, parties, etc. Complete less chassis, cabinet and speaker (available if required)—data 1/6 (free with parts). Price 19/6, plus 2/6 post and insurance.

"CHIMELITE" 19/6



It is a hall light, as well as a double chime and you can make it in a couple of evenings for the total cost of only 19/6, including instructions, post 2/-—data available separately price 2/-.

Simplex Transistor Kit

Makes ideal bedroom radio, uses one transistor and one crystal diode. Complete less case 19/6, case 5/- extra, post and ins. 1/6

A.C./D.C. Multimeter Kit

Measures A.C./D.C. volts and ohms. All the essential parts including 2in. moving coil meter, selected resistors, wire for shunts, range selector switches, calibrated scale and full instructions, price 19/6 plus 1/9 post and insurance.

BAND III CONVERTER

Suitable London, Midlands, North, Scotland, etc. All the parts including 2 valves, coils, fine tuner, contrast control, condensers, and resistors. (Metal case available as an extra.) Price only 19/6, plus 2/6 post and insurance. Data free with parts or available separately 1/6.

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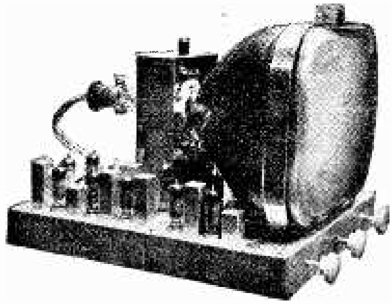

Undoubtedly the most up-to-date televisor for the home constructor. You can build it in an evening and the set when finished will be equal to a factory-made equivalent. What other constructor T.V. has all these features?

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- ★ 12-channel circuitry.
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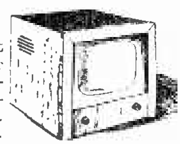
The building cost (less tube) is only £29.10.0, plus 10/- carriage and insurance. All parts guaranteed 12 months. **Full information and data, price 3/6.**

TAPE DECK SNIP

TAPE DECK—Made by the famous Truvox Company. This contains exactly the same essentials as the current model. Only the styling is different. It also takes the stereophonic head. Specification: 3 B.T.H. shaded pole motors with silent friction drive eliminating wow and flutter. Push-button controls, electrically and mechanically interlocked. Patented electric type push-button controlled brake. Tape loading on the drop-in principle, accommodation for reels of 7in. diameter. Tracking sense to British and American standards. Playing times: up to 3 hours with L.P. tape or 2 hours with L.P. tape or 2 hours with Standard tapes. Two tracks side by side with safety gap. Positive Azimuth adjustment of Record/Player head. High Impedance Heads. Overall size 14¼in. x 12¼in. x 5in. approx. 120 only of these fine decks offered at non-repeatable price of £17/10/- or £3 10/- down and eight monthly payments of £3. Non-callers add 10/- carriage and insurance.

14" T.V. CABINET



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

LAST FEW

HIGH FIDELITY AMPLIFIER

3 valve 4 watt with frequency response better than 40-15,000 C.P.S. Control Panel size 8 x 2½in. comes fixed to chassis but is intended for independent mounting. Separate bass and treble controls giving fullest variation of cut and lift. Separate switch, absolutely no mains hum. Remarkable value at £4/19/6.

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

American Service Sheets	R.109
A.1134	78 receiver
BC.348	76 receiver
BC.312	R28/ARC5
R.103A	R1116/A
BC.342	RA-1B
RA-1B	AR88D
R-208	AN/APA-1
R-1155	78
R-1124A	76
R-1132A/R-1481	R.T.18
R-1147	CAY-46-AAM-RADAR
R-1224A	A.S.B.-3
R-1082	Indicator 62A
R-1355	Indicator A.S.B.3
B.C.1206-A/B	Indicator 62
B-455-A (or -B)	Indicator 6K
B-454-A (or -B)	R.F unit 24
B-453-A (or -B)	R.F. unit 26
Transmitter T1154	R.F. unit 25
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	Demobbed valves

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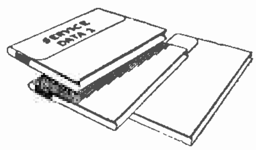

SERVICE DATA

100 service sheets, covering British receivers which have been sold in big quantities and which every service engineer is ultimately bound to meet. The following makers are included: Aerodyne, Alba, Bush, Cossor, Ekco, Ever-Ready, Ferguson, Ferranti, G.E.C., H.M.V., Kolster Brandes, Lissen, McMichael, Marconi, Mullard, Murphy, Philco, Philips, Pye, Ultra. Undoubtedly a mine of information invaluable to all who earn their living from radio servicing. Price £1 for the complete folder.

INSERT MICROPHONE

Ref. No. Mic 253-A, a really beautifully made magnetic mike of little over 1in. in diameter. Price 3/6, post free.

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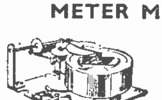

These are very small A.C. mains operated motors which have many applications for driving toys or other light loads. All are in good condition, but not new, having been stripped from electric light meters. Final speed of approx. 1 rev. per hour. Price 8/6 each. Post and insurance 2/-.

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Mains transformer	22/6
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Regulator Stud Switch	3/6
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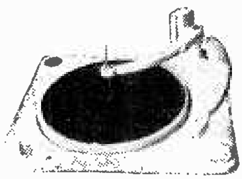
Mains on/off Switch	2/6
0-5 amp. Moving Coil Meter	12/6
Construction Data	1/6

Or if bought all together price is 52/6, plus 3/6 post and packing.

Yours for £1.10.0 Down



The latest most up-to-date Record Player made by the famous B.S.R. company. Using Hi-Fi Crystal Pick Up and fitted with every modern device. Definitely a record changer which will give years of trouble-free music. Not surplus but the current model. Price £8/10/- or £1/10/- deposit and 8 monthly payments of £1, carriage and insurance 5/-.

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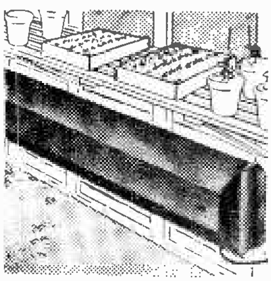


Convector heater, 1 kW. rating, 4ft. long, made from heavy gauge sheet steel (galvanised). Can be used for greenhouse, workshop, aviary, etc., etc. Price £2/10/-, or with thermostat, £4/5/-, carriage 5/-. GUARANTEED 5 YEARS.

2 KW MODEL. Free standing thermostatically controlled, £5/17/6.

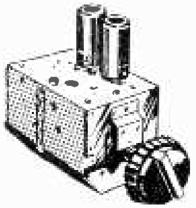
500 WATT MODEL. For very small greenhouses, 32/6. Carriage 5/-.

CABINETS FOR ALL

The CONTINA

Another addition to our range of cabinets. This is of new revolutionary design, styled after the best of continental radios. Externally, it is finished in highly polished dark walnut veneer, with panelling picked out in gold. Interior is of same very high standard, its veneer being light mahogany which contrasts nicely with the dark walnut and generally gives a very pleasing appearance. The doors slide on metal runners and are fitted with gold insert finger plates. A really excellent cabinet for any home—size 3ft. 1½in. long, 1ft. 3in. deep, 2ft. 1½in. high, including legs which are 10in. from floor. Motor board 12½in. x 17in., equipment aperture 17½ x 9½in. gives ample space for 8in. speaker. Ample storage space for recordings. Price £19 19/-, carriage and insurance 20/-.

Turret Tuner



Brand new stock, not surplus, with coils for Band I and III complete with valves PCC84 and PCF80—I.F. Output 33/38 Mc/s with instructions and circuit diagram, 79/6. With knobs 3/6 extra, post and insurance 2/6.

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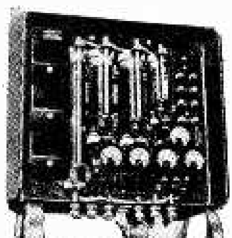

Offered at about one-twentieth of original cost. This is an ex-Government switchboard. It contains three reverse current relays, one voltmeter, one main ammeter, two secondary ammeters and three variable resistors for controlling circuits. These are original cases. Price £2/15/-. Carr. 10/-.

The "CRISPIAN" Portable Radio

A 4-valve truly portable battery set with very many good features as follows: Ferrite rod aerials, low consumption valves, superhet circuit with A.V.C. ready-built and aligned chassis if required, beautiful two tone cabinet covered with I.C.I. rexine and Tygan. Guaranteed results on long and medium waves anywhere. All parts, including speaker and cabinet are available separately or if all ordered together the price is £7/15/- complete, or 35/- down and 7 payments of £1/0/0, post and ins. 3/6, ready-built chassis 30/- extra. Instruction booklet free with parts or available separately price 1/6.

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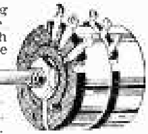


Single and 2 gang types available standard size with good length spindle all new and boxed. Single types 1/- each, values available: 10K., 25K., 50K., 100K., 250K., 1 meg., 2 meg. Gang type, 3/- each—values available: 5K. +5K., 100K. + 100K., ½ meg. + ½ meg.

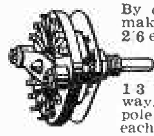
GLASS PANELS

Size 10½ x 9½—parcel of five panels. 7/6, plus 3/6 carriage.

CRYSTAL MICROPHONE

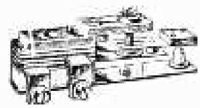
Miniature crystal type has high gain and is suitable for all purposes — tape recorders — amplifiers. Price 4/9, post and ins. 9d.

CERAMIC SWITCHES



By one of our best makers, 3 pole, 3 way, 2/6 each, also standard type switches 12 pole, 2 way, 1/3 each, 6 pole, 3 way, 1/3 each, 2 pole, 6 way, 1/6 each.

THERMOSTATS



2½in. x 1in. x 1½in. high. Useful for the control of appliances such as convectors, gluepots, vulcanisers, hot plates, etc. Adjustable to operate over temperature range 50-550 deg. F., fitted with heavy silver contacts. 1½ amp., 3/6; 5 amp., 8/6; 2 amp. QMB. 5/6; 15 amp. QMB. 15/-. 15 amp. wall mounting type, 19/6.

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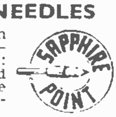

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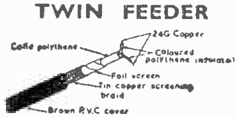

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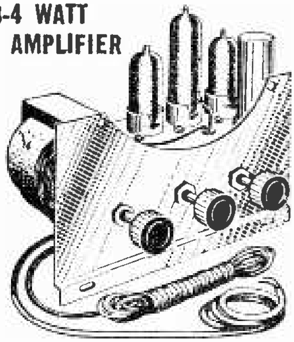
3-4 WATT AMPLIFIER



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Cabinet size, 10¾in. x 8¾in. x 4¾in.

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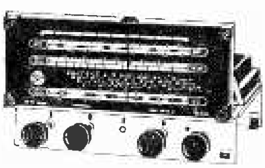

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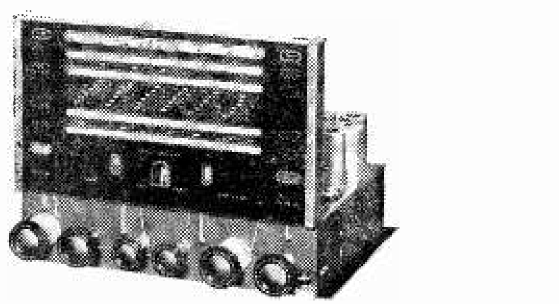

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6AB7	8/-	6J5GTG	5/6	10C1	15/-	30F5	12/6	AZ31	12/6	EBF89	9/6	EM80	10/6	OC72	30/-	U78	7/-	XFY12	6/6
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6AK5	5/-	6K7GT	6/-	11E3	15/-	31	7/6	CV63	10/6	ECC33	8/6	EZ40	8/-	PCC85	12/6	UAF42	10/6	Z77	9/-
6AL5	6/6	6K8G	8/-	12A6	6/6	33A/158M		CV85	12/6	ECC35	8/6	EZ41	10/6	PCF80	12/6	UB41	12/7	Z719	12/6
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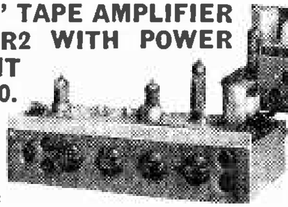
The "fidelity" TAPE AMPLIFIER Model HF/TR2 WITH POWER SUPPLY UNIT



PRICE £16.0.0.

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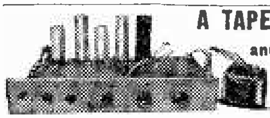

STERN'S MODEL HF/TR1.—A completely assembled Pre-amplifier with own Power Supply. Can be supplied correctly matched for use with Truvox or Collaro Decks and incorporates Recording Level Indicator and Monitoring facilities. Please send S.A.E. with any enquiry.
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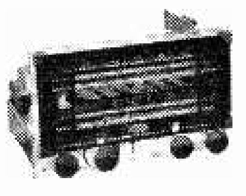

THE MODEL H.4. is illustrated but all Chassis and Tuners are similar—send S.A.E. for leaflets. H.P. and CREDIT SALE TERMS are available. Send S.A.E. for details.

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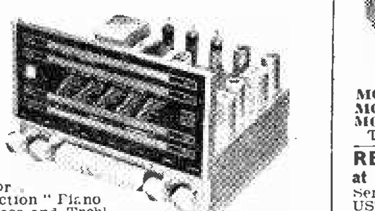
The NEW ARMSTRONG PB. 409 A.M./F.M. Radiogram Chassis



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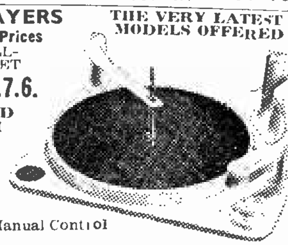

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- A "MIXER" Auto-changer complete with High Fidelity Crystal "Turn-over" head.
- Incorporates the Manual Control Position

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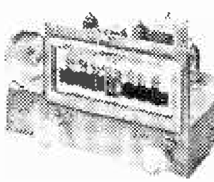

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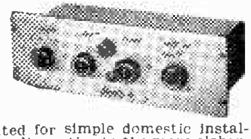
COMPLETE KITS of PARTS for the "Hi-Fi" ENTHUSIAST

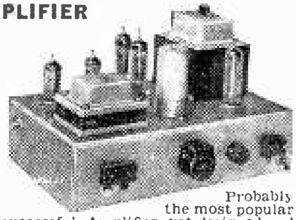
STERN'S REMOTE CONTROL UNIT



Designed in particular for use with the MULLARD 5-10 Main Amplifier

Ideally suited for simple domestic installation as an alternative to the more elaborate Pre-amplifier (shown and described opposite). Tone Control facilities are really excellent and in conjunction with the "5-10" Main Amplifier reproduction is of very high quality. Perfectly suitable for use with all the popular Record Players (B.S.R., Collaro, Garrard) and the modern Radio Tuner Units. Front Panel contains: (a) Coloured Indicator. (b) Separate BASS and TREBLE CONTROLS. (c) 3 position Selector Switch. (d) Volume control. Inputs on back for Radio and Gram. and Gram equalising is incorporated.
FULL DATA is contained in the 5-10 MAIN AMPLIFIER MANUAL at 1/6.

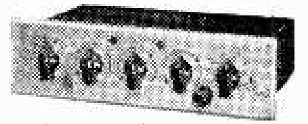
The MULLARD "5-10" MAIN AMPLIFIER



Probably the most popular and successful Amplifier yet designed and certainly needs no recommendation from us. Our kit is complete to MULLARDS specification including the latest ULTRA LINEAR OUTPUT TRANSFORMER and the recommended Mullard Valve line-up. All specified Components are supplied and Power Supply is available to drive a Radio Tuner Unit.
PRICE OF COMPLETE KIT OF PARTS (Plus 5/- carr. & Ins.) **£9.10.0**
or alternatively we supply — FULLY ASSEMBLED and TESTED for (Plus 5/- carr. & ins.) **£11.10.0**
The ASSEMBLY MANUAL containing FULL SPECIFICATION is available for 1/6. It also includes full data on the REMOTE CONTROL UNIT.

STERN'S "fidelity" PRE-AMPLIFIER TONE CONTROL UNIT

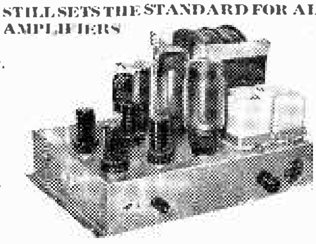
"A design for the Music Lover"



This unit can be used with any Main Amplifier. Briefly it has inputs for all types of MICROPHONES, HIGH and LOW GAIN PICK-UPS and a RADIO TUNING UNIT. It incorporates (a) GRAM EQUALISING CONTROL. (b) STEEPCUT FILTER. (c) Continuously variable BASS and TREBLE CONTROLS, a variable OUTPUT CONTROL which enables its use with any type of Amplifier, and Jack Sockets on Front Panel for TAPE RECORD and TAPE PLAYBACK.
Used with the "5-10" the reproduction is comparable to that normally associated only with the very expensive commercially made High Fidelity Amplifiers. PRICE OF COMPLETE KIT OF PARTS **£6.6.0**
WE ALSO OFFER IT ASSEMBLED READY FOR USE. £8 (plus 5/- carr. & ins.).
The ASSEMBLY MANUAL contains full specification, and is available for 1/6.

BRITAIN'S FINEST "Hi-Fi" AMPLIFIER
THE GENUINE WILLIAMSON

STILL SETS THE STANDARD FOR ALL AMPLIFIERS

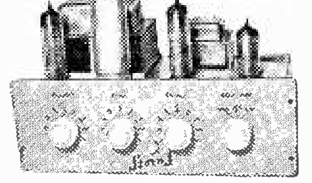


Many versions of the Williamson have been offered to the public at various low prices, but the "only Williamson" is the Amplifier built to the designer's specification and employing only the very high grade Components, i.e., PARTRIDGE TRANSFORMERS, CHOKES, etc., that he specifies. It is only in doing this that the exceptionally high standard that has made this Amplifier so famous, particularly in America, is obtained . . . WE HAVE DONE THIS ! . . . and we offer these KITS OF PARTS including Partridge and other high grade Components as follows:
(a) To build the MAIN AMPLIFIER ONLY (Illustrated above). **£14.10.0**
(b) To build the TWIN POWER SUPPLY UNIT ONLY (insufficient space to illustrate this). **£13.10.0**
(c) COMPLETE KIT to build both above. **£27.0.0**
We will also supply both **COMPLETELY ASSEMBLED** and will be pleased to quote. Credit and H.P. Terms are available. The complete SPECIFICATION and general ASSEMBLY INSTRUCTIONS are available for 3/6.
Our "fidelity" PREAMPLIFIER illustrated and described above (or alternatively the R.C.A. Pre-amplifier at £16.5.0) is recommended for use with the Williamson.

SPECIAL PRICE REDUCTIONS . . . WE OFFER YOU . . .

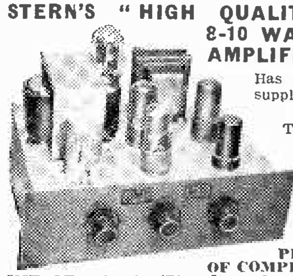
(a) The **COMPLETE KIT of PARTS** to build both the **MULLARD** 5-10 and the **REMOTE CONTROL UNIT** for........ **£11.11.0**
(b) The **COMPLETE KIT of PARTS** to build both the **MULLARD** 5-10 and the "Fidelity" **PRE-AMPLIFIER TONE CONTROL UNIT** for...... **£15.15.0**
ALTERNATIVELY WE WILL SUPPLY ASSEMBLED and FULLY TESTED, as follows—
(a) The **MULLARD** 5-10 and the **REMOTE CONTROL UNIT** for......... **£14.0.0**
CREDIT SALE TERMS. £3.10.0 **Deposit and 9 monthly payments of £1.5.8. H.P. TERMS. £7 Deposit and 9 monthly payments of 17/9.**
(b) The **MULLARD** 5-10 and the "Fidelity" **PRE-AMPLIFIER-TONE CONTROL UNIT** for.......... **£18.18.0**
CREDIT SALE TERMS. £4.15.0 Deposit and 9 monthly payments of £1.14.7. H.P. TERMS. £9.9.0 Deposit and 12 monthly payments of 17/6.
WHEN ORDERING PLEASE INCLUDE 7/6 to cover cost of Carriage and Insurance.

THE MULLARD "3-3" QUALITY AMPLIFIER



A small compact Amplifier capable of HIGH QUALITY REPRODUCTION on both RADIO and GRAM.
PRICE FOR COMPLETE KIT OF PARTS, £6.19.6 (plus 6/6 carr. & ins.)
Alternatively supplied ASSEMBLED and READY FOR USE (plus 6/6 carr. & ins.). **£8.12.6**
The Complete SPECIFICATION and ASSEMBLY DIAGRAMS are available for 1/6.
Developed from the very popular 3 valve 3 watt Amplifier designed in the MULLARD LABORATORIES. We strictly adhere to the specification list; in addition we have added switched equalising for L.P. and 78 Records and a position for Radio Inputs, plus additional power to feed a Radio Tuning Unit. Extremely simple to assemble and ideally suitable to incorporate with an F.M. Tuner or Record Player in a small installation.

STERN'S "HIGH QUALITY" 8-10 WATT AMPLIFIER



Has power supply for Radio Tuning Unit

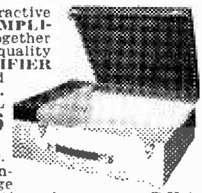
PRICE OF COMPLETE KIT OF PARTS (Plus 5/- carr. & ins.) **£7.10.0**
SUPPLIED ASSEMBLED and READY FOR USE **£9.10.0**
Proved one of the most popular models yet offered to the HOME CONSTRUCTOR. Provides excellent reproduction up to 8 watts, employing 6V6's in push-pull, incorporating negative feedback. Provides for use of both 3 and 15 ohm speakers.

CALLERS ONLY

We have in stock various designs for HOME CONSTRUCTORS including F.M. Tuners, A.M./F.M. Tuners, Midget Battery Portable, Mains Units, etc., etc.

WE ALSO SUPPLY SEPARATELY—
(a) The 2-Stage (plus Rectifier) **AMPLIFIER**............ £4.2.6
(b) The **PORTABLE CARRYING CASE**............ £3.17.6
(c) 6½in. **P.M SPEAKER**........ 16/9
Carriage and insurance, 4/- extra.
We also have a smaller **PORTABLE CASE Ideal for Record Players.** PRICE ONLY £3.3.0 (plus 3/- carr. & ins.).

SPECIAL CASH ONLY OFFER !!



This very attractive **PORTABLE AMPLIFIER CASE** together with a good quality **GRAM AMPLIFIER** and a matched 6½in. **P.M. SPEAKER, ALL FOR ONLY £8.7.6** (plus 7/6 carr. & ins.).
The Amplifier consists of a 2 Stage design incorporating the modern B.V.A. valves types ECC83, EL84 plus EZ80 Rectifier and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger, and is attractively finished in Maroon and Grey colour Rexine.

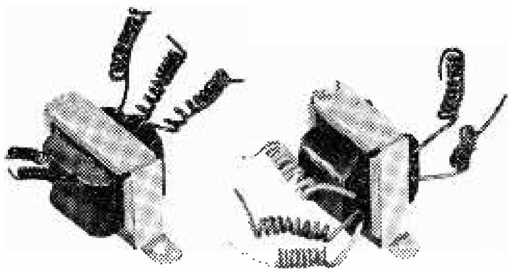
(Dept. P.W.)

109 & 115 FLEET ST., LONDON, E.C.4.

Telephone: FLEet 5812/3/4.

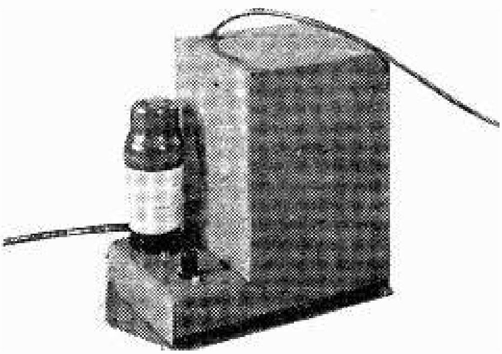
www.americanradiohistory.com

TRANSISTOR TRANSFORMERS



... two examples—a Driver and an Output type—from our miniature lightweight range.

150 mW Range	Size	Weight	Frequency	Price
Driver	1.11/32"x13/16"x13/16"	1oz.	120 c/s-17 Kc/s	13/-
Output	do. do. do.	do.	100 c/s-17 Kc/s	8/6
250 mW Range				
Driver	1.3/4"x13/16"x1.1/8"	2oz.	50 c/s-16 Kc/s	14/6
Output	do. do. do.	do.	50 c/s-16 Kc/s	9/3



The NERA R.F. E.H.T. UNIT

... designed to provide a safe and reliable source of D.C. high voltage for all C.R.T.s including the new wide angle aluminised types. Output is continuously variable between 8-12 kV at approximately 500 µA. Power supplies necessary are 6.3 v. at 1 amp., and 250/350 v. at 40 mA. Ample shielding prevents radiation and interference to broadcast receivers.

Price : £7 . 10 . 0

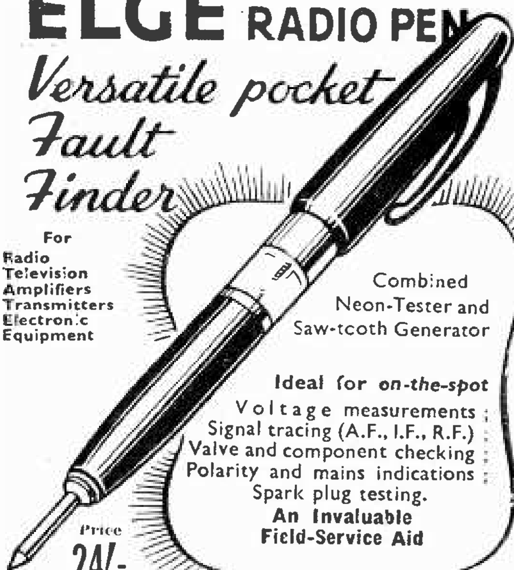
Coil and rectifier assembly only : £4 . 10 . 0

P·A·M Ltd MERROW · GUILDFORD SURREY *Tel. Guildford* 2211

(One of the group of companies associated with the Southern Areas Electric Corporation Ltd.)

ELGE RADIO PEN

Versatile pocket Fault Finder



For
Radio
Television
Amplifiers
Transmitters
Electronic
Equipment

Combined Neon-Tester and Saw-tooth Generator

Ideal for *on-the-spot*
Voltage measurements;
Signal tracing (A.F., I.F., R.F.)
Valve and component checking;
Polarity and mains indications;
Spark plug testing.
An Invaluable Field-Service Aid

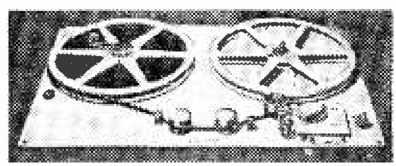
Price **24/-**

MERCIA ENTERPRISES LIMITED

Godiva House, Allesley Old Road, Coventry

Free leaflet on request. Trade Enquiries invited

"ASPDEN" TAPE RECORDER KITS



TAPE DECKS, 2-speed, twin track, easy to assemble kits with finest motor, Ferroxcube heads and full instructions.
MODEL 582 for 5in. spools, kit **£8.5.0.**
MODEL 782 for 7in. spools, kit **£9.5.0.**
Either model assembled and tested, 30/- extra.

AMPLIFIER kit, 2½ watt, record/replay, 2 recording positions, neon indicator, etc., **£5.18.0.** Power pack kit for above, £2.18.6 (both without valves). Carr. and packing extra.

YOU CAN BUILD A QUALITY TAPE RECORDER

M.G. from Baghdad writes :—
"...really nice to have this amazing tape deck."

D. B., Malaya, writes :—
"The recorder is now working as well as a commercial model and I am very pleased with it."

This tape deck and amplifier is being used in the Antarctic by an Expedition member.

Send stamp for full particulars to:—

W. S. ASPDEN Stanley Works, Back Clevedon Rd., BLACKPOOL, Lancs.

www.americanradiohistory.com

C.R.T. ISOLATION TRANSFORMER
Type A. Low leakage windings. Ratio 1 : 1.25 giving a 25% boost on secondary.
2 v., 10/6 ; 4 v., 10/6 ; 6.3 v., 10/6 ; 10.8 v., 10/6 ; 13.3 v., 10/6.
Ditto with mains primaries. 12/6 each.
Type B. Mains input 220/240 volts Multi Output 2, 4, 6.3, 7.3, 10 and 13 volts. Input has two taps which increase output volts by 25% and 50% respectively. Low capacity, suitable for most Cathode Ray Tubes, 21/-. Ditto for 6v. C.R.T. only, 17/6.
Type C. Low capacity wound transformer for use with 2 volt Tubes with falling emission. Input 220/240 volts. Output 2-2½-2¾-3 volts at 2 amps. With Tag Panel, 17/6 each.
NOTE.—It is essential to use mains primary types with T.V. receivers having series-connected heaters.

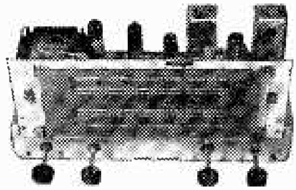
TRIMMERS Ceramic, 30, 50, 70 pf., 9d. ; 100 pf., 150 pf., 1/3 ; 250 pf., 1/6 ; 500 pf., 750 pf., 1/9.
RESISTORS. All values. 10 ohms to 10 meg., ¼ w., 4d. ; ½ w., 6d. ; 1 w., 8d. ; 2 w., 1/-.
HIGH STABILITY. ½ w., 1%, 2/-. Preferred values 100 ohms to 10 meg.
5 watt } **WIRE-WOUND RESISTORS** {1/3
10 watt } 25 ohms—10,000 ohms.............. {1/6
15 watt } {2/-
15,000 ohms—50,000 ohms. 5 w., 1/9 : 10 w., 2/3.

12/6 PURETONE RECORDING TAPE
1,200 ft. on standard 7" Metal reels. Spools 5" metal, 1/6, 7" metal, 2/3.
FERROVOICE 1,200 ft. Plastic Tape 25/- on Plastic Spools.

O/P TRANSFORMERS. Heavy Duty 50 mA., 4/6. Multiratio, push-pull, 7/6. Miniature, 384, etc., 4/6.
L.F. CHOKES 15-10 H. 60/65 mA., 5/- ; 10 H. 80 mA., 8/6 ; 10 H. 150 mA., 12/6.
MAINS TRANS. 350-0-350, 80 mA., 6.3 v. tapped 4 v. 4 a., 5 v. tapped 4 v. 2 a., ditto 250-0-250, 22/6. Bargain 300-0-300 65 mA., 6 v. 4 a., 4 v. 2 a., 15/-.
HEATER TRANS. Tapped prim., 200/250 v. 6.3 v. 1½ amp., 7/6 ; tapped sec. 2, 4, 6.3 v., 1½ amp., 8/6 ; prim. 230 v. Sec. 6.3 v. 3 amp., 10/6.
ALADDIN FORMERS and core, ¼in., 8d. ; ⅜in., 10d. 0.3in. **FORMERS 5937/8** and **Cans TVI/2.** ⅝in. sq. x 2in. and ½in. sq. x 1¾in., 2/- ea., with cores.
TYANA.—Midget Soldering Iron 200/220 v. or 230/250 v., 16/9. **Solon Instrument Iron, 24/-.**
MAINS DROPPERS. 3in. x 1½in. Adj. Sliders, .3 amp. 750 ohms, 4/3. .2 amp., 1,000 ohms, 4/3.
LINE CORD. .3 amp., 60 ohms per foot, .2 amp., 100 ohms per foot, 2-way, 6d. per foot. 3-way, 7d. per foot.
LOUDSPEAKER, P.M. 3 OHM. 2½in. square, 17/6. 5in. Goodmans, 17/6. 7in. x 4in. Goodmans, 21/-. 3½in. square, Elac, 21/-. 8in. Plessey, 19/6. 6½in. Goodmans, 18/6. 10in. R. & A., 30/-. TSL Tweeter, LSH75, 8/6. 12in. Plessey, 30/-. 8in. M.E. 2.5k field, tapped O.P. transf., 24/6. 15 ohm Plessey 10 wt. 12in. with Tweeter, 97/6.
CRYSTAL DIODE G.E.C., 2/-. **GEX34, 4/-.**
HIGH RESISTANCE PHONES. 4,000 ohms, 16/6 pr.
MIKE TRANSF. Ratio 50 : 1, 3/9 ea. ; 100 : 1, 10/6.
SWITCH CLEANER Fluid, squirt spout, 4/3 tin.
TWIN GANG TUNING CONDENSERS. 365 pf. miniature 1in. x 1⅛in. x 1⅜in., 10/-. .0005 Standard with trimmers, 9/- ; less trimmers, 8/- ; midget, 7/6 ; single, 50 pF, 2/6 ; 100 pF, 7/- ; 150 pF, 8/6.
SPEAKER FRET. Expanded Metal Silver, 15⅞in. x 9¼in., 2/- each.
GOLD CLOTH. 18in. x 25in., 5/- ; 25in. x 36in., 10/-. Tygan 4ft. 6in. wide, 10/- ft. ; 2ft. 3in. wide, 5/- ft.
MORSE KEYS, good quality, 2/6 ea.

All Boxed **VALVES** New & Guaranteed

1R5	8/6	6K8	8/6	EB91	6/6	EH148	1/6
1S5	8/6	6L6	10/6	EBC33	8/6	HABC80	
1T4	8/6	6Q7	10/6	EBC41	10/6		12/6
2X2	3/6	6SA7	7/6	EBF80	8/6	HVR2A	7/6
3S4	8/6	6SN7	8/6	ECC84	12/6	MU14	10/6
3V4	8/6	6V6G	7/6	ECF80	10/6	P61	6/6
5U4	8/6	6V6GT	8/6	ECF82	10/6	PCC84	12/6
5Y3	8/6	6X4	7/6	ECH42	10/6	PCF80	10/6
5Z4	10/6	6X5	7/6	ECL80	8/6	PCF82	10/6
6AM6	8/6	12A6	7/6	ECL82	12/6	PCL82	10/6
6B8	5/6	12AH8	10/6	EF39	7/6	PEN25	6/6
6BE6	7/6	12AT7	10/6	EF41	10/6	PL82	10/6
6BH6	10/6	12AU7	10/6	EF50	5/6	PY80	10/6
6BW6	8/6	12AX7	10/6	Equip.		PY81	10/6
6BW7	8/6	12BE6	10/6	EF50	5/6	PY82	10/6
6CH6	10/6	12BH7	10/6	Sylv.	8/6	SP61	5/6
6D6	7/6	12K7	8/6	EF80	10/6	UBC41	8/6
6F6	7/6	12Q7	8/6	EF92	5/6	UCH42	8/6
6H6	3/6	35Z4	10/6	EL32	5/6	UF41	8/6
6J5	6/6	80	8/6	EL84	10/6	UL41	8/6
6J6	7/6						
6J7	8/6	954	1/6	EY51	11/6	UY41	8/6
6K6	6/6	EA50	1/6	EZ40	10/6	U22	10/6
6K7	5/6	EABC80	8/6	EZ81	11/6	X79	10/6



1957 RADIOGRAM CHASSIS
THREE WAVEBANDS. FIVE VALVES
S.W. 16 m.—50 m. LATEST MULLARD M.W. 200 m.—550 m. ECH42, EF41, EBC41, L.W. 800 m.—2,000 m. EL41, EZ40.
12 month guarantee.
A.C. 200/250 v. 4-way Switch ; Short-Medium-Long-Gram. A.V.C. and Negative feedback 4.2 watts. Chassis 13½ x 5½ x 2¼in. Glass Dial 10 x 4½in., horizontal or vertical available. 2 Pilot Lamps, Four Knobs, Walnut or Ivory. Aligned and calibrated. Chassis isolated from mains.

10 gns. Carr. & Ins., 4/6.

TERMS : Deposit £5.5.0 and six monthly payments of £1.
MATCHED SPEAKERS FOR ABOVE CHASSIS 8in., 17/6 ; 10in., 25/- ; 12in., 30/-.

RECOMMENDED FOR ABOVE CHASSIS
★ **COLLARO** ★
HIGH-FIDELITY AUTOCHANGER
1957 Model RC456
7in., 10in., 12in. Records
16, 33, 45, 78 r.p.m.
4 SPEEDS—10 RECORDS
With Studio "O" pick-up
BRAND NEW IN MAKER'S BOXES
OUR PRICE £9.15.0 post free
TERMS: Deposit £5.5.0 and six monthly payments of £1.
Space required 14in. x 12½in. 5in. above and 3in. below. Cut Out board, 6/-.

GARRARD 4-SPEED RECORD CHANGERS RC120/4H 1957 MODELS
Brand new and fully guaranteed 12 months.

AUDIO PERFECTION

Designed to play 16, 33, 45, 78 r.p.m. Records, 7in., 10in., 12in. Lightweight Xtal pick-up, turnover head, two separate sapphire styli, for Standard and L.P., each plays 2,000 records. Voltage 200/250 A.C.

OUR PRICE **£10.15.0** each. Post Free.

Terms : Deposit £6 and 6 monthly payments of £1. Space required 14in. x 12½in. 5in. above and 3in. below. Cut Out board, 6/-.

AMPLIFIER—RECORD PLAYER CABINETS. Cabinet size 18½in. x 13½ x Ht. 8½in., with motor board 14 x 12½in., £3.3.0. post 3/-.

ALUMINIUM CHASSIS. 18 s.w.g. undrilled. With 4 sides, riveted corners and lattice fixing holes, 2½in. sides, 7 x 4in., 4/6 ; 9 x 6in., 5/9 ; 11 x 7in., 6/9 ; 13 x 9in., 8/6 ; 14 x 11in., 10/6 ; 15 x 14in., 12/6 ; 18 x 16 x 3in., 16/6.

TRANSISTORS. Audio, 10/- ; R.F. 2.6 Mc/s, 21/-. Mullard OC71, 20/-.

SUPERHET COIL PACK. 27/6. Miniature size 2½in. x 2¾in. x 1½in. HIGH "Q" Dust cored Coils. Short, Medium, Long, Gram Switching. Single hole fixing with connection diagram and circuit. 465 Kc/s I.F.

COLLARO 4-speed Motor and Turntable with selecting switch for 16, 33, 45, 78 r.p.m. records. 200-250 v. A.C. 50 cps. Also **HIGH FIDELITY** Lightweight Pick-up Acos Xtal turnover head, separate Sapphire styli for L.P. and Standard records. **SPECIAL OFFER. THE TWO! £4.12.6,** post 2/6. Cut Out Board, 14 x 12½in. 6/-.

SUITABLE AMPLIFIER-PLAYER CABINET. Ready cut out for above. 45/-.

CRYSTAL MIKE INSERT by Acos, precision engineered. Size only 1½ x 3/16in. Bargain Price 6/6. No transformer required.

CHAMPION VHF (FM) TUNER, 88-96 mc/s.
5 Mullard valves and superhet tuning heart. Maroon and cream receiver styled cabinet 12 x 6 x 6in. Features : This is a self-powered 200/250 v. A.C. VHF (FM) Adaptor with operating and servicing data and a screened lead for connection to pick-up sockets of any radio, radio-gram. or amplifier.
Brand new with 12 months' guarantee. List price, 16 gns. Our price, **10 gns.,** carr 4/6.

Volume Controls
Long spindles. Guaranteed 1 year. Midget 10,000 ohms to 2 Meg.
No Sw. S.P.Sw. D.P.Sw.
3/- 4/- 4/9
Lin or Log Tracks.

80 ohm CABLE **COAX**
Semi-air spaced Polythene insulated. ¼in. dia. Stranded core. Losses cut 50% **9d.** yd.
STANDARD ¼in. Coax. **8d.** yd.

COAX PLUGS ... 1/- **DOUBLE SOCKET** ... 1/3
SOCKETS ... 1/- **OUTLET BOXES** ... 4/6
BALANCED TWIN FEEDER, yd. 6d. 80 or 300 ohms.
DITTO SCREENED per yd. 1/-. 80 ohms only.
WIRE-WOUND POTS. 3 WATT. Pre-Set Min. T.V. Type. All values 25 ohms to 30 K., 3/- ea. 50 K., 4/-. (Carbon 50 K. to 2 m., 3/-.)
WIRE-WOUND 4 WATT. Pots 2¼in. Spindle. Values, 100 ohms to 50 K., 5/6 ; 100 K., 6/6.
CONDENSERS. New stock. .001 mfd. 7 kV. T.C.C., 5/6 ; Ditto, 20 kV., 9/6 ; 100 pf. to 500 pf. **Micas 6d.** : Tubular 500 v. .001 to .01 mfd., 9d. ; .05, .1, 1/- ; .25, 1/6 ; .5/350 v., 1/9 ; .1/350 v., 9d. ; .1/600 v., 1/3 ; .1 mfd., 2,000 volts, 3/6.
CERAMIC CONDS., 500 v., .3 pf. to .01 mfd., 10d.
SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/- ; 600 pf. to 3,000 pf., 1/3. **DITTO** 1%, 1.5 pf. to 500 pf., 1/9 ; 515 pf. to 5,000 pf., 2/-.

I.F. TRANSFORMERS 7/6 pair
465 Kc/s Slug tuning Miniature Can. 2½in. x 1in. x 1in. High Q and good bandwidth. By Pye Radio. Data sheet supplied.
Wearite M800 IF 465 Kc/s, 12/6 per pair.

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4/450 v.	2/-	16+16/500 v.		25+20/450 v.	5/6
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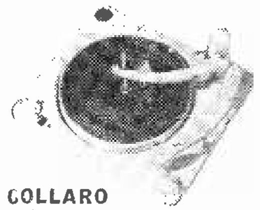

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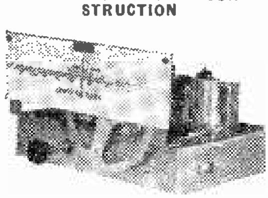

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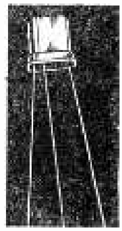

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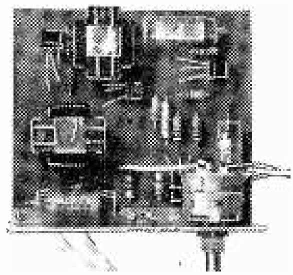

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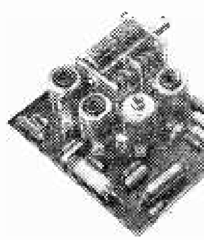
ON PRINTED CIRCUIT



Uses 3 R.F. Transistors and 1 germanium diode, 3 I.F. transformers, Ferrite rod aerial. Operates from one 6 v. battery and one 1.5 v. cell. Size of printed circuit, 3¼in. x 3¼in.

CAN BE BUILT FOR ONLY £5/12/9

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Full details and illustrations post free on request.
Demonstrations at both addresses.

Note.—This Tuner in conjunction with our Transistor Amplifier (as above) makes an excellent Transistorised radio. Cabinets available.

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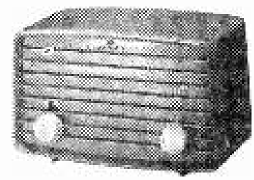

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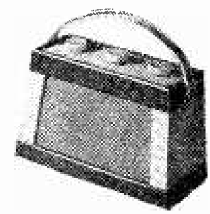

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Performance of this 4-valve, 2-wave superhet equals ready-built Portables costing pounds more. The PRINTED CIRCUIT supplied makes construction amazingly easy.
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EVERY MONTH
VOL. XXXIII, No. 612, DECEMBER 1957

EDITOR : F. J. CAMM

25th YEAR OF ISSUE

COMMENTS OF THE MONTH BY THE EDITOR

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CONTENTS :

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

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THE SPACE AGE ARRIVES

AFTER years of scientific debate, the space age was born on October 6th by the successful launching by the Russians of their artificial satellite without a hitch. It has encircled the earth a large number of times at speeds estimated at 30,000 miles an hour. Although this issue goes to press some weeks in advance of publication, it may still be travelling on its orbit by the time these words appear.

It is a magnificent achievement and every credit must be given to the Russians for it. The space age has arrived, and this preliminary experiment, which must have far-reaching results, is but the precursor of many more experiments of a complicated nature which will lay the foundation of space travel, with the moon as the preliminary destination. The Bleep-bleep which has been received from its ingenious radio transmitter, itself a remarkable piece of mechanism, has given the whole world aural evidence that the satellite is functioning as it was designed to do. We have been able to witness its passage through the empyrean. It is travelling at an altitude of between 500 and 600 miles—the highest altitude ever attained by a mechanical object.

Notwithstanding the prior agreement by all nations that each would announce to the others when any such experiments were to take place, the Russians launched their satellite in secrecy, following it with the explanation that it was a doubtful experiment. The result was that all the observing posts throughout the world which were brought into existence in this geophysical year were unable in the early stages to make any observations, and our own radio telescope erected at enormous expense for this very purpose at Jodrell Bank was not able to make any contribution until some days had elapsed and the satellite had made some hundreds of circuits.

The experiment is of the highest importance to science, and it will have the effect of accelerating the activities in geophysics which is taking place in America and somewhat tardily in this country. It seems a pity that this country, which has done more than any other to advance the science of astronautics and probably knows more about it than any other, should have to take second place in a great scientific adventure of this sort because of lack of money. Had that money been forthcoming no doubt we should have been the first to have projected an artificial satellite into the heavens. It cannot be denied that the achievement of the Russians has greatly enhanced their world-wide prestige, even if it has caused some tremors in American scientific circles.

Incidental advantages which must follow from the launching of this satellite must benefit radio science. We shall know far more in the near future about cosmic rays and sun spots, and their effect on radio transmission. The advantage, of course, will be to short-wave, ultra-short wave and micro-wave transmissions, about which at present there is much to learn. In the course of the year there will be startling developments.—F. J. C.

Our next issue, dated January, will be published on December 6th.

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Round the World of Wireless

By "QUESTOR"

Broadcast Receiving Licences

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

Region	*Sound*
London Postal...	1,140,231
Home Counties	1,151,120
Midland	873,507
North Eastern	1,144,139
North Western...	844,966
South Western...	725,247
Wales and Border Counties ...	457,839
Total England and Wales ...	6,337,049
Scotland	824,797
Northern Ireland	192,178
Grand Total	7,354,024

The Spacistor

FROM the U.S.A. comes news of a new semi-conductor amplifier. Resembling a valve rather than a transistor, this component is a reverse-biased p-n junction (negative voltage applied to the p section and position to the n section). The input and output impedances of the Spacistor are extremely high —about 30 megohms. Owing to the small output capacity it is expected that these components may be constructed to work at frequencies higher than 1,000 Mc/s.

VHF for Southampton

THE Southampton Harbour Board has awarded a substantial contract to Marconi's Wireless Telegraph Co. Ltd. for equipping the Port of Southampton Operation and Information Service with frequency-modulated V.H.F. radio. The equipment will conform to the standards laid down at the Hague Convention of January last and will form the basis of a new system of port communications that may eventually have a world wide application.

BBC Engineer Visits U.S.A.

THE BBC are sending their Head of Engineering Training Department, Dr. K. R. Sturley, to the United States to study methods of training in broadcasting and radio engineering. He will see the work of the chief American broadcasting networks in New York and Chicago. The training methods used in industry and selected technical institutions in Washington, Cleveland, and Boston, will be examined. While there Dr. Sturley will be presenting three technical papers written by other members of the BBC Engineering Division for the Audio Engineering Society's Annual Convention in New York and for the Society of Motion Picture and Television Engineers' Convention in Philadelphia.

Private Mobile Radio Licences

AT the end of August there were 1,561 licences in force for private mobile radio services (excluding police and fire). These covered 1,805 base stations and 13,010 mobile stations.

Details of the mobile stations from which messages are transmitted and received are as follows:—

Cars (including ambulances, cranes, taxis, etc.)	11,411
Ships (including small ships and tugs)	901
Hand portable stations	563
Transportable stations	133
	13,008

A private mobile radio licence costs £3 for each of the first two stations and £2 for each additional station per year. Two new types of licence have recently been introduced; one, giving up to twenty-eight days coverage which makes it especially useful for shows and exhibitions, costs only £1. The other covers "inductive" paging systems and is used in hospitals and large buildings. The licence fee in this case is £2 for five years for an unlimited number of stations operated.

A contract, valued at £1,000,000 has been awarded to Marconi's Wireless Telegraph Co., Ltd., for the complete reorganisation of the L.F. broadcasting station at Ankara. The order includes the supply of a new 120 kW. L.F. transmitter which will be installed for parallel operation with the existing 120 kW. L.F. transmitter supplied by Marconi's in 1937, which has given extremely satisfactory service for 20 years. This illustration shows the transmitter hall at Etimesgut, Ankara, as it appears at present. The original 120 kW. transmitter supplied by Marconi's in 1937 can be seen on the left.

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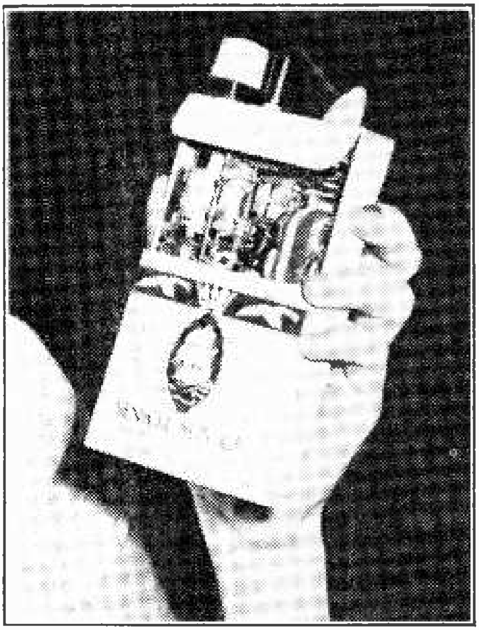
Award to Cossor Director

THE British Institution of Radio Engineers has announced the award of the 1956 Brabazon premium for the most outstanding contribution on radio and electronic devices for air-craft safety to Mr. K. E. Harris, Technical Director of Cossor Radar and Electronics Limited, for his paper "Some problems of secondary surveillance radar systems."

This is the second such award in three years, as the 1954 Brabazon premium was given for a paper on "A high definition general-purpose radar" by four Cossor Engineers, Messrs. Jenkins, Evans, Chambers and Wallace.



A miniature receiver seen at this year's Radio Show. It is not in production, but merely to show how small a receiver can be made. It was by Siemens-Ediswan and uses standard components.

Radio Sales Rise

RETAIL sales of radio and television receivers and radiograms for the first eight months of the year were higher than in the corresponding period of 1956. The monthly retail survey of the British Radio Equipment Manufacturers' Association shows that sales for radio receivers were up by 22 per cent.; for television receivers by 10 per cent. and for radiograms by 31 per cent.

The proportions of hire purchase and credit sales in August was 52 per cent. for television receivers (same as July); rose from 56 per cent. to 62 per cent. for radiograms; and fell from 36 per cent. to 33 per cent. for radio receivers.

Mr. Harold Leak to Visit the U.S.A.

MR. HAROLD J. LEAK, M. Brit. I.R.E., Chairman and Managing Director of H. J. Leak & Co., Ltd., is to visit New York.

He will spend much time at the New York High Fidelity Fair and will demonstrate some of the Leak equipment exhibited.

Mr Harold Leak is the doyen and leader in the field of Hi-Fi sound reproduction, having started 23 years ago. He leads not only in the designing and manufacturing of amplifiers, pick-ups and pre-amplifiers, but in the fundamental scientific research on sound reproduction. Recently he was awarded the "Dr. Norman Partridge Memorial Award" of the British Institution of Radio Engineers, for his paper on "High Fidelity Loudspeakers: The Performance of Moving Coil and Electrostatic Loudspeakers." He is the only Britisher ever to receive the honour of being elected a Fellow of the Audio Engineering Society of America.

New Zealand Buys English Radar

FOLLOWING an exhaustive evaluation of equipment available both in Europe and America, the Civil Aviation Administration (Air Dept.) of New Zealand has awarded a contract to Marconi's Wireless Telegraph Co. Ltd., of Chelmsford, England, for the supply and installation of two complete surveillance radar systems.

One installation will serve the Cook Strait Zone and Rongotai Airport, which is currently under construction at Wellington, N.Z. The other is for use at Ohakea Airfield, a busy Royal New Zealand Air Force operational base. Both installations incorporate duplicate high-power (500kW) equipment of an entirely new type, the Marconi Type S264A.

Obituary

THE death is announced of Dr. Irving Langmuir at the age of 76. The inventor of the mercury vapour pump, he will be remembered for his pioneer work on high vacuum tubes.

LAST MINUTE CHRISTMAS GIFTS

There's still time to send your friends who are radio enthusiasts the ideal Christmas gift . . . a year's subscription for PRACTICAL WIRELESS. All through the year your gift will bring them repeated pleasure . . . every new issue, reminding them of your good wishes.

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Applications of the OCP71

SOME USEFUL INFORMATION ON THE PHOTO-TRANSISTOR

By J. G. Ransome

THE photo-transistor is a normal p-n-p germanium junction transistor in which the inherent photo-electric effects are exploited. The normal transistor is sensitive to light, and it is for that reason that they are encased in a light-proof container. The photo-transistor has many advantages over the conventional vacuum or gas-filled types apart from those of a purely mechanical consideration. They are very much smaller, are much more sensitive, and do not need amplifiers to operate such devices as relays.

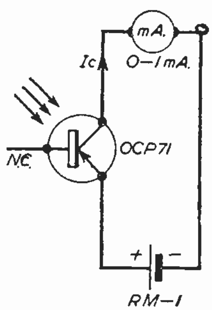

Fig. 1.—Basic circuit.

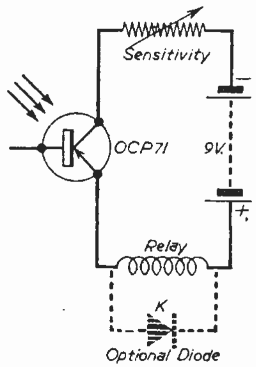

Fig. 2.—The alternative circuit.

COMPONENTS FOR FIG. 1

1 OCP 71.
1—Mallory cell type RM-1.
1 Meter 0-1 mA.

The photo-transistor to be used in the following circuits is the Mullard OCP71. If the constructor has a transistor of the OC70 or OC71 type which may have the opaque coating damaged he may like to remove with acetone (nail-varnish remover) or a similar solvent, all of the covering material to expose the clear glass and try this modified transistor in the circuits shown. These may prove inferior, since the OCP71 has a special diffusing silicone grease to increase the sensitivity to light from all directions.

Characteristics

Dark current	300μA
Sensitivity with preferred direction of light	1.5—4mA
Cut off frequency	3 kc/s
Vc max.	−25 volts
Ic max.	−10mA
Pc max.	25 mW
Max. operating temp.	45°C.

First Circuit

The first application is for a small photo-electric exposure or luminous intensity meter. The circuit, in effect, measures the collector current, which varies with the degree of illumination on the junction. The whole unit was built inside the case of the meter, and the meter calibrated against a professional job borrowed from a friend. A small 1½volt cell of the Mercury type was used, and proved very good, since the current drawn is so small and the life of the battery is almost shelf-life. Another advantage of this type of cell is that the outer case is positive, enabling the main metalwork of the meter movement to be used as a common "earth" point, the cap only being

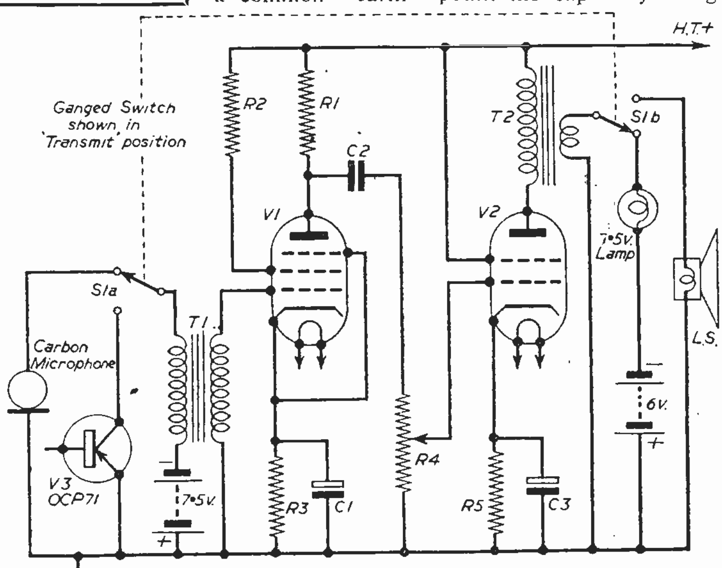

Fig. 4.—A suitable amplifier for the OCP71.

COMPONENTS FOR Fig. 4

R1—220 KΩ
R2—680 KΩ.
R3—2.2 KΩ.
R4—500 KΩ variable.
R5—220 Ω.
C1—25 μF 25 vwg.
C2—0.01 μF 350 v.w.
C3—25 μF 25 vwg.
T1—Mic. Trans. 150 : 1.
T2—Output Trans. 6V6 to 3 Ω.
V1—EF 37A.
V2—6V6.
V3—OCP 71.
Carbon Mic. 7.5 v. bulb.
DPDT switch. 6 v. and 7.5 v. batteries.

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negative. The meter used was a fairly good quality type of sensitivity. 0-1mA.

As the dark current is so low, a switch was not found to be necessary. If, however, one is required, it may be wired in, in the normal way.

Second Circuit

Another use to which the photo-transistor may be put is the operation of a small relay. The photo-transistor is connected in series with a sensitive relay of about 3,000 ohms resistance, to a 9 volt battery. The relay must be sufficiently sensitive to close on about 2mA across a 9 volt supply. The one used in the prototype was a small ex Government relay P. 27258 which, after a little adjustment, closed on about 1½mA. The OCP 71 is employed in rather conservative circuitry for two reasons; it helps to avoid failures due to overheating when the cell is continually illuminated; second, for reasons of back EMF. When the photo-transistor is illuminated, a current of about 2mA is flowing through the relay coil. As soon as the illumination ceases the current drops to about 200μA. This causes a collapse in the magnetic field in the relay coil. This results in a "back-kick" of opposite polarity to that previously applied. This may be fairly large, of the order of 30 volts. Much of this is taken up in the relay coil itself, but some may appear in the circuit, which, unless a small "H.T." is used, may do damage to the photo-transistor. In order to reduce this back EMF an optional crystal diode may be connected, as shown.

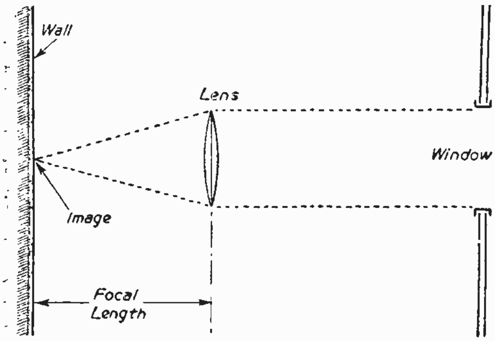

Fig. 3.—Finding the focal length.

The uses of such a circuit as this have been enumerated in previous articles on the ordinary P.E.C., such devices as garage door openers, burglar alarms (a blue filter in front of the exciter lamp renders the beam almost invisible), liquid level controls, or even, with the relay adjusted and the sensitivity control very carefully set, as a smoke detector and fire indicator. In the original model the sensitivity control was found to be useful for experimental purposes. It may be dispensed with if desired.

Since quite a high degree of illumination is required by the cell, a simple lens system was found to be necessary. The system was not elaborate. A very scratched and battered lens was discovered. The focal length of the lens was found by focusing an image of a window on an opposite wall, see Fig. 3. The lens was mounted in a box which had been blackened inside, and the photo-cell mounted at the focus, this very simple arrangement was found to be excellent for the purpose. If a small arrangement is required the lens should be of short focal length. It must be remembered that with these lens systems it is inadvisable to direct the assembly at very high sources of luminous intensity, such as the sun, as the photo-transistor may become damaged. It might be worth mentioning that if an electric light bulb is held too near to the cell damage might result due to the heating effect of the lamp raising the temperature of the junction

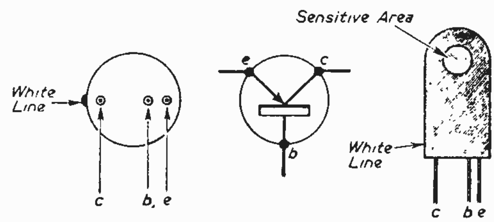

Fig. 6.—Connections of the OCP71.

COMPONENTS FOR Fig. 5

T1—250-0-250 volts at 120 mA.; 6.3 volts at 2 amps. C.T.; 5 volts at 2 amps.
Ch. 1 and 2—10H choke at 60 mA.
C1 and C3—16 μF 350 v. wkg.
C2 and C4—8 μF 450 v. wkg.
V1—5Z4.
F1 and F2—500 mA. fuses.

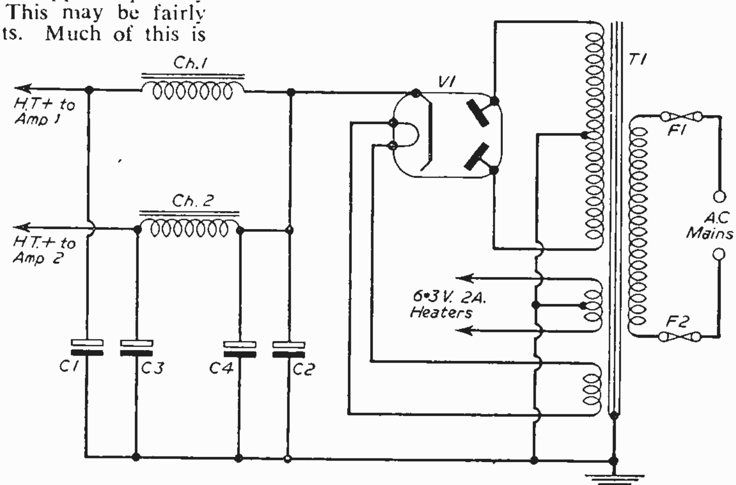

Fig. 5.—A power pack for the amplifier in Fig. 4.

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causing a "run away," irreparably damaging the photo-transistor. When soldering these cells in circuit the normal precautions should be observed to prevent damage by heat. (A very efficient heat shunt has been devised by one firm. It consists of a slice of potato about ½in. thick, through which the wires are pushed and then soldered into circuit.)

COMPONENTS FOR FIG. 2

1—OCP 71.
1—Relay of about 3,000 Ω.
1—Variable resistor about 500 Ω.
1—9 volt battery.
1—OA 71 diode optional.

So far we have confined our activities to some simple projects, using the photo-transistor. The device about to be described has been used as a model demonstrating the underlying principles of radio communication and is a little more ambitious.

A Light Transmitter

The principles of operation are simple. A small pea-bulb is fed with current modulated with current fed from a small A.F. amplifier. The varying light from the lamp is transmitted by a suitable lens arrangement and passed on to the photo cell. The photo-transistor converts the varying light into electrical pulses which is fed into another A.F. amplifier.

The range of the system depends, of course, upon the power of the lamp, and the lens efficiency. The larger the lamp the greater the modulating power, the lower the fidelity, due to the thermal inertia of the filament. The range attained in a fairly carefully set-up arrangement was a little over 350ft. The system is a very long way from Hi-Fi, but is sufficient for the transmission of speech.

In the transmitting position the output from the amplifier is applied via the output transformer to a bulb and battery wired in series. The A.C. fed from the transformer varies the light output from the bulb in sympathy with the output from the microphone, and this may be regarded as "modulated light." The circuit is quite conventional as far as the rest of the circuitry is concerned. The original circuit was a "one way only" system, but as can be seen from the diagram, the system has been modified for two-way communication.

The photo-transistor is contained in a light-proof box to prevent "jamming" from sources such as 50 c.p.s. mains lighting. D.C. mains should not affect the system. The power pack was built on a separate chassis and was used to feed both amplifiers (two amplifiers of the type shown in Fig. 4 are needed).

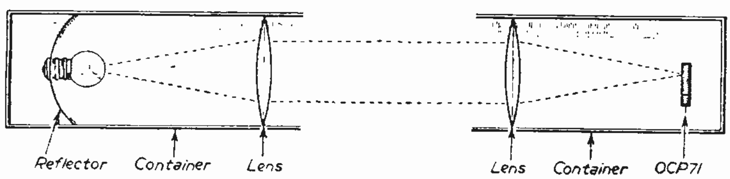

Fig. 7.—Details of a condenser lens.

A battery version of the circuit has been tried, but it was found to be very inferior to the mains model. For a long distance operation a condenser lens is required. A suitable arrangement is shown in Fig. 6. In Fig. 5 we give a circuit for a suitable power supply.

Experimental Standard Frequencies

AN experimental 60kc/s standard frequency broadcast, begun on July 1, 1956, at the Boulder (Colorado) Laboratories of the National Bureau of Standards, is opening up several interesting applications, some of which are already in use. A. H. Morgan, Chief of the Radio Broadcast Service Section of the NBS Radio Standards Laboratory, is supervising the experiment.

The Bureau has been broadcasting standard frequencies since 1923, when radio was in its infancy and very few people owned radio receivers. Through the years higher power and more frequencies have been added until at present the NBS standard frequency broadcasts are on six high frequencies (2.5, 5, 10, 15, 20, and 25 Mc/s) at WWV, Beltsville, Maryland; and on three (5, 10, and 15 Mc/s) at WWVH, Maui, Territory of Hawaii. Up to 10 kilowatts are radiated on some of the frequencies. Specialised radio receivers for these broadcasts have been commercially available for many years.

Measurements by the Boulder Laboratories and others have revealed that the regular standard broadcasts at high frequency (H.F.) are subject to changes in frequency as they travel away from the transmitting aerial. This is sufficient to make these H.F. broadcasts unsuitable for many applications.

To meet this urgent situation, W. D. George, Acting Chief, Radio Standards Laboratory, initiated a plan to begin the experimental broadcasts at several low or very low frequencies. The 60kc/s frequency is being put into use first under the call sign KK2XEI.

The principal reason for studying standard frequency broadcasts at frequencies below about 100kc/s is to determine a practical method whereby the radio propagation errors are minimised and users may accomplish high-accuracy frequency comparisons in a shorter measurement time.

The experimental broadcast on 60kc/s, although on low power, has already presented several intriguing possibilities. With the co-operation of Professor Pierce, it has been possible to compare the NBS primary frequency standard, broadcast on 60kc/s, with the British standard, which is broadcast on 16kc/s and 60kc/s, to an accuracy of comparison which is better than two parts in one billion. This has been done almost continuously since the broadcasts began last July.

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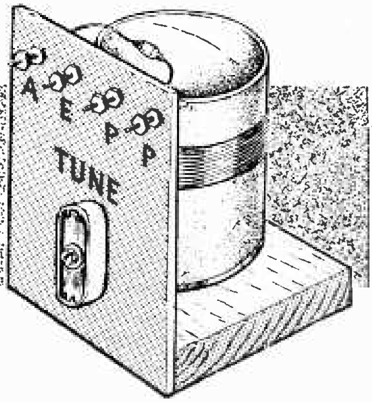
A BEGINNER'S CONSTRUCTIONAL COURSE



AS DISTINCT FROM A THEORETICAL COURSE, THIS SERIES STARTED WITH A SIMPLE CRYSTAL SET, WHICH IS GRADUALLY MODIFIED IN STAGES, UNTIL IT BECOMES A CRYSTAL AND TWO TRANSISTOR LOUDSPEAKER SET

By E. V. King

(*Continued from page 604, November issue.*)

Improving the Selectivity

YOU are now ready to make the receiver more selective. To do this, remove all leads soldered to the aerial tag. Fix another trimmer of about 500pF value above the other one. Fix one tag of the new trimmer (C1) to the aerial tag, remembering to solder all shims together on some types of trimmer. The other tag of C1 takes the leads which previously went to the aerial tag, i.e., one to the diode, one to the other trimmer C2, and one to the lead M of the coil (Figs. 17 and 18).

The trimmer C1 now becomes a variable selectivity control and C2 remains the tuning control. Naturally you may fit larger variable condensers with knobs if you wish, but the cost will be greater, the performance the same.

You will have to find by trial and error the best position for C1: as the selectivity improves the volume will drop. While this is a simple crystal set this is very important, but when a transistor is added selectivity becomes paramount as ample volume is readily available. Performance will be greatly improved on adding a transistor and volume control and modifying the coil to cover long waves as well as medium.

No doubt the experiments which have so far been given proved interesting and instructive as well as having given you much confidence. If you have not made up this radio you can easily do so now; if you are a real beginner do so only in stages and test each first.

It is assumed that you now have the simple radio working and that it is fitted with the aerial series condenser which has been mentioned. The front panel thus holds two trimmers (or variable condensers) and four terminals.

PARTS REQUIRED
(For the modifications given this month).
VR1—30 K or 50 K volume control.
Tr1— Red spot or OC71 transistor.
1 oz. 32 g. enam. copper wire.
S1, S2—2 toggle switches.
R1—1 220 K ¼ w. resistor.
R2—1 30 K or 33 K ¼ w. resistor.
One 500 pF Trimmer
1 T5 torch battery.

How to Modify the Coil to Receive Long Waves

In order to receive Droitwich and other Long Wave stations you must remove the coil and wind on another 120 turns of 32 s.w.g. enamelled copper wire in three piles of 40 wound in the same direction as the original 24 turns (Fig. 19). Each group of 40 turns is wound in a space of ¼in. in a

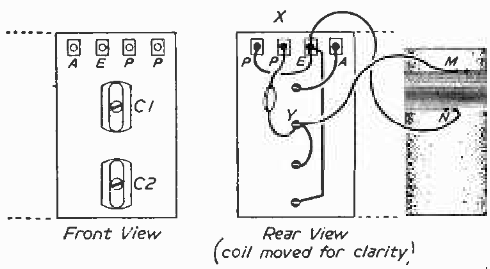


Fig. 17.—Practical wiring for the Fig. 18 circuit.

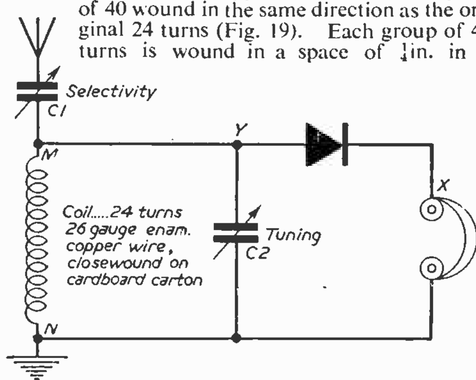


Fig. 18.—The modified circuit for improved selectivity.

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pile and not side by side. The top of the new winding is carefully scraped and soldered to the bottom (N) of the old winding. There are now three connections to the coil, M, N and O.

The coil is now fixed back on the base and a wave-change switch is fixed to the front panel.

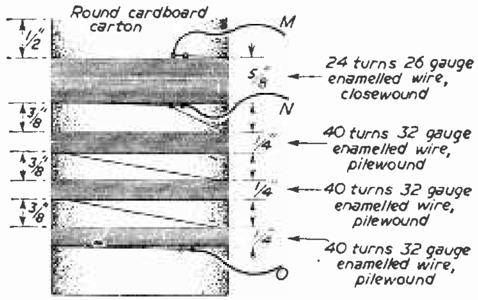


Fig. 19.—Modifying the coil for Long Waves.

Any type of on/off switch will do. The writer had some rather large Air Ministry ones which he used. The switch position is shown in Fig. 21.

The wiring is completed (see Figs. 20 and 21b). The "O" lead goes to the earthed tag of C2. The "M" lead goes to its previous position on C1. Lead "N" goes to one side of the switch, the other side going to the earth tag.

Testing on Long Waves

Put the switch on (Medium Wave) and connect up phones, aerial and earth. The set should function just as it did before because the switch is shorting out the new long-wave winding. Now open the switch and do up C1 fairly tightly, then tune with C2. You will easily locate Droitwich, the author found that the Light Programme was better received on this band. Many Continental stations can also be received too, but some difficulty is experienced in separating them adequately.

How to Fit a Transistor for Much Greater Volume

Later, when a transistor is added, C1 can be loosened off and the selectivity thus improved. If you are using a very short aerial (i.e., a bedstead) and you have sufficient experience you could arrange to short out C1 when S1 is in the "off" position (Long Waves).

With one transistor fitted, and balanced-armature phones, the author received the Home programme in Surrey with such strength that a person ten yards from the phones could clearly hear speech or music! The Mullard OC71 is suitable, but the author used a 10s. Red Spot.

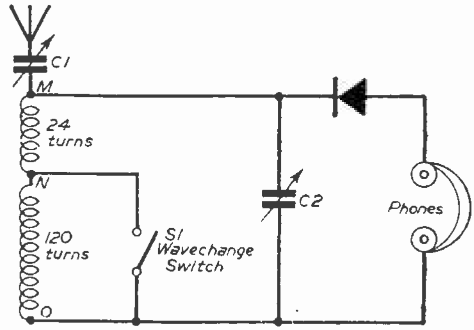
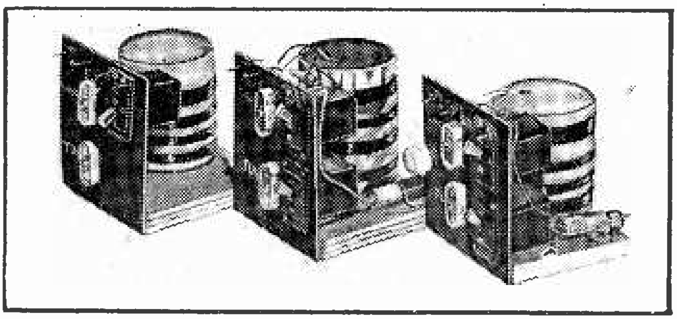


Fig. 20.—Theoretical circuit for dual range reception.

Power is drawn via another switch from a T5 torch battery which is fixed to the base beside the coil with a small tinplate clip (Fig. 24b).

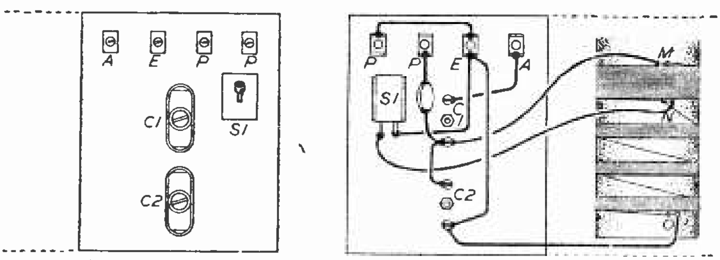
The on/off switch, which may be of any type, is mounted underneath the wavechange switch (see Fig. 23). In future you will have to switch this one off when the set is not required or there will be a continual drain from the small battery. The current is, however, extremely small at about .1 or .2 mA according to the transistor used. The battery will last very many months.



The three stages covered in this article.

Wiring the Transistor Circuit

Here is a suggested plan for the beginner to follow with the help of the theoretical and practical circuits of Figs. 24a and 22. Connect the earthy side of C2 to the newly fitted switch (S2), switch it off and connect the other side to the



(a) Front Panel Layout (b) Back View (coil moved sideways)

Fig. 21.—Practical wiring for Fig. 20.

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brass cap (plus) of the T5 cell. Take a 33,000 ohm resistor and another of 220,000 ohms, shorten the leads to 1in. and join one lead of each together and take the spare 220k lead to the far phone tag and then to the negative side of the T5 cell. Join the spare 33k lead to the earth tag. The resistors are now freely suspended in the wiring with a solder blob where they join. The wire which previously joined one phone terminal to earth is removed. The diode is now unsoldered from the phone tag and is re-connected to the solder blob at junction R1 and R2. Make sure the black side goes to the blob and the red side to the tuned circuit.

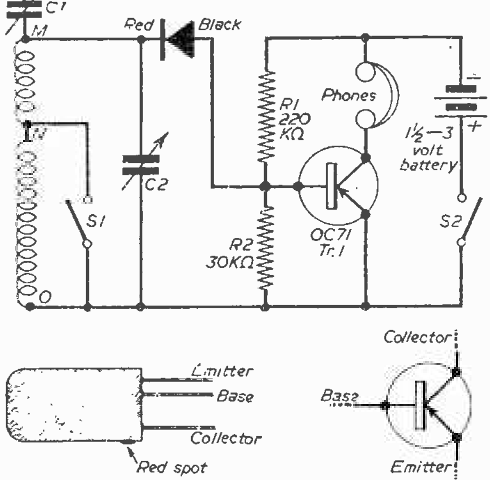


Fig. 22.—The theoretical one-transistor circuit.

Now take the transistor and study it carefully with reference to the plans of Fig. 22. Leave the leads full length and slip some sleeving over them for protection against shorts. When soldering transistors you should always tin the parts they are to be fixed to, apply fluxite to the leads. Then take up some solder on the iron and quickly solder each lead in position. Do not let the hot iron warm up the body of the transistor, and if by any chance the soldering is not successful wait five minutes before having another go. The writer is convinced that no special technique is really required in soldering transistors provided the operation is done quickly; he has had only one develop a fault in fixing out of hundreds which he has used. The beginner may like to play safe and make the sleeves on the short side so that he may hold each transistor lead with pointed pliers while it is soldered. This will take the heat away and is known as a thermal shunt.

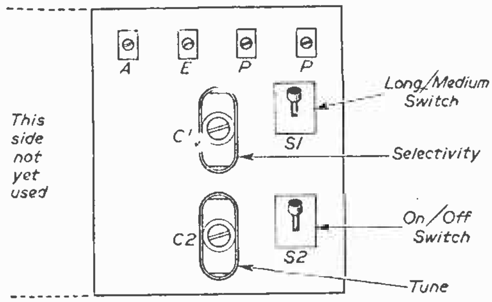
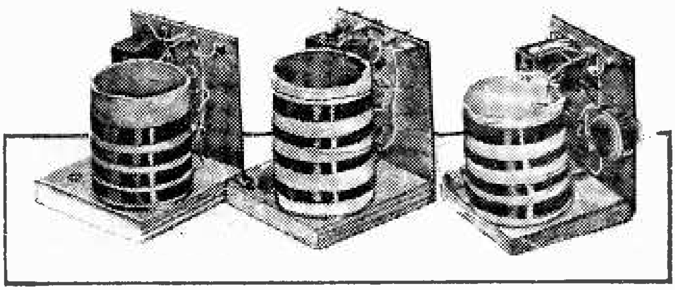


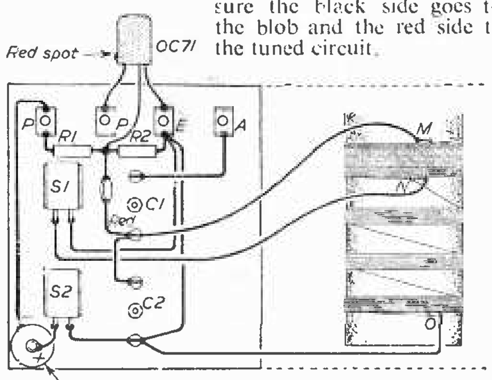
Fig. 23.—Front of panel layout for the one-transistor receiver.



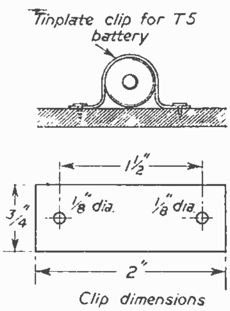
Rear view of the units shown on the opposite page.

Solder the collector (this is near the red spot) directly to the spare phone terminal tag where the diode used to be. The base (the centre lead) to the solder blob at junction R1 and R2, and the emitter (remote from the red spot) to the earth tag. The transistor is now freely suspended in the wiring, tuck it underneath but do not bend leads close to the body itself.

Check very carefully that you have wired up correctly; especially note that the battery is fixed the right way round.



(a)



(b)

Fig. 24.—Rear view of the one-transistor receiver.

Testing the Transistor Receiver

Connect up aerial, earth and phones and switch

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on S2. The receiver will now work with really super volume and clarity. You will find that you can, if you wish, receive local stations on quite short lengths of aerial and scores of Continental ones with a good long one. If you have a milliammeter you may check the transistor drain on the battery by fixing it in one of the leads to the battery

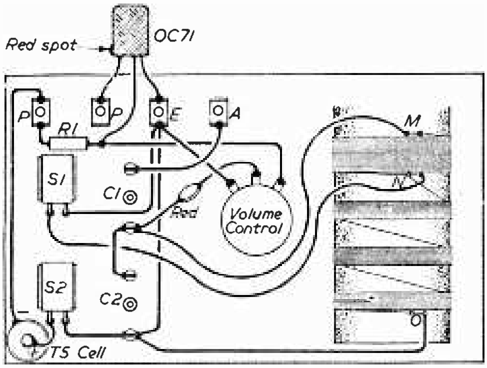

Fig. 25.—Rear view showing volume control.

Fitting a Volume Control

Although the above set is now highly satisfactory you will appreciate the need for a volume control unless you put the phones underneath your pillow! (This is, by the way, a handy way of listening when in bed.)

The control, which is an ordinary 30k (50k will do) potentiometer and is fitted on the panel, the back view of which is shown in Fig. 25. The control should be just about under the aerial terminal.

The diode is disconnected from the solder blob and is connected to the slider (centre) of volume control. The remaining tags of the volume control are taken respectively to the earth tag and the solder blob. R2 is now removed, for the volume control has taken its place. The circuit should now look like Fig. 25 except that the coil would actually hide the switches and trimmers. A

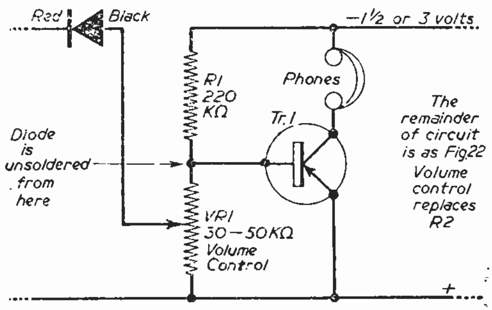

Fig. 26.—The circuit modified for use with volume control.

theoretical picture of the part of the circuit which is altered is shown in Fig. 26.

You may, if you wish, shunt the 50k volume control with a 100k resistor, the real value will then be 30k, but the author found very little difference in performance. If your control works the wrong way round simply reverse the connections to the outside tags.

The radio as it now stands will make a splendid standby receiver, bedroom, or camper's radio, if it is fitted in a wooden cabinet. The receiver is everlasting and the cell will last almost as long as it would on a shelf! You may, of course, fit normal condensers with knobs as previously stated.

Next month details will be given of fitting another transistor so that a loudspeaker may be worked at good volume.

(To be continued)

New Design of Radial Transducer

THE L.276, a new type of ultrasonic cleaning bath for small components and precision piece parts, is announced by Mullard Ltd. as being in full production.

The company's considerable experience in the development and application of ultrasonic techniques has shown a specific need for a compact, hand-fed cleaning bath to supplement conveyorised equipment for the rapid and effective cleaning of small articles. Much of the design of this new bath is directly related to extensive field investigations undertaken to determine the precise requirements of many industries.

Ultrasonic Techniques

Although their history is relatively short, ultrasonic cleaning techniques have proved highly successful in all those industries where they have been adopted. In many cases, almost spectacular improvements in cleaning standards, with material reduction in processing times, have been achieved over conventional methods.

With the introduction of the L.276 even greater possibilities for the treatment of small components and precision piece parts are opened up.

New Design

The outstanding performance of the L.276 is attributable largely to a new design of low-frequency radial transducer, developed specifically for the equipment. This transducer has two important advantages, both of which result in improved cleaning efficiency and shorter processing times. First, it effectively focuses the cavitation intensity in the centre of the cleaning fluid container, where the component would be situated. Second, the cavitation effect is directed equally to all sides of the component simultaneously; therefore, unless exceptional requirements call for multi-stage processing, the entire surface area of the article can be cleaned with one dip.

The beaker is easily removable—it simply stands in position in the centre of the transducer annulus; multi-stage processing with a variety of cleaning agents when exceptionally high cleanliness is required can therefore be carried out by simple substitution of beakers.

The radial transducer incorporated in the L.276 is a low-frequency type operating at 20 kc/s. The choice of frequency (low as opposed to high) is dictated largely by the nature of the contaminations which the cleaning bath is intended to deal with.

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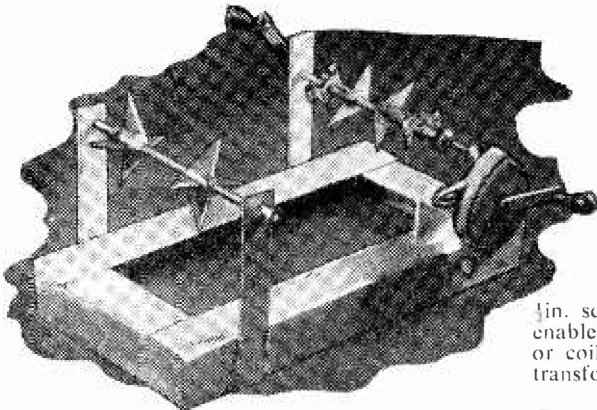
Making a COIL & TRANSFORMER WINDER



THE CONSTRUCTION OF HOME-MADE COILS, ETC., IS GREATLY SIMPLIFIED IF YOU HAVE A WINDING MACHINE SUCH AS THIS

By K. H. Parkes

MOST constructors have tried winding their own coils and transformers, and the usual arrangement consists of a drill fixed in a vice and the cutting of wooden blocks to fit various formers and bobbins. The writer tackled a few filament transformers in this way but soon realised that some kind of machine was essential if transformer construction was to be carried out with any rapidity.

After trying and rejecting various methods and consulting one or two "old hands" about this phase of radio construction, the following machine was evolved. The materials used were odds and ends found in the spares box, and the few additional items should not cost more than fifteen or sixteen shillings.

The base shown in Fig. 1 consists of four pieces of angle iron, welded or bolted to form a skeleton-type chassis. The size can be varied, but in the original 1¾in. angle iron was used, two pieces 14in. long and two pieces 7½in. long. Three uprights of 16 s.w.g. mild steel are bolted on to form bearings for the spindles. Uprights are 6in. long by 1in. wide, drilled ¼in. hole for shaft. The spindles are two lengths of ¼in. rod, originally extension shafts for potentiometers. The rear one taking the bobbin of wire is 9in. long and the winding spindle 7½in. long. Four brass bushes 1¼in. long by ½in. thick drilled centrally with a ¼in. hole are required for clamping the bobbins centrally around the spindles. These bushes could be brass spindle couplers. Each bush is given four saw cuts lengthwise to accommodate the brass vanes. Sixteen brass vanes are required in the shape of right-angled triangles, as in Fig. 3. These can be cut out of old brass condenser vanes. A hole is drilled in each bush in one of the spaces between the saw cuts and tapped 4 BA to take a grub screw. When this is done the vanes are carefully inserted in the slots and sweated in with solder. These chucks are self centring and will take any bobbin or former, round or square or oblong up to a maximum size of 4 sq. in. core dia. or a minimum of ¼in. sq. in. It will be seen that this flexibility enables almost any type of transformer bobbin or coil former to be wound, except, of course, transformers over ½ kilowatt or thereabouts.

Operating Mechanism

The coil winding mechanism consists of a small grinding machine giving a turns ratio of 8 to 1. This grinding machine was obtained from the popular stores and should present no difficulty regarding purchase.

To fix this on the stand a small piece of angle iron was welded on, but a bracket of 16 s.w.g. iron can be bolted to the side serving the same purpose. A large brass nut is soldered on the ¼in. spindle to screw on to the grinding machine, which is provided with a locknut. The other end of the driving spindle is filed square, as in Fig. 5, and tapped centrally 4 BA. A small handle is made

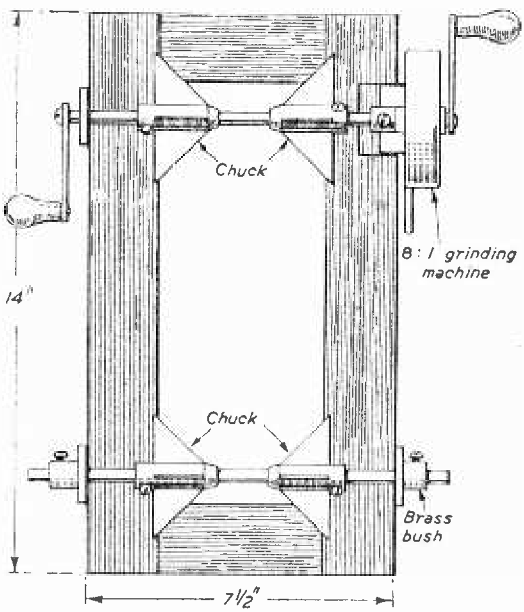


Fig. 1.—Details of the coil winder.

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from a length of 16 s.w.g. strip 3in. × ½in., and using a square file a 3/16in. hole at one end is filed square to fit the shaft. A short piece of 4 BA studding at the other end provides the

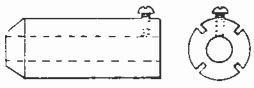
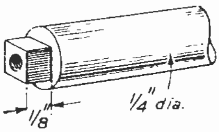


Fig. 2.—The boss which carries the chuck fins.



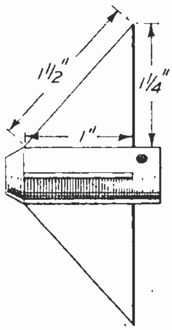


Fig. 5.—(Above) The boss which carries the handle, and Fig. 3 (right) details of the fins.

handle. When winding fairly heavy L.T. windings this handle is fixed on with a 4 BA bolt and enables the turns to be laid slowly and tightly.

On each end of the wire-carrying spindle two brass bushes taken from tuning knobs are fixed to prevent the spindle coming out of the upright bearings. These also serve as tension devices, due to the springiness of the uprights.

No provision has been made for counting turns, but a small rev. counter could no doubt be attached to the upright on the driving end.

Now that transformer construction can be undertaken with reasonable speed and confidence, it is surprising to find what materials are readily obtainable. High cycle transformer laminations can be used. Field coils and relay bobbins provide a source of wire. Cardboard for bobbins, waxed paper from condensers, can be pressed into service.

Setting Up

A final word on how to set up the winder. Take a reel, bobbin or old transformer core containing the wire, slip off one brass bush and chuck, slide the bobbin on, replace chuck, tighten up, and replace brass bushes. Undo the small grinding machine slide off one chuck and fit bobbin or core to be wound. Tighten up chuck, replace grinder, and the machine is ready.

The usual precautions regarding transformer winding should be observed, i.e., insulation, dropped turns, etc.

Practice proves that this machine is very versatile and should more than pay for itself in next to no time.

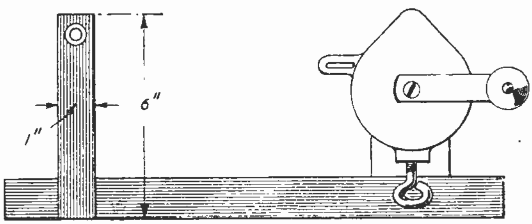


Fig. 4.—Side view of the winder.

News from the Clubs

THE NOTTINGHAM AMATEUR RADIO CLUB (G3EKW)
Hon. Sec.: F. V. Farnsworth, 32, Harrow Road, West Bridgford, Nottingham.

THE club meets every Tuesday and Thursday at Woodthorpe House, Mansfield Road, 7.15 to 10 p.m., for practical construction work, morse training under expert tuition with latest equipment, lectures and discussions. The Club transmits on top band and after some reconstruction work hopes to be on other bands as well. Prospective members are very welcome to visit the club.

THE BURY RADIO SOCIETY
Hon. Sec.: Mr. C. L. Robinson, 56, Avondale Avenue, Bury.

MEETINGS of the above society are held on the second Tuesday of the month at the George Hotel, Kay Gardens, Bury, at 8 p.m.

Forthcoming meetings are:
November 12th. Mr. T. C. Platt (G2GA)—"An Old Timer Looks Back."
December 10th. A.G.M. and Junk Sale.

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

THE club station (G3JBN) at the Church House is available every day of the week for the use of members. Instructional and constructional classes are held on every Tuesday and Wednesday evening. Extra morse classes will be held on Monday evenings when the demand is sufficient. The "Slade Net" will be on the air on the following Friday evenings: November 29th; December 27th.

November 8th. "Astronomy and Cosmology," by the Astronomer Royal, and "Interplanetary Travel," by W. A. Scarr, M.A., (G2WS). Two recorded tape lectures from the R.S.G.B. Library; plus recordings of transmissions from GB3SP.
November 22nd. Annual General Meeting.
December 6th. "Air Traffic Control." A talk by an air traffic control officer from Birmingham (Elmdon) Airport.
December 20th. "Fun and Games," presented by Messrs. L. H. Blackwell and G. L. Turner (members).

SPEN VALLEY & DISTRICT RADIO & TELEVISION SOCIETY
Hon. Sec.: N. Pride, 100, Raikes Lane, Birstall, nr. Leeds.

THE above club has altered its title to "Spen Valley Amateur Radio Society."

The officials for the year are: president, J. Charlesworth (G3IJC); vice-president and hon. treasurer, Mr. L. A. Metcalfe; committee, Messrs. F. Varley (G2FCP), G. Crossley (G2CGR), and J. J. Rose.

The meetings for November are:
Wednesday, November 13th: Supper at George Hotel, Cleckheaton.
Tuesday, November 26th: A joint meeting with the Bradford Radio Society at Bradford Technical College by E. M. Price, M.Sc., on "Some Experiments with Microwaves."
Thursday, December 5th: Joint meeting with Leeds University Union Amateur Radio Society at Leeds University Union, when Messrs. Eddystone will lecture on Communication Receivers.

LIVERPOOL & DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: Mr. W. D. Wardle (G3EWZ), 16, Mendip Road, Liverpool, 15.

AUTUMN programme is as follows:
November 5th—Debate.
November 12th—Films.
November 19th—Open Night.
November 26th—Construction Contest.
December 3rd—Junk Sale.
December 10th—Police Radio.

Meetings are *every* Tuesday at the Community Centre, Penny Lane, Liverpool, 15.

The Society are very keen to get more young members and SWLs. The Annual General Meeting was held on October 1st when Mr. Basil O'Brien, R.S.G.B. Regional representative, presented the Society with both the Region 1 Trophy and the Trophy for the highest score in National Field Day. This is the first time both have been won by the same Society in any one year.

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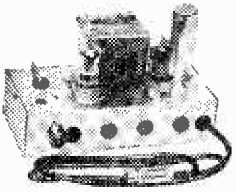


BAND 3 T/V CONVERTER—185 Mc/s - 199 Mc/s

Suitable for London, Birmingham, Northern and Scottish ITA Transmissions.

Mk. 2 Model as illustrated. Latest Cascode circuit using ECC84 and EF80 valves giving improved sensitivity of 15 db over standard circuits. Built-in Power supply AC 200-250v. Dimensions only 6½in. x 3in. Ht. 4in. Simple and easy to fit only external plug in connections. **Wired, aligned and tested ready for use.** State Channel required. **Guar. Bargain Offer** - good results or full refund, only **£3.19.6.** Carr. & Pack. 2/6.

Mk. 1 Model using 2 SD3's or EF80's. Full constructor' Kit of Parts including drilled chassis 7in. x 4in. x 2¼in., blueprint, valves and all components, etc., excluding Power supplies to modified W W design. **Bargain Offer only 2 gns.** P. & P. 2/6. **Power Supply Kit. Complete 20/-.** P. & P. 1/6. Band I-Band III Switch Kit, 6/6.

CONVERTER ACCESSORIES
Band I-Band III Cross-over Unit, 7/6. Var. Attenuators 6db-36db., 6/9. BBC Pattern Filter, 8/6. Band III Aerials-outside Single Dipole with 4 yds. co-ax., etc., 13/9. 3 Element Beam, 27/3. 5 Element, 35/-, etc.

Volume Controls

Log. ratios, 10,000 ohms - 2 Megohms. Long spindles. 1 year guarantee. Midget Ediswan type.
No Sw. S.P.Sw. D.P.Sw.
3/- 4/- 4/9
Linear Ratio, 10,000 ohms — 2 Megohms. Less switch. 3/- each. **Coax plugs, 1/2. Coax sockets, 1/-.** Couplers, **1/3. Outlet boxes, 4/6.**

80 ohm CABLE COAX

STANDARD ¼in. diam. Polythene insulated. GRADE "A" ONLY

8d. yd.

SPECIAL — Semi-air spaced polythene. 80 ohm **Coax** ¼in. diam. Standard core. Losses cut 50%. Ideal Band 3. **9d. yd.**

TWIN-FEEDER, 80 ohms, **6d.** yd. ; 300 ohms, **8d.** yd.
TWIN SCREEN FEEDER, 80 ohms, **1/3** yd.
TRIMMERS, Ceramic, 4 pf.–70 pf., **9d.** ; 100 pf., 150 pf., **1/3** ; 250 pf., **1/6** ; 600 pf., **1/9. PHILIPS** Beehive Type—2 to 8 pf. or 3 to 30 pf., 1/- each.
RESISTORS. Pref. values 10 ohms 10 megohms.

CARBON
20% Type, ¼ w., **3d.** ; ½ w., **5d.** ; 1 w., **6d.** ; 2 w., **9d.**
10% Type, ½ w., **9d.** ;
5% Type, ½ w., **1/-** ;
1% Hi-Stab, ½ w., **2/-**.

WIRE-WOUND
5 w. } 25 ohms 1/3
10 w. } 10,000 1/6
15 w. } ohms 2/-
5 w. } 15,000 - 1/9
} 33,000
10 w. } ohms 2/3

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

3w. LAB. COLVERN, etc. Standard Size Pots, 2¼in. Spindle, High Grade. All Values, 100 ohms to 50 K. **5/6** ; 100 K., **6/6**
W/W EXT. SPEAKER CONTROL, 10 Ω. **3/-**.

CONDENSERS.—Mica or S Mica. All pref. values 3 pf. to 680 pf., **6d.** ea. Ceramic types, 2.2 pf. 5,000 pf., **9d.** each. **Tubulars,** 450 v., Hunts and T.C.C., .0005, .001, .005, .01 and .1 350 v., **9d.** .02, .05, 1/500 v. Hunts T.C.C., **1/-**. .25 Hunts, **1/6.** .5 Hunts, **1/9.** .1 2kV., T.C.C. (Simplex), **3/6.** .001 6 kV., T.C.C., **5/6.** .001 20 kV., T.C.C., **9/6.**

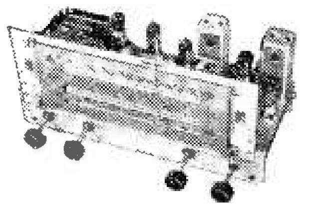
SCOTCH BOY, EMITAPE, etc., 1,200ft., **27/-**. Long playing, 1,800ft. reels, **40/-**. Paper tape, good quality, 1,200ft., **12/6.** Reels only, 3in., **3/-**. 5in., **3/8** ; 5¾in., **4/-** ; 7in., **4/3.**

RECORD PLAYER CABINETS

Contemporary style rexine covered cabinet in mottled red with cream interior. Size 18¾ x 15½ x ht. 8¾in. fitted with all accessories, including speaker baffle board and plastic fret. Space available for all modern amplifiers and autochangers, etc. Uncut record player mounting board 14 x 13in.

Cabinet Price, £3. 3. 0. Carr. and ins. 3/6.

2 VALVE AMPLIFIER (to fit above cabinets), modern circuit with EL84 output, ready built, with 6in. speaker and output transformer, **£3.12.6.** carr. and ins., 2/6.



ALL-WAVE RADIOGRAM CHASSIS

3 WAVEBANDS **5 VALVES**
S.W. 16 m. –50 m. LATEST MIDGET
M.W. 200 m. 500 m. B.V.A.
L.W. 800 m.–2,000 m. SERIES

Brand new and guar. A.C. 200/250 v., 4 pos. W/C sw. Short-Medium-Long-Gram. P.U. socket. High Q dust core coils. Latest circuit technique, delayed AVC and neg. feedback. O/P 4 watts. Chassis size 13½ x 5½ x 2¼in. Dial 10in. x 4½in. Hor. or Vert. station names. Walnut or ivory knobs to choice. Aligned and calibrated ready for use. **Sensitivity and Quality at Low Cost.**
Chassis isolated from mains. **BARGAIN PRICE 9½ gns.** Carr. and ins., 4/6.
8 or 10in. speakers to match, **20/-** and **25/-**.
7 Valve De Luxe, push-pull EL41 version, 7 watt output, with H Duty Output Transformer, £12.10.0. Carr. & ins., 5/-.

RECORD PLAYER BARGAINS

SINGLE PLAYERS.—3 sp. **BSR** (TU8), **92/6.** 4 sp. **BSR** (latest model, TU9), **99/6.** 4 sp. **COLLARO, 5** gns. 4 sp. **GARRARD** (4 S.P.), **£7.10.0.** Carr. & ins., 3/6.
AUTO CHANGERS.—3 sp. **COLLARO** (RC54), **£7.19.6.** 4 sp. **BSR** (UA8), **£8.15.0.** 4 sp. **COLLARO** (RC456), **£9.15.0.** 4 sp. **GARRARD** (RC120 4H), **9½ gns.** Carr. & ins., 4/6.
All above models, Brand New and Guar. Fitted latest style l'weight Xtal. P.U. with turnover head and twin sapphire styli.
SPECIAL OFFER -GARRARD 6 v. Battery operated single 45 r.p.m. Record Player with l'weight Xtal. P.U. Ideal unit for battery portable use.
BARGAIN £5. 19. 6. Carr. & ins., 3/-.

NEW BOXED **VALVES** **ALL GUARANTEED**

1R5, 1T4	7/6	DAF96	9/-	ECL80	10/6	PCF82	10/6
1S5, 1S4	7/6	DF96	9/-	EF41	10/6	PCL83	12/6
3S4, 3V4	8/-	DK96	9/-	EF80	10/6	PL81	11/6
5Z4	9/6	DL96	9/-	EF86	12/6	PL82	10/-
6AM6	8/6	35L6	10/6	EF91	8/6	PL83	11/6
6K7	6/6	EABC80	9/6	EM85	11/6	PY80	9/6
6K8	8/6	EB91	6/6	EL41	10/6	PY81	9/6
6Q7	8/6	EBC41	10/6	EL84	11/6	PY82	8/6
6SN7	8/6	ECC81	9/6	EY51	10/6	U22	8/6
6V6	7/6	ECC84	12/6	EZ40	8/6	U25	11/6
6X4	7/6	ECF80	12/6	EZ80	8/6	UCH42	10/6
6X5	7/6	ECF82	12/6	MU14	9/6	UF41	10/-
7C5	9/-	ECH42	10/6	PCC84	10/6	UL41	10/6
7Y4	8/6	ECH81	10/6	PCF80	10/6	UY41	8/6

SPECIAL PRICE PER SET
1R5, 1T4, 1S5, 1S4 or 3S4, or 3V4 ... ... 27/6
DK96, DF96, DAF96, DL96 ... ... 35/-
6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5 ... ... 35/-

SPEAKER FRET.—Expanded Bronze anodised metal 8in. x 8in., **2/3** ; 12in. x 8in. **3/-** ; 12in. x 12in., **4/3** ; 12in. x 16in., **6/-** ; 24in. x 12in., **8/6,** etc.
TYGAN FRET (Murphy pattern). 12in. x 12in., **2/-** ; 12in. x 18in., **3/-** ; 12in. x 24in., **4/-**, etc.

ELECTROLYTICS ALL TYPES NEW STOCK

Tubular Wire Ends			
25/25 v., 50/12 v.	1/9	32 + 32/350 v. B.E.C.	5/3
50/50 v., 4/500 v.	2/-	**Can Types, Clips 3d. ea.**	
100/25 v., 2/450 v.	2/-	8/450 v.	2/6
8/450 v. B.E.C.	2/3	8 + 8/450 v. T.C.C.	4/6
8/500 v. Dub.	2/9	8 + 16/450 v. Hunts	5/-
8 + 8/500 v. Dub.	4/6	16 + 16/450 v. T.C.C.	5/6
8 + 16/450 v. T.C.C.	5/-	32/350 v. Dub.	4/-
16/450 v. B.E.C.	3/6	32 + 32/275 v. Hunts	4/6
16/500 v. Dub.	4/-	32 + 32/450 v. T.C.C.	6/6
16 + 16/450 v. T.C.C.	5/6	250/350 v. B.E.C.	8/6
32/350 v. Dub.	4/-	60/350 v. T.C.C.	6/3
32/500 v. Dub.	5/-	60 + 16/250 v.	11/6
50 + 50/350 v. B.E.C.	6/6	60 + 60/275 v.	12/3
		100 + 250/275 v.	12/3

Many other types in stock.

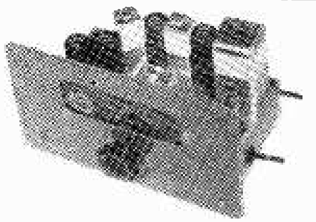
TRANSISTOR. Midget Electrolytics.
2 mfd., 4 mfd., 8 mfd., 6 v. 3/6
6 mfd., 10 mfd., 16 mfd., 3 v., 32 mfd., 1½ v. 3/6

SENTERCEL RECTIFIERS. E.H.T. Type Fly-Back Voltages. K3/25 2 kV., **5/-** ; K3/40 3.2 kV., **6/9** ; K3/45 3.6 kV., **7/3** ; K3/50 4 kV., **7/9** ; K3/100 8 kV., **13/6. MAINS TYPES.**– RM1, 125 v. 60 mA., **4/9** : RM2 125 v. 100 mA., **5/6** ; RM3 125 v. 120 mA., **7/6** ; RM4 250 v. 250 mA., **16/-** ; RM4B type 270 mA., **17/6** ; RM5 250 v. 300 mA., **21/-**.

I.F. TRANSFORMER—465 kc/s
Brand new ex-manufacturer's midget I.F.T., size 2½in. x ⅞in. x ⅞in., dust core tuning. Litz wound coils, High Q. Bargain offer, 7/6 pair.

MAINS TRANSFORMERS.– Made in our own Workshops to Top Grade spec. Fully interleaved and impregnated. **RADIO AND AMPLIFIER TYPE.**—250 v. 60 mA., F.W. sec., 5 v. or 6.3 v. 1 a. rect. 6.3 v. 2.5 a. set Htrs., **22/6.** etc. **C.R.T. HTR. ISOLATION TYPE.**—Low leakage with or without 25% sec. boost voltage. Ratio 1 : 1 or 1 : 1.25. 2 v. 4 v., 6 v. or 13 v., **10/6** ea. Ditto with mains primaries 200/250 v., **12/6.** SPECIALS to order.
L.F. CHOKES.—10 H. 65 mA., **5/-** ; 15 H. 100 mA **10/6** : 10 H. 120 mA, **10/6** ; 20 H. 150 mA., **15/6.**
OUTPUT TRANSF. Standard pentode, **4/6** ; push-pull 12 watt, **13/6.** Small pentode, **3/9** Midget battery pentode (1S4, etc.), **4/6.**
SPEAKERS. PM-3 ohm. 2½in. Elac., **16/6.** 3½in. Goodmans, **18/6** ; 5in. R. & A., **17/6** ; 6in. Celestion, **18/6** ; 7 x 4in. Goodmans, **18/6** ; 8in. Rola, **20/-** ; 8in. Special Cone G'mans, **21/6** ; 10in. R. & A., **25/-**.

8in. P.M. SPEAKER (3 ohm)
Ex-Mfrs'. units. Rola, W.B., Celestion, etc. All reconditioned and guaranteed. Ideal ext. unit 7/6. P. & P. 1/6. Ditto with O/P Trans. **9/6.**



F.M. TUNER-UNIT (87 mc/s -105 mc/s) **by Jason.** As described in Radio Constructor. Designer Approved Kit of parts to build this modern highly successful unit, drilled chassis and superior type ill. glass dial, coils, cans and all quality components, etc., for only **5 Gns.,** post free. Set of 4 specified min. valves, **30/-**, post free. Illustrated handbook with full details **2/-** post free.
2-day alignment service now available.

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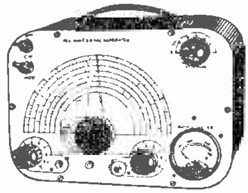
TRANSFORMER & COIL WINDING CAPACITY AVAILABLE FOR PROTOTYPES & SMALL RUNS.

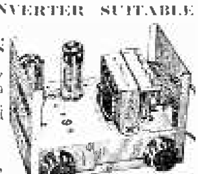
Terms C.W.O. or C.O.D. Kindly make cheques, P.O.s, etc. payable to T.R.S. Post, Packing up to ½lb. 7d., 1lb. 1/1, 3lb. 1/6, 5lb. 2/-, 10lb. 2/9.

SIGNAL GENERATOR



Coverage 120 kc/s. 84 Mc/s. Metal case 10in. x 6¼in. x 4¼in. Size of scale, 6¼in. x 3½in. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F. output continuously variable 100 milli-volts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Grey hammer finished case and white panel. Accuracy plus or minus 2%.
£4/19/6 or 34/- deposit and 3 mthly payments 25/-. P. & P. 4/6 extra.

COMMERCIAL TELEVISION CONVERTER SUITABLE ANY T.V. (except Philips) WITHIN 35 MILES OF I.T.A. TRANSMITTER. ALL CHANNELS NO ALTERATIONS TO SET.



Complete with built-in power supply 230-250 v. A.C. mains. Crackle finish case 5¾in. long, 3½in. wide, 4½in. high, incorporating gain control and band switch. Illus. with cover removed.
£3.19.6 Plus P. & P. 2/6. Hire purchase available.
3 element folded dipole I.T.A. LOFT AERIAL 15/-. P & P. 2/-. Coax cable 8d. yd.

AC/DC MULTI-METER KIT

Comprising 2in. moving coil meter, scale calibrated in A.C. D.C. volts, ohms and milli-amps. Voltage range AC DC 0-10, 0-100 and 0-500, Milli-amps 0-10, 0-100. Ohms 0-1,000 and 0-10,000. Front panel, range switch, wire-wound pot (for ohms zero setting) two toggle switches, resistors and meter rectifier. In grey hammer-finish case

19/6 Plus P. & P. 1/6.

Point to point wiring diagram 1/- free with kit.

4 VALVE ALL-DRY SUPERHET PORTABLE KIT

incorporating Ferrite rod aerial
Medium and long waves. In grey leatherette. Size 9in. x 7in. x 6in. Valve line-up : 1T4, 1R5, 1S5, 3V4. Complete kit of parts (less batteries).
£5.19.6 Plus. Post & Packing 3/6

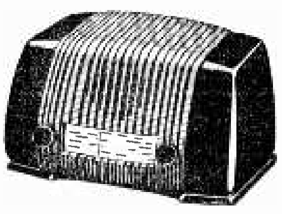
COMPLETELY BUILT PORTABLE AMPLIFIER

approx. size 6¾in. x 2½in., incorporating 2 valves, contact-cooled metal rectifier, bass and treble lift controls and double wound mains transformer 230-250 v. **39/6** Plus P. & P. 3/6
5" P.M. SPEAKER & O.P. TRANSFORMER, if purchased with the above, 18/6. Plus P. & P. 1/6.

COLLARO 4-SPEED AUTOMATIC CHANGER

Model 456 (suitable for use with above amplifier). A.C. mains, 200-250 v., turnover crystal head. Brand new, fully guaranteed.
£8.19.6 Plus P. & P. 5/-. or £3 deposit, plus P. & P. 5/-, and 6 monthly payments of **£1-4-0.**

T.R.F. KIT in PLASTIC CABINET



3 valve plus metal rectifier, A.C. mains 200-250 v. Medium and Long waves. In pastel blue or brown. Valve line-up : 2 VR65s and VT52. Size 15½in. long by 9in. high by 7in. deep.
£3.19.6 P. & P. 7/6.
Point to point wiring diagram 1/6. Free with kit.

RADIO & T.V. COMPONENTS (Acton) LTD.
23 HIGH STREET, ACTON, LONDON, W.3
GOODS NOT DISPATCHED OUTSIDE U.K.

TRANSISTORS

JUNCTION TYPE P-N-P

(British Manufacture)

RED-SPOT 800 kc/s Audio Frequency	10/-
BLUE-SPOT 1.6 Mc/s Mixer and Frequency Changer	15/-
WHITE-SPOT 2.5 Mc/s R.F. and I.F. Amp.	20/-

All Transistors are Tested and Guaranteed.
N.B. The Red Spot is similar to Mullard OC71.

The New "TRANSISTOR—8"

Push-Pull Portable Superhet
Can be built for £11/10/-.

This Portable 8 Transistor Superhet is tunable for both Medium and Long Waves and is comparable in performance to any equivalent Commercial Transistor Set
Simplified construction enables this set to be built easily and quickly into an attractive lightweight cabinet supplied.

TEN STAR FEATURES

★ 8 Specially Selected Transistors
★ 250 Milliwatts Output Push-Pull
★ Medium and Long Waves
★ Internal Ferrite Rod Aerial
★ 7 x 4 Elliptical High Resistance Speaker
★ Drilled Plastic Chassis 8½ x 2¼in.
★ Point to Point wiring and practical layout.
★ Economical. Powered by 7½ v battery
★ Highly sensitive
★ Attractive lightweight contemporary case

N.B. Pair of Matched OC72's or equiv. Supplied at additional cost of 40/-.

We can supply all these items including Cabinet for **£11 10/-** All parts sold separately.

Send for circuit diagrams, assembly data, illustrations and instructions, and full shopping list, **1/6.**

Call and hear demonstration model.

"EAVESDROPPER"

THREE TRANSISTOR POCKET RADIO
(No Aerial or Earth required)

Variable Tuning. Total cost, as specified including Transistors, Transformers, Coils, Condensers and Battery, etc. with circuit and plastic case. **77/6** POST FREE
All items sold separately
With single phone, **82/6.** With Acos Mike, **90/-.** With Min. Hearing Aid **92/6.**

MINI-TWO

TWO-TRANSISTOR MINIATURE POCKET RADIO

The smallest Transistor set offered on the market. Variable Tuning, Drilled Chassis, Plastic Case size 3in. x 2in. x ¾in., Miniature Hearing Aid 2 Transistors and all components including 1½ volt Battery. Circuits and full practical layout diagrams.

Total Cost **49/6** Complete

TRANSISTOR SIGNAL TRACER
Complete Kit with 2 Transistors, Components, Phones, with Circuit and plastic case. 42/6.

TRANSISTOR SQUARE WAVE GENERATOR
Complete Kit with 2 Transistors, Components, Circuit and plastic case. 25/-.

QUARTZ CRYSTALS
5/- each
Send for Lists.

"HOMELIGHT" 2-TRANSISTOR PERSONAL PORTABLE
Variable Tuning
We can supply all components including 2 Transistors Diode, Resistors, Condensers and Miniature Hearing Aid and Plastic Case size 4¼ x 2¾ x 1¼in. and 1½ v. Battery.
FOR 52/6
All items sold separately.

6 v. VIBRATOR PACKS
Output 120 v. 40 mA., 12/6.
Brand new.

R.F.24. 10/-. R.F.25. 12/6.
R.F.26 25/-. Brand new with valves, carr. 2/6.

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TRANSISTORS in Practice

AN EXPERIMENTAL TRANSISTOR CHASSIS

By R. Hindle

(*Continued from page 616 November issue*)

Many readers experience difficulty in understanding how the modern transistor operates, and therefore this short series of articles has been prepared to explain their action—in theory and practice. This month we give an experimental transistor set.

IT is important to remember that for the miniature battery portable for which purpose the transistor excels it will be as well to be satisfied with the 200mW. of power output that is easily available from commonly available transistors. A modern speaker of good efficiency can give a good account of itself on such an audio power. There is one application, however, that has, no doubt, sprung into the minds of readers. A car accumulator is quite happy with a drain in the order of amps. and the idea of avoiding the conversion of the battery voltage to a H.T. voltage by means of a vibrator should prove popular when transistors giving watts of power are available. It is hoped, in due course, to present such a design. But first of all some simple designs will be presented.

Transistors were first applied to audio amplification work for which, in view of the frequency limitations of the earlier models, they were particularly suited, and the constructor will be wise to try out such a circuit first to accustom himself to transistor conditions of operation. It seemed to the writer that something more than the usual form of completed design was called for in the present instance. The chassis here described was produced, therefore, as a basis for the experimental use of transistors. On this an audio circuit is first built, but from the beginning facilities are provided for developing a simple receiver in progressive steps.

The point was made in the preliminary explanation of transistor principles that these devices are very sensitive to temperature rise. Indeed, such a rise, whether due to operating conditions or to a source of heat applied externally, can destroy a transistor and consequently great care must be taken when doing constructional work, not to allow the heat from the soldering iron to damage them. It is not a pleasant prospect to think that transistors bought at their comparatively high present price should fail before they have even begun to give a good account of themselves. They can be soldered into the circuit and if care is taken no trouble will arise. This care amounts to the use of a heat shunt applied between the point of contact of the soldering iron and the transistor body to conduct the heat away. The method is identical with that adopted electrically when a low resistance shunt it put across a sensitive meter to conduct away the majority of the current and protect the meter. Quite simply, a pair of pliers forms a suitable shunt, so that all that need be done is to hold the transistor with the pliers gripping the connecting wire to be soldered—and of course nearer to the body of the transistor than the point to receive the solder. Such a course is quite suitable when transistors are being soldered in for all time, but in the early days of transistor use there is a temptation to try out the components in different circuits. Continual soldering and unsoldering (particularly the latter—it always seems harder to take a component off than to wire it in) means exposing the device repeatedly to the risk of damage. This risk arises not only when the transistors themselves are being fixed or removed, but also when, say, a resistor adjacent to the transistor is being changed.

In the present case it was decided to avoid this risk by providing sockets for the transistors. This preserves the components for more permanent designs that will follow, using the same parts as the experimental first unit. The wires of the transistors were bent back on themselves about $\frac{3}{4}$in. from the body. Holding each such connecting wire in the jaws of the pliers as a heat shunt, in the manner previously described, solder was run on to the extremes of the wires to stiffen them. This was a once for all operation; the stiffened ends of the wires could then be plugged into the sockets like valves (in fact miniature valve sockets were used for the purpose) and they could be withdrawn when modifications were being made to the chassis, or for incorporation in other devices. It is agreed that transistors used in this way do not look so elegant as when wired in, but at least they are preserved for subsequent use and, in fact, the leads are left long enough to be soldered in later when it is decided where they are to be put to permanent use. There is one word of warning about using transistors in this way. Care has to be taken to insert the wires in the correct sockets and not to force them in by means of the body of the transistor, for this may cause mechanical damage that would be just as bad as the electrical variety or, failing that, the wires that are very close together at the point of lead-out from the transistor may be pushed into contact. The safe procedure is to locate the wires in the top of the socket and then force home with a

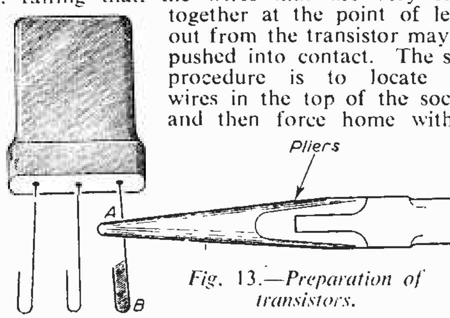

Fig. 13.—Preparation of transistors.

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pair of fine-nosed pliers, gripping the wires at the top of the part that was stiffened by the solder. Fig. 13 indicates the technique, point A being the place to hold with the pliers whilst soldering the wires and when pressing them home into the sockets whilst, at point B where the wires are bent back, the solder is run in.

Facilities Provided

The audio amplifier that it is proposed to build on this chassis has two stages, both of low power. It can be used by itself in the early stages, and later it can feed a power output stage. A position for a third transistor is provided in readiness for the later stages in the development of the design and there is room for a fourth should this be required subsequently. No provision is made for the power stage on the present chassis. If the constructor wished he could make the chassis somewhat larger with this in view but it seems better to relegate this to a separate panel. The writer is experimenting with a somewhat different method of construction that seems particularly suited to transistor work when the first excitement of experimental work is over and a design is made up more permanently; the power stage is being made on these new lines and will attach to the present chassis if required.

In addition to the transistors themselves, some means for tuning is provided in readiness for the next stage. Until recently the transistors available in this country were not really suited for medium-wave work and some experimental receivers have been described working on long waves only. It seemed better, however, to await some genuine H.F. specimens and these now being to hand, medium waves can be operated without difficulty. Consequently there is every reason to provide tuning facilities and a miniature two-gang capacitor is built on to the chassis. The first tuner circuit on this chassis uses only a single section but the second section will be useful later on.

The Chassis

The chassis produced with this purpose in mind is not so small as a transistor design will allow but it is still quite small, whilst allowing sufficient room for alteration and experiment and leaving open access to components. After all, it is an experimental chassis. The particular dimensions were chosen because they happened to fit the small cabinet used for the Mini-four and Mini-amp designs appearing in PRACTICAL WIRELESS some time ago. The battery, and the power stage later to be described, stow away in the lower compartment and the speaker incorporated in the earlier designs can then be used for the transistor experiments. This cabinet is not necessary, however, and the chassis as described stands by itself.

Fig. 14 gives the dimensions of the chassis and the layout of the major components to be mounted upon it. It will be seen that there is provision for a second control in addition to the tuner. If desired, a switch could be mounted at this second control position to control the battery. The hole is used, in fact, in the next stage for a regeneration control and, as this is resistive, a volume control potentiometer is used. This naturally incorporates a switch and is actually a 25KΩ component. It is suggested, therefore, that the constructor should mount such a control at the outset and at this early stage use only the switch.

A place is also left on the chassis for a miniature transformer at the output position. The amplifier is likely to be used in the first instance with a pair of phones, which can be connected directly into the collector circuit but for alternative uses a transformer will be specified. The component allowed for is a miniature version produced by Belclere especially for transistor work at a very satisfactorily low price. The transistor being fundamentally a power producing rather than a voltage producing device, and therefore matching conditions being important for best efficiency, the provision of a transformer is desirable. As the input transistor characteristic demands current instead of voltage, the circuit feeding a power output transistor has to be looked upon as a driver stage, in the same sense that a driver stage is considered necessary before a class B valve stage in which grid current is allowed to flow. The present amplifier can be looked upon

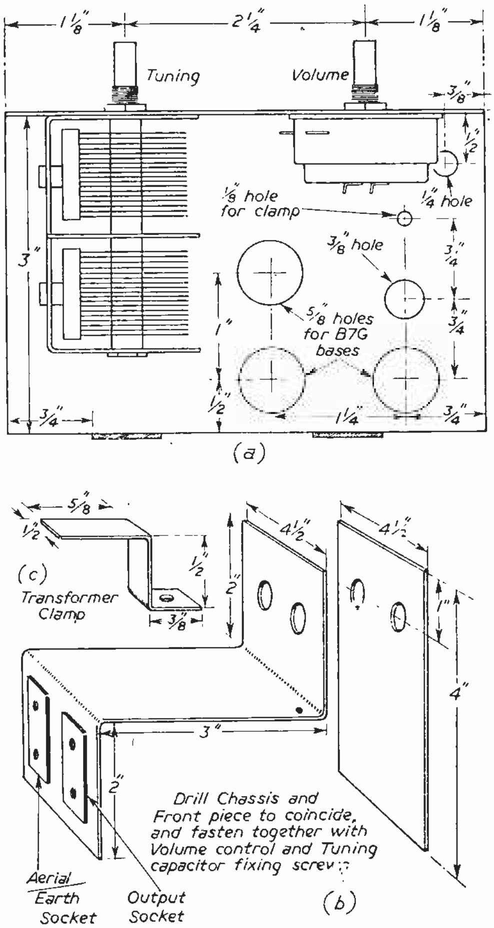

Fig. 14.—Aluminium chassis and layout. (Top of chassis.)

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therefore, as a driver for the following circuit and the transformer will permit the transfer of maximum power. These miniature transformers have no mounting brackets. They can be held in place by the wiring, as will be seen in the permanent circuit versions planned, but for this experimental model the component is fixed by means of a small aluminium clamp which is also illustrated in Fig. 14. Both parts of the chassis are made of sheet aluminum.

Amplifier Circuit

The circuit used for the amplifier part of this design is given in Fig. 15. Both stages operate in the common emitter configuration as shown previously in Fig. 12, except that a transformer load is indicated for T2. The inter-stage coupling is by resistance/capacitance as previously described, and D.C. stabilisation by the preferred method is provided at both stages. A battery supply of 6 volts is chosen, this being a convenient value giving economical working.

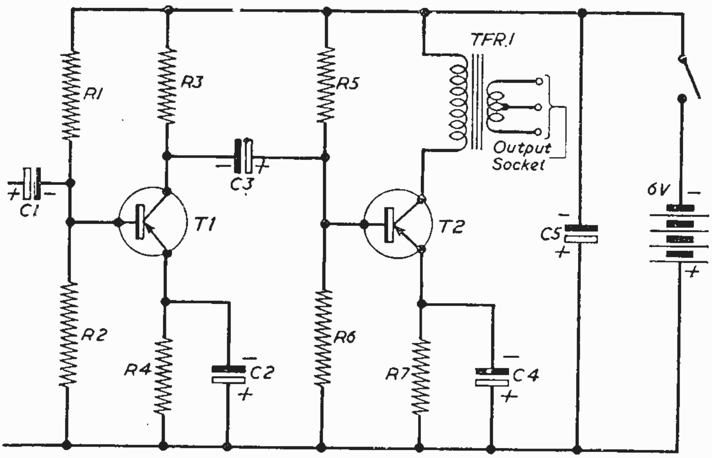

Fig. 15.—Circuit diagram of the amplifier described in this article.

R4 is a D.C. feedback resistor for stabilisation purposes and is chosen to provide the degree of stabilisation required, having in mind the manufacturing spread and the likely variation in operating conditions. A voltage drop across the resistor of between ½ volt and 1½ volts is generally chosen for this purpose—it must not be too high or there will be insufficient voltage left to operate the transistor satisfactorily. The actual value depends on the emitter current flowing through it, and this current is practically the same as the collector circuit, the difference being accounted for by the base current.

What value of emitter and collector current has to be taken, then? In valve technique, it is well understood that a bias has to be applied to the grid so that the anode voltage can swing on either side of the quiescent voltage in conformity with the input signal, the excursions above and below the no-signal condition being equal for minimum distortion. Failure to apply such a bias results in distortion to the signal in the form of clipping of the positive half-cycles. The transistor also requires a bias at its base and for similar reasons, except that the bias is in the form of a current. There is an upper and a lower limit to the collector current excursion—an upper one set by the maximum dissipation permissible, as specified by the transistor manufacturer (audio transistors of the type used in this amplifier are rated at 50mW.) and this is governed by the permissible rise in junction temperature. In case the reader should be inclined to quibble about the rating given for the dissipation limit of 50mW., this is the upgraded limit now specified by Mullard for the OC71, which was previously rated at 25mW. Assuming 3 volts across the transistor (the remainder will be lost in the load and feedback resistors) this would seem to allow a working range of collector current up to about 15mA. The lower limit is set by the leakage current that passes even when there is no current at the imput position. As this current flows at the collector without any current at the base, clearly it is not subject to control by the base and consequently the base must swing with the input signal only over a range that will cause a collector current greater than this leakage current. Often, the leakage current for the common base circuit is the only one specified by the makers in their literature, this being the current that flows through the diode formed by the collector and base by virtue of the fact that the resistance to a reversed voltage is not infinite, as we so often like to think it. The leakage current for common base connection is, in fact, quite small. For the common emitter circuit, however, as here used, this leakage current is subject to amplification of the order of the current amplification factor (α^1) of the common emitter transistor and, under these conditions, is of the order of 150μA.

A range of between 150μA. and 15mA. leaves quite a choice. In the interests of economy, however, as low a current as is likely to be satis-

COMPONENT LIST FOR FIG 15.

R1—22K R2—4.7K R3—3.3K R4—1.8K
R5—12K R6—4.7K R7—470Ω } ¼ watt

C1, 2, 3, 4	10μF	6 volt	Daly H2 5/1
C5	50μF	12 volt	Daly E2 15/2
T1, 2	OC71	Mullard	
TFR1	BN1826	Belclere Interstage.	

ALSO REQUIRED :

1 chassis as described.
1 Two gang miniature tuning capacitor, 500pF Osmor.
1 Volume control 25K linear law with single pole switch.
3 Valve holders miniature 7 pin.
1 Tag strip, 1 plus earth.
2 Knobs.
1 6 volt battery.

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factory will be adopted. There is an additional virtue in low consumption that is likely to be considered even more important. The transistor tends to introduce noise in proportion to collector current and so economy leads to better signal/noise ratio. One would expect to see, therefore, in cascaded transistor amplifiers, that each stage along the chain would have progressively more collector current as the signal was amplified and each stage was being driven by a greater signal current than its predecessor. The first stage is commonly designed around a current of 500μA., which will permit a signal output of up to about the same figure peak to peak. Current gain being of the order of 50 times in the average case, the stage can be expected to accept an input signal of up to 10μA. and the base current in the quiescent state, i.e., the bias to be provided, would be around 10μA. This condition of working is used for the first stage of this amplifier.

Though the emitter current is equal to the collector current plus the base current, the latter is so small comparatively (10μA. compared with 500μA.) that its effect is negligible—after all, the normal resistor tolerance is more than the proportion of collector to base currents. So, to drop 1 volt across the emitter resistor with a current of 500μA. the resistor should be 2KΩ. An easily available size must be chosen for R4, however, so 1.8KΩ is specified.

The collector load resistor, R3, if one were to

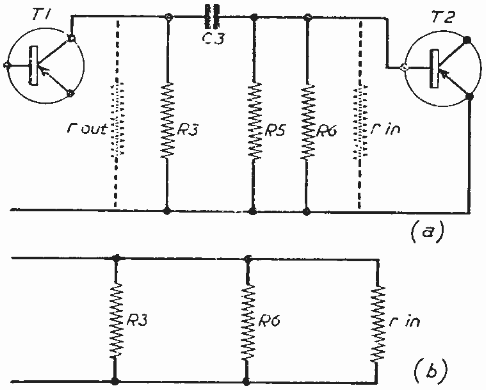

Fig. 16.—Circuits of the equivalent load on T1.

aim at taking off the maximum signal voltage, as in the case of a valve, would be made as high as possible. The aim, in the case of a transistor feeding a following transistor is, however, to pass on the maximum signal current to the second stage. Any signal current flowing through R3 is, therefore, wasted because a current cannot flow through this and also through the next transistor base circuit when both are in parallel. The larger R3 is made, the less will be the current that will flow through it in preference to taking the intended path to the next transistor base so, as in the case of the valve, the collector resistor should be as large as possible. From the point of view of D.C., however, this resistor is the only path from the battery to the collector, C3 effectively blocking the alternative path to D.C. It has already been decided that 500μA. should flow to the collector. The battery supply is 6 volts and almost 1 volt has been taken up in the emitter resistor. A value of 10KΩ at R3 would mean that 5 volts would be dropped across it for a current of 500μA. (by Ohms Law), leaving nothing for the transistor, which is obviously absurd. Therefore, R3 must be less than 10KΩ.

The actual load on T1, from a signal point of view, is quite complex and is in the form given at Fig. 16(a), where the component identities are the same as in Fig. 15. If the value of C3 is properly chosen so as to have negligible reactance at the frequencies to be operated it can be neglected for the present purpose and it will be seen shortly that R5 is many times greater than R6, so consequently it is of little importance from the point of view of T1 load. The input resistance of T2 (i.e., r in) is likely to be about 1KΩ. The output resistance of T1 (i.e., r out) is high and consequently has little effect as a shunt. Thus the load given at Fig. 16(a) reduces to that given at Fig. 16(b), the aim being to put the maximum current through r in. So long as R3 is at least three times r in it is not likely to affect the signal gain seriously and, on the other hand, is not so large as to starve T1 of volts and so R3 is made 3.3KΩ. This, and the emitter resistor, leave about 2 volts across the transistor which is reasonable for the low level of signal expected at this stage.

Cheap Transistors

R3 and R4 thus account for about 4KΩ in series with the transistor across 6 volts supply. Now if the whole of this voltage were to be dropped across these resistors only 1½ mA. could flow, so obviously no more current can pass when the transistor is also in series. This is well within the rating of the transistor, which is thus fully protected from damage by excessive current. It might be thought, therefore, that no D.C. stabilisation is really necessary. This would be quite true if the conditions for operation of the transistor were to be set in the first instance by means of a meter to suit the particular component used and if, when the transistor was changed, the setting up procedure were to be repeated. Stabilisation is introduced, however, to cover variations due to manufacturing spread and variations in normal operating temperatures. Cheap transistors are available from many sources; these are generally outside the spread quoted by manufacturers and results cannot be guaranteed in these cases. Users of such transistors could satisfy themselves that their operating conditions are not widely different from those quoted by measuring the collector current flowing. The safety of the transistor is ensured by the series resistors, so users without a suitable meter need not worry on that score. In all fairness, it should be stated that the amplifier here described has been worked with every satisfaction using two transistors of the kind obtainable at a cost of 10s. each from a well-known supplier and without changing any component values.

The current gain of the first stage transistor has been quoted as about 50 times, but it could be as low as 30 times, due to manufacturing spread.

(*To be continued*)

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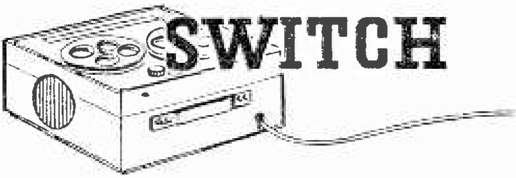
A TAPE RECORDER DICTATION SWITCH



A SPEECH-OPERATED MOTOR CONTROL TO CONSERVE TAPE By Hugh Guy

(Continued from page 627 November issue)

THE first resistors to be mounted are R3, R2, R8 and R9. The remaining resistors are mounted above or alongside these four as indicated in the under chassis view. Resistors R4, R5, R6, which are connected to VR1, are best left until the support panel has been attached to the chassis. When this is done C5 and C6 can then be connected and the three resistors coupled to the control, VR1. The connection to V2a cathode from C5 is taken via the 8 BA hole in the chassis by V3. The loudspeaker can also be wired to the transformer primary.

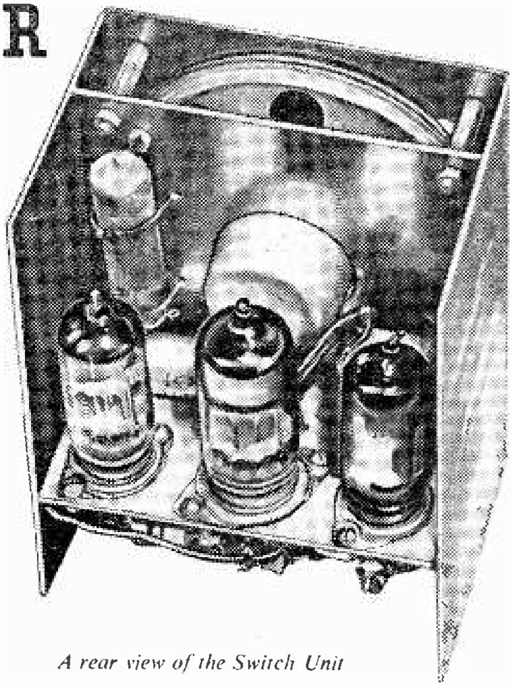
Remaining connections are associated with cable A, which forms a flexible lead from the unit terminated in a four-pin battery plug to mate with the corresponding socket specially mounted for this purpose on the tape recorder.

The socket SK1 is an optional extra and on the unit described in this article has been replaced by a flying lead terminated in a jack plug for direct connection to the tape recorder. Temporary leads can be connected in the first instance to test the unit, a procedure which can now be attempted.

In the final completed wiring the only connections yet to be made are those coupling up the override switch to the appropriate part in the circuit. These are made through the ⅜in. diameter hole in the support panel, the override switch itself being mounted in this design on the front panel and therefore lying in the space between the support panel and front panel.

Testing the Unit

The circuit is designed to operate from 250 to 300v. H.T. After plugging in the valves and switching on, the circuit should be left for some five to ten minutes to warm up and stabilise. The 6,000 ohm relay may either be open or closed during this period, but after this time has elapsed rotation of VR1 should cause it to click in and out as a certain point on the track is passed. In a correctly functioning circuit and in reasonable silence the proportion of track covered going from one relay condition to the other, and back again, should be very small and is representative of the "backlash" of the circuit. This degree of "backlash" is very important in determining the sensitivity of operation, and if it is found excessive, resistance R10 should be replaced by one of value 6.8 K.



A rear view of the Switch Unit

Adjust the control VR1 so that the relay RL1 just closes. A snap of the fingers in front of whaever is being used as a microphone will now cause the relay to open for about a second. Similarly, speech should cause the relay to open for the duration of the signal. It should not be necessary to bellow into the microphone to make it work, but on the other hand the voice should not be allowed to fall during the use of the device as a more or less constant level is required.

The time for which the relay is operated is controlled by the combination C6, R8. If it is found that the time given by the present combination is not long enough, then C6 should be increased in value. It should be pointed out here that an electrolytic condenser of reasonably low leakage (i.e., one in good condition) should be used here as the leakage resistance of the condenser itself can modify the characteristics of the circuit.

The presence of C4 is to assist in the speed of operation of the circuit. As the diversion of current from V3b to V3a commences the potential at V3b anode rises and this initial rise is fed back to V2a in such a manner as to assist the overall switching of V3 anode current and thereby the switching of motor contacts.

Final Notes

Although the device is direct-coupled, drift problems are practically non-existent once the unit has warmed up, because, unlike a D.C. amplifier, the D.C. levels in the circuit are only critical to within half a volt or so. It is only important in this respect to ensure that the H.T. supply provided by the tape recorder remains at a fairly constant level.

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On Your Wavelength

BY THERMION

The Ban on Muggeridge

I OBSERVE that the BBC decided not to interview Malcolm Muggeridge on his controversial article written for an American periodical in which he discussed the question of the monarchy and whether Great Britain really needed one. If this question needed to be discussed at all Mr. Muggeridge should not have been allowed to set himself up as an authority on the topic and to discuss the matter as though he were a spokesman for the British nation. He is a self-appointed critic and his views must necessarily be his own, since he cannot have had an opportunity of discussing the subject on a national basis. As such, the BBC was remiss in arranging the interview at all. It should have known, after the resentment felt when Lord Altrincham and the youthful Lord Londonderry voiced their noxious opinions, that such a broadcast would be unpopular. The BBC, however, without any regard for public sentiment and learning of the article which was to be published during the Queen's tour of Canada, thought that it would be a scoop to interview the author of it. There can be no doubt that this was their point of view, because on the evening in question, when the interview was booked to take place, Mr. Muggeridge was to have appeared in another programme where he was to have been the interviewer. At the last moment, it was announced that he was to be interviewed on his article. Had the speaker been someone of the standing of Sir Winston Churchill, the Prime Minister, or someone having national status one could perhaps understand, without excusing, the BBC giving programme time to it. Instead, Mr. Malcolm Muggeridge, who after all is only a BBC entertainer, was considered to be a suitable person to debate such a controversial topic. He is a political nobody and is certainly not qualified to speak to the nation on this subject, upon which his views are of no more value than that of an ordinary citizen. No weight, therefore, could be attached to his views. Mr. Muggeridge, we are told, was paid handsomely for his article. He says that he had no idea, when he wrote his article, that its publication would coincide with the Queen's tour. He might, with a little thought, however, have anticipated such events, and have made it clear that publication should not coincide with the Queen's tour even though when he wrote it the tour had not been finally decided upon.

There is a tendency amongst too many of these BBC entertainers to be controversial. They are all endeavouring to imitate that comic character, the late Cyril Joad. Gilbert Harding is endeavouring to follow in his footsteps and now we, have Muggeridge, the ex-editor of a humorous paper, endeavouring to follow suit.

The BBC's judgment in these matters has been consistently unsound over a long period of years. It has allowed curious people to expound curious views. Quack Joad, for example, was allowed to justify a person taking his own life, in spite of the fact that it is against the law. Lord Altrincham, Lord Londonderry, and even Mr. Muggeridge, as well as the BBC, seemed delightfully ignorant of *lèse-Majesté*, under which, of course, it is an offence to attack the sovereign. The words actually mean "injured Majesty." If such questions attacking the constitution need to be discussed, and I suggest they do not, they should be discussed by competent people, and I opine that Mr. Muggeridge, Lord Altrincham, and the youthful Irishman, Lord Londonderry, are not the people to do so. If the noble Lords are sincere in their expressions of opinion, they should renounce their titles.

The BBC should seek other methods of attracting a listening or viewing audience, and not descend to the level of the yellow press.

Radio and D.I.Y.

FOR many years, the radio trade has adopted the narrow attitude of the closed shop as far as radio repairs are concerned. They will not issue circuit diagrams nor service data to anyone except their recognised dealers, and in some instances will not even supply the press. This is, however, a D.I.Y. era, and the building trade as well as the motor trade, which have adopted a similar policy, are beginning to recant. The exorbitant charges and quite often questionable charges made by some radio dealers for repairs, some of them mythical, have forced many people to endeavour to service their own receivers, as well as their own cars and their own domestic apparatus. The motor trade particularly is beginning to supply service data to members of the public and I suggest that the time is ripe for the radio trade to bring their ideas into line with modern tendencies, especially in these days of high taxation and money shortage.

After all, several firms now make quite a business of hiring out or selling service manuals and sheets, many of which are merely typed or copied prints, and it would thus be in the firm's interests to make certain that authentic sheets were supplied. Of course, out-of-date manuals are a different category and could be hired in the same way as motor-car manuals.

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14S7	14 6
15D2	7 9
20D1	10 6
20L1	13 6
20F2	13 6
20P3	11 6
25L6GT	9 6
25Y5G	9 9
25Z4G	9 -
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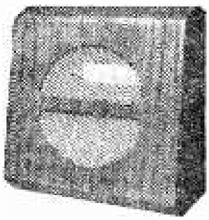

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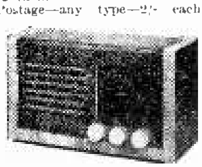

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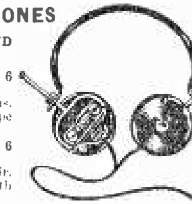

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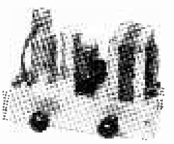

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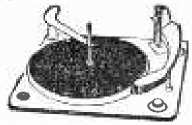

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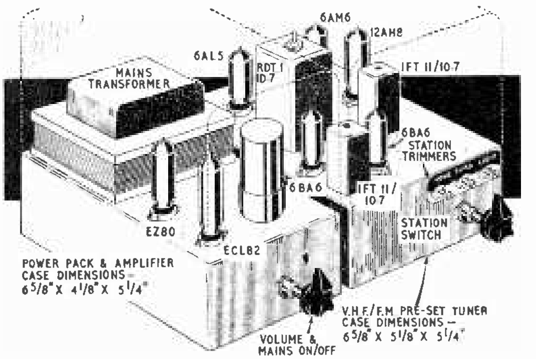

Full constructional details, point-to-point wiring diagrams and alignment instructions for building the " MAXI-Q " **COMBINED POWER PACK AND AMPLIFIER. PRE-SET F.M. TUNER** and also the **VARIABLE TUNED** version are given in Technical Bulletin DTB.8, 1/6.

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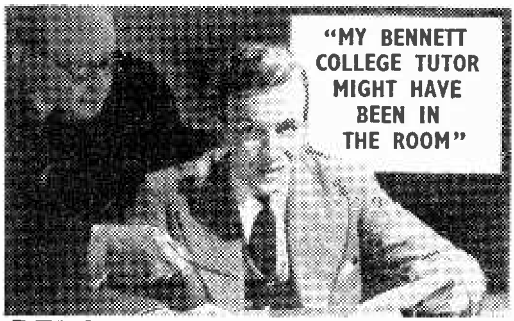

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3S4	8/6	7H7	8/6	DK96	9/11	EF91	6/11
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A Transistorised Pulse Generator

THIS UNIT HAS MANY APPLICATIONS IN MODERN ELECTRONIC TECHNIQUES

By B. E. Wilkinson

ORIGINALLY designed as the basis of a winking light system for a motor car, the device has been found of great use where short duration pulses of fairly low frequency are required.

The generator consists essentially of a capacity, charged through a resistance and suddenly discharged, the frequency of the pulsing being dependent upon the values of the charging capacity and resistance. The circuit is shown in Fig. 1. An unusual feature is the use of the coils of the relay as transformer windings. In the first model built, a transformer was necessary. The relay windings, however, were found to be separate, and an attempt to use these as a 1:1 transformer proving successful, the transformer was abandoned. The components required are as follows: One relay type AP 52257 (resistance of each coil 250 ohms), obtainable from Electronic Precision Equipment, 1, Sutton Road, Eastbourne, one 250 KΩ miniature potentiometer, 25 μF electrolytic condenser, A.F. red spot transistor, 47 KΩ ½ watt resistor, small strip of aluminium, wire for wiring, 30 volt battery.

Constructional Data

Since the relay forms the chassis for the pulse generator, we will begin with a short description of this component. There are five leads from the relay, two to the coils, a common contact and one make and one break. The terminal block (as in Fig. 2) carries four tags, two of which are among the five lead out connections. These four tags go directly to the coils. In order that the coils shall be connected in series, there is a small piece of wire joining two of these tags. It should be removed, so that the relay coils become separate. Underneath the terminal block are three tags. These correspond to the make, break and common lead to the contacts of the relay. The relay is designed to be mounted by means of two 4 B.A. screws, which will fit two tapped holes on the right-angled projection of the relay frame. If the screws are not provided it is well to obtain some, since they are necessary for affixing an aluminium bracket which will carry the potentiometer. The various screw adjustments of the relay should not be touched until the unit is complete.

Construction

The aluminium bracket must be made first. Fig. 3 gives the actual shape and dimensions. A suitable piece of aluminium can probably be found in almost any spares box. The thickness is immaterial so long as the bracket is fairly rigid. The potentiometer should now be fixed to the bracket through the ⅜in. hole and the bracket fixed to the relay by means of the 4 B.A. screws. The transistor leads should be trimmed to measure ¾in. and short lengths of sleeving put over them. Having trimmed the ends of the leads, taking care not to overheat the transistor, it may now be soldered into position. The collector lead goes to the outermost of the four tags while the emitter lead goes to the innermost tag (the illustration shows this). The base lead is connected to the 47 KΩ resistor, which is then taken to the fixed side of the potentiometer. The other side of the potentiometer is joined by a lead, passing under the transistor and the relay

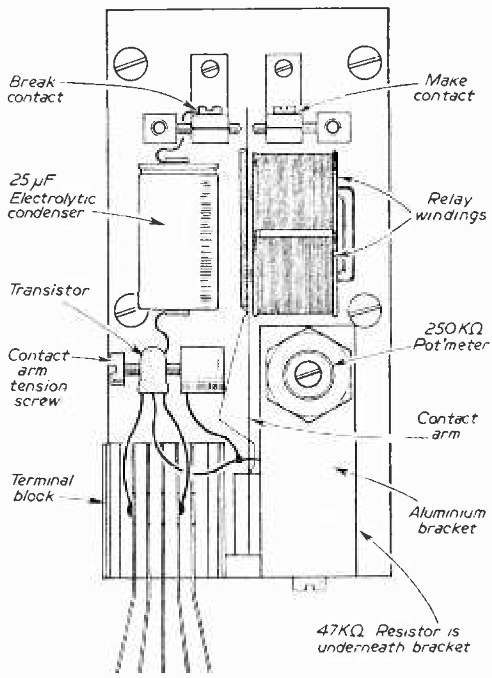

Fig. 2.—Lay-out and wiring.

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contact arm, to the second tag (next to the collector tag). The third tag is connected by a short lead to the outermost tag underneath the terminal block. This tag, it will be seen, is connected to the break contact. The condenser is now connected, positive lead to the break contact, and negative lead to the junction of the emitter lead and the 47 KΩ resistor. This resistor cannot be seen in the illustration as it is underneath the bracket.

The power supply lead may now be taken from the unit.

Of the five lead out connections to the relay, the upper two form the power supply connections. The right-hand one, being connected to the emitter, is obviously the positive connection, the left-hand one being the negative. One should be very careful of this polarity, since confusion over it may lead to the incorrect application of voltage, and the transistor will then be ruined. It is a very good plan to use coloured wire—black for negative and red for positive—since, once the connections have been correctly made, one need not then worry about confusion over polarity.

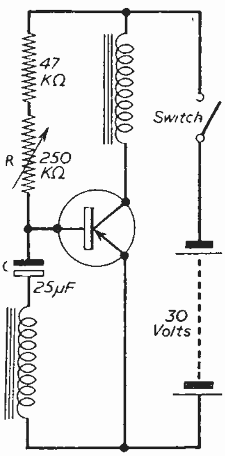

Fig. 1.—Theoretical circuit.

Connections

Before connecting to the power supply, check the circuit once more. When satisfied that all has been connected correctly, the 30 volts may be applied. If the unit is functioning correctly the contact arm will be pulled from the break contact and released at a particular frequency. Varying the potentiometer values will either increase or decrease the frequency. Failure of the unit to function will be due (assuming that the transistor and other components are not faulty) to:

(a) Bad adjustment of the contact arm, or
(b) Phase reversal in the collector and base circuits.

Three screws are provided for tension adjustment, though if it is suspected that such adjustment is necessary, one should place a finger on the contact arm with the unit switched on. One can then feel the pulsing of the generator. Should adjustment prove necessary, the screws on the make and break contacts should be slackened off and the contacts unscrewed slightly. The tension screw just beneath the transistor should be loosened and then gradually tightened until the generator is pulsing correctly. Movement of the arm should be seen as a clean, sharp jump. Once the motion of the arm is satisfactory, the contact screws may be tightened until the action of the unit causes the break and make contacts to operate once per pulse. Finally, the screws holding the contact tight should be secured.

If no pulsing of the arm can be detected, and it is certain that the circuit is not functioning, then the fault lies in the phasing of the collector base circuits. To remedy this merely entails reversing the coil connections to tags 1 and 2. To do this the collector lead and potentiometer lead must be disconnected, then the coil leads can easily be removed and reversed. The collector and potentiometer leads can then be soldered back in their original position.

The effect of this action is to bring the collector in phase with the base. There is now no reason why the pulse generator should not work correctly.

The frequency of the pulse generator depends on the values of R, C, and increase of either of these valves produces a lower frequency. The frequency range of the unit as described is approximately ½ cycle per second to 10 cycles per second. This may not be suitable for every purpose, but the reader will easily find, by variation of C, which range is to him most desirable. The lowest frequency the author could achieve was 1 cycle per 35 seconds! C was 1,000μF, and the potentiometer was disconnected, making R effectively infinite.

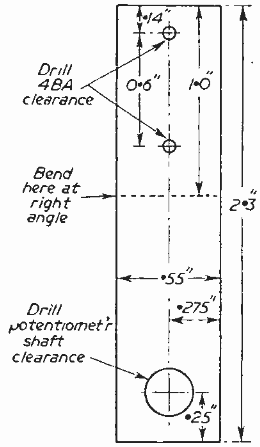

Fig. 3.—The aluminium bracket.

As to supply voltage, the 30 volt deaf aid batteries work the unit admirably and were chosen because of their availability. If it is desired to work the unit from a lower supply voltage, the Ever-Ready B.1578 12-volt recorder battery is admirable. The pulse generator will function from a 4.5 flashlight battery. However, it must be pointed out that the lower the supply voltage, the less distinct will be the movement of the arm, until finally, when the voltage is very low, the current flowing in the circuit will be insufficient to operate the arm.

One final point—when using the pulse generator do not allow the current flowing through the make or break contacts to an external circuit to become excessive. They are not designed to carry heavy currents, and, if forced to, would soon burn away. If it is desired to use the generator in a circuit carrying heavy current, such as a motor car winking light system, the contacts should be made to operate a further relay capable of carrying more current.

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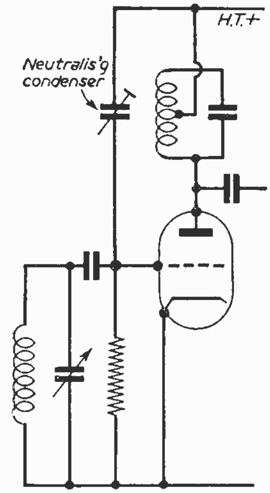

Fig. 1.—Triode neutralised stage.

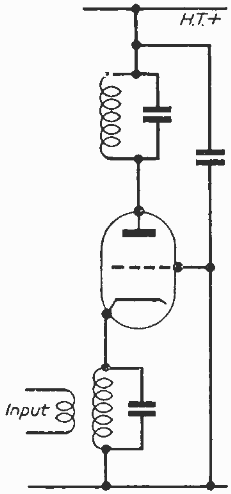

Fig. 3.—Cathode input, or earthed grid stage

When amplifying radio frequencies, the higher the frequency the more difficult it is to do so. The reasons for this are:

(i) The transit time for electrons to pass from cathode to anode of a valve becomes an appreciable fraction of a cycle, and thus gives rise to losses.

(ii) The inter-electrode capacitances, though small, can cause oscillation.

(iii) Tuning capacitors must have very low self-inductance.

(iv) The input resistance of the valve at very high frequencies, falls, thus damping the grid circuit and reducing the anode load of the preceding stage. This calls for more power to drive it.

(v) Skin effect. This is due to the fact that very high frequencies tend to travel only on the outside of the conductors, thus increasing their effective resistance.

(vi) The wiring to the valve itself has appreciable reactance.

Triode Used as V.H.F. Amplifier

The triode if used as an amplifier for very high frequencies has to be neutralised. This is due to the fact that the anode/grid capacitance of the valve itself gives a feedback between the input and output circuits. This generally causes oscillation or severe loss of gain. Fig. 1 shows a triode as a neutralised triode amplifier. Here the neutralising condenser provides another feedback path of opposite phase and stabilises the circuit. Unfortunately this will not hold good over a wide range of frequencies, so the neutraliser must be altered when changing frequency.

Using a balanced push-pull amplifier and cross-neutralising, this can be overcome and the circuit will be stable over a wide band. Fig. 2 shows this circuit.

Grounded Grid Amplifiers

In the normal amplifying circuit, the input is applied between grid and cathode, with the cathode near or at earth potential. In this type of amplifier, however, the grid is earthed and the input applied to the cathode (Fig. 3). It will be noticed here that the anode/grid capacitance is across the tuned output circuit, so there is no feedback and neutralising is not required. The fault with this circuit is that its low input impedance heavily damps the aerial circuit, so causing very low aerial circuit gain. It also gives poor selectivity. As the cathode is "hot" in a grounded grid stage, the heater/cathode capacitance will call for chokes in the heater leads.

The Cascode Amplifier

This circuit has developed from the grounded grid amplifier and is now used in most tuner units of television sets and in some frequency modulation receivers. Fig. 4 shows one using two separate triodes and Fig. 5 a double triode valve.

As will be seen from the circuit, the first triode is an ordinary triode amplifier followed by a grounded grid triode. This ensures a low noise output and also the grounded grid triode acts as

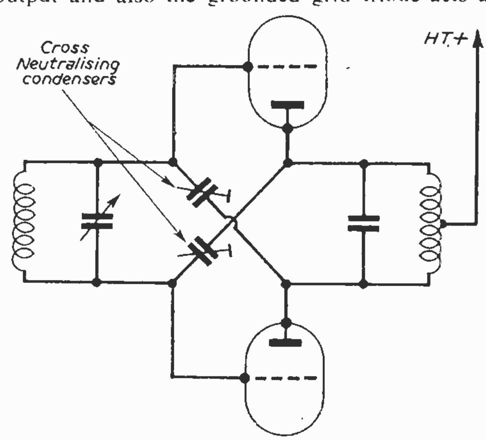

Fig. 2.—A cross-neutralised stage.

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buffer between the oscillator and the aerial and thus prevents radiated oscillation. As the anode load of the first triode is low, due to the low impedance input of the second triode, neutralising is not necessary.

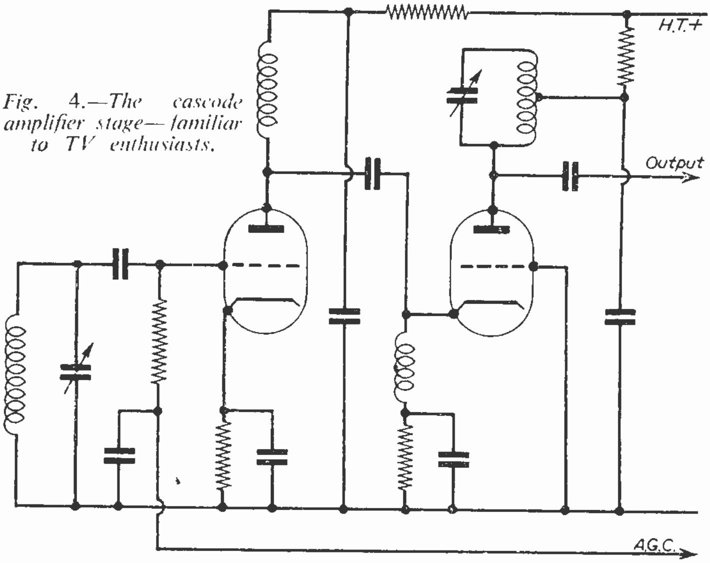

Fig. 4.—The cascode amplifier stage—familiar to TV enthusiasts.

In Fig. 6 is shown a direct coupled cascode amplifier. This circuit is more efficient, for if automatic gain control is applied, it increases the anode cathode voltage of V2 and thus increases the value of grid bias required for anode current cut off. The valve thus has variable μ. It will be noticed that neutralising is necessary here but an alternative circuit as shown in Fig. 7 renders this unnecessary, as if the two condensers C1 and C2 are in the same ratio as the anode/grid and grid/cathode capacities of the valve. There will be no feedback.

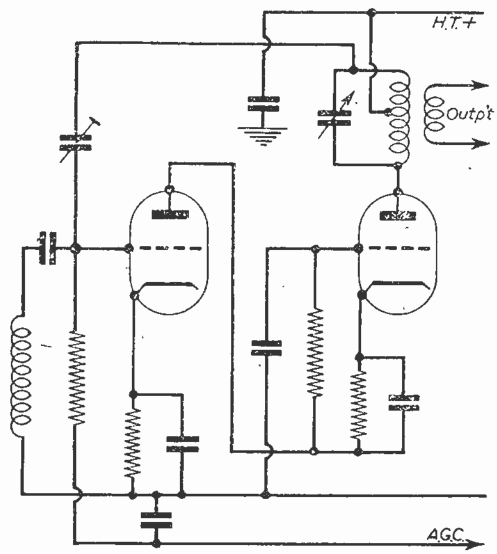

Fig. 6.—A direct-coupled cascode amplifier.

It will be noticed in Fig. 7 that the grid is effectively shorted to earth by a capacitor at the frequency used. This should be of a low series inductance type. The gain of this amplifier is quite good and has the advantage of low noise. When a double triode valve is used the two triodes are generally screened from each other and care is taken to minimise capacity between them.

Precautions to be Taken

The capacitors used as decouplers must offer a low impedance at the frequency used. Low inductance is of more importance than high capacity. If instability occurs it may be necessary to decouple heaters by means of chokes and condensers to prevent feedback between the various stages. Earths should be taken to the nearest point on valveholders and in the tuning circuits be careful that the chassis is not a part of the circuit. For instance, the earth end of the input coil should be connected to the same point as the cathode decoupling condenser. Leads should be kept as short as possible as at very high frequencies even the shortest has an appreciable reactance.

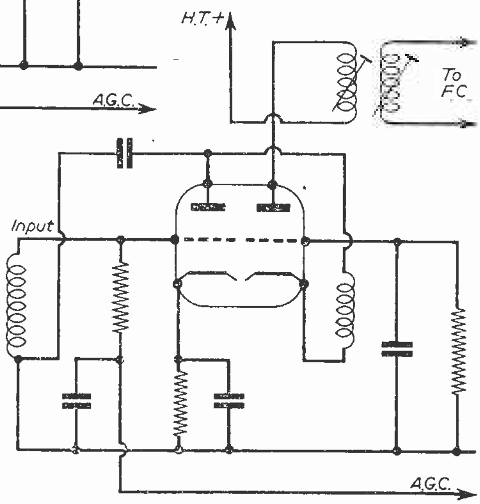

Fig. 5.—A double triode in the grounded grid arrangement.

Frequency Changing

At very high frequencies it is usual to employ a local oscillator valve and a mixer valve. The oscillator frequency is nearly always above the signal frequency. The circuits employed in the

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oscillator are either Hartley or Colpitts. The main problem encountered in these circuits is drift. Receivers should always be allowed to warm up for quite a time before any alignment takes place. It is usual to have condensers of

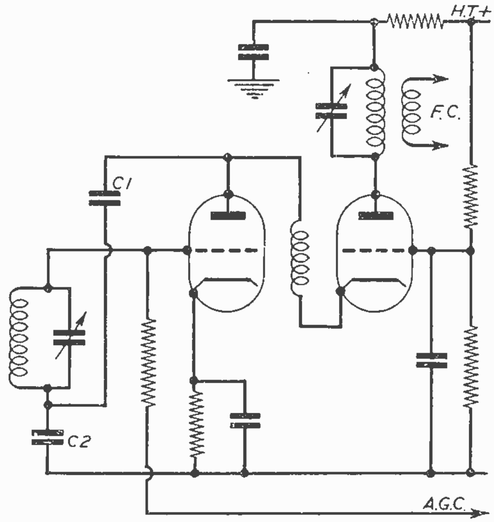


Fig. 7.—A modified Fig. 6 to avoid neutralising.

positive and negative co-efficients, combined to combat this drift. A circuit of a V.H.F. oscillator and mixer is given in Fig. 8. Here the mixer is a pentode, but when a triode is used it is necessary to neutralise it, owing to feedback being set up at the intermediate frequency. This can be achieved either by a capacitor between the load resistance of the mixer and ground or by means

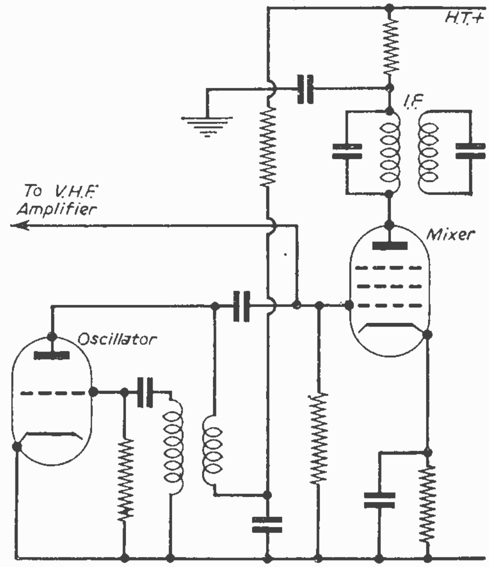


Fig. 8.—A V.H.F. oscillator—mixer stage.

of an extra winding on the I.F. transformer, coupling the I.F. to the cathode of the mixer.

Speeding Circuitry Design

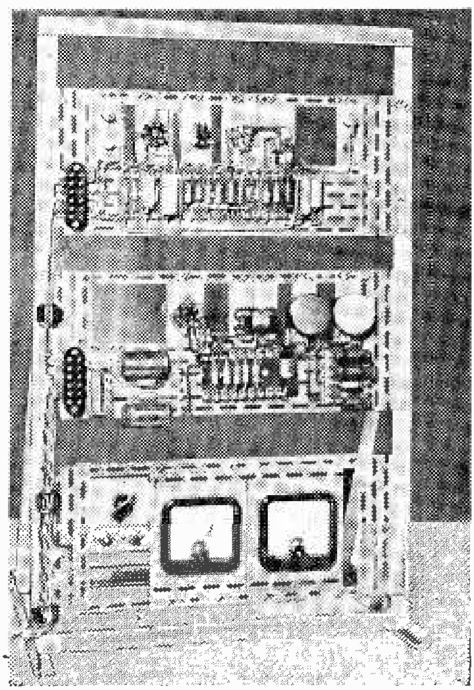
RAPIKON, the rapid construction electronics chassis system, has been released by Shandon Electronics Ltd.

Departing entirely from the concept of the conventional box chassis, Rapikon gets down to basic fundamentals in chassis construction, eliminating all preparatory metal work. The component parts—which are firmly held on a rack—require only to be screwed together, assembled in a matter of minutes.

Pre-punched holder plates take such focal components as valves, etc. These plates are individually placed where required. One end is pronged so that they can be slipped into position behind tag panels and components and just as easily moved if necessary. Wiring can consequently be kept short. The slotted plates and girders are mounted vertically on the rack to any required layout.

Because of this vertical layout, components are always accessible for wiring, replacement or measurement. Layouts can easily and rapidly be modified. Several chassis or circuits can be simply connected to one another without taking up bench space and with no flying leads.

But Rapikon is more than just a "chassis-in-minutes" kit. It is a carefully designed method for the experimental assembly of complete electronics systems, with each chassis forming a block of the system block diagram. A modified version of any block can be constructed and inserted when ready—without disrupting work on the system as a whole.



The "Rapikon" chassis

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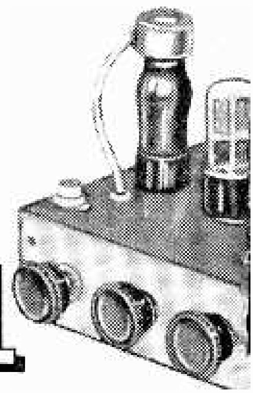
A PUSH-PULL GRAMOPHONE AM



PRIMARILY DESIGNED FOR RECORDS, THI
RADIO AMPLIFICATION

THERE are available nowadays very reasonably priced record players, especially those with crystal pickups, and they are capable of giving excellent quality when used with a good amplifier and speaker system. I wanted such an amplifier, but my enthusiasm, like that of a great many of us, is often severely damped when the cost involved is considered. I therefore set out to see what could be accomplished with ordinary standard components and valves that I had on hand, and which, anyway, are cheaply and easily obtainable. I had in mind the following basic features:

(1) About 6-8 watts push-pull output maximum.
(2) Negative feedback where possible.
(3) Simple controls for compensation of record characteristic.
(4) Straightforward circuitry with no tricky adjustments.

The circuit which I finally drew up satisfies these conditions, and details are shown in Fig. 1.

Circuit Details

V1 is a pentode voltage amplifier working at high gain, and an EF37A was used here because I had one, but if preferred a 6J7 could be used instead. Simple switched bass-boost and top-cut compensation is provided by S1 and S2 respectively. V2 (6SL7) is a "floating" paraphase type of phase splitter, and this circuit is to a large degree self-balancing, and also contributes some gain. Another advantage is that the output from each triode has only to be half the input grid-to-grid drive voltage to the output valves. The output stage employs a pair of 6V6's connected in class AB1 push-pull. Negative feedback is taken from the secondary (15-ohm) winding of the output transformer via R23 to the cathode of the first half of V2. The power pack is conventional and a 5Z4 is used as a full wave rectifier.

Construction

I possessed a four-sided aluminium chassis 12in. × 8in. × 2½in. and the layout used on this is shown in Fig. 2. This chassis is perhaps a little large, but my mains transformer (a drop-through type) was a hefty one, and if an upright type is used this usually takes up less chassis room. In order to minimise any possibility of interaction between mains transformer and L.F. choke, the mounting of these components should, if possible, be arranged so that their axes are at right angles. In this respect the output transformer has been mounted well away from the power pack. The valves should be well spaced from one another and to act as a guide, suggested dimensions for positioning the valveholders are shown in Fig. 3. I always find it easiest, when deciding on the size of chassis, to arrange the main components on a sheet of paper. Then when the chassis is obtained those components are again arranged to facilitate marking out. An important point which should be borne in mind is that electrolytic capacitors should not be mounted too near output or mains rectifier

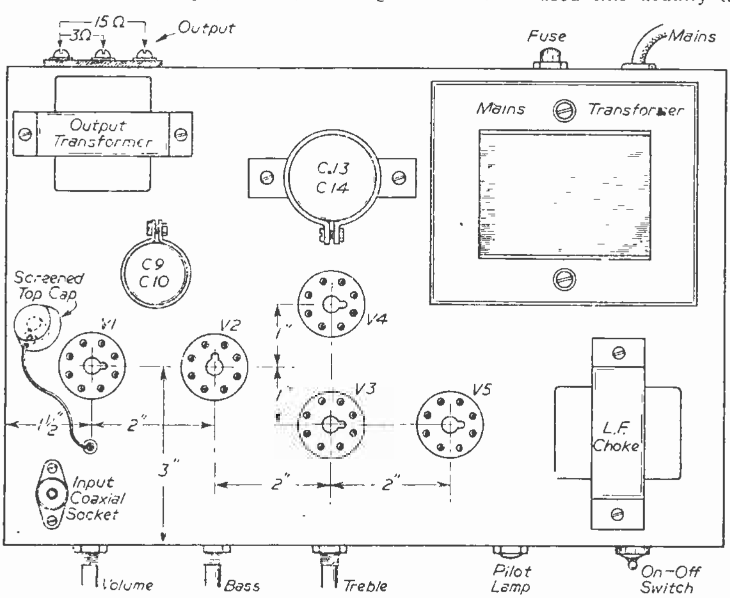


Fig. 2.—Lay-out and drilling data.

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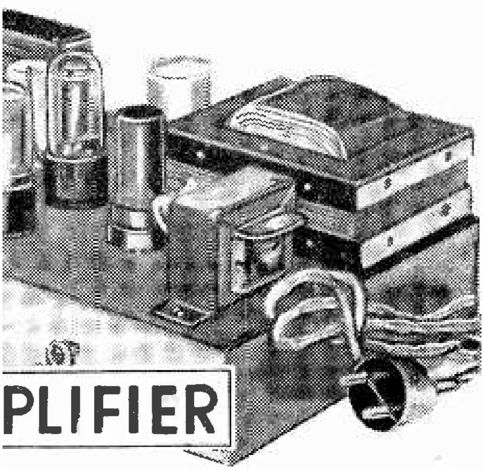

PLIFIER

AMPLIFIER MAY ALSO BE USED FOR

By C. Newport

valves as the heat generated may in time cause these capacitors to "dry up."

The heater leads were run in well-twisted pair and dressed hard against the chassis bottom, well away from grid pins. One side of the 6.3 volt heater supply was connected to chassis at the mains transformer—this is essential, as otherwise a mysterious harsh form of hum becomes apparent. A 500-ohm "humdinger" was tried across the 6.3 volt supply, but I could detect no difference with it in, and it was subsequently removed. Of course, if the 6.3 volt winding on your mains transformer has a centre tap, this is connected to chassis.

All the earth returns associated with V1, that is, the bottom ends of R1, C1, R5, C2, are returned to a single tag fixed under one of the bolts holding the input socket, as in Fig. 3. Insulated screened cable is used where indicated and the metal braiding is earthed at one end only, as shown in Fig. 3. V1 should be a shielded type valve, and pin. No. 1 on the valve-holder is earthed; a screened top-cap is used for V1. The tone compensating capacitors should be grouped in front of their respective switches. The wiring here should be kept as short as is practicable, to avoid hum pick-up, even though the negative feedback will help to cancel this. No screened leads were found necessary in the wiring of the tone compensating circuit.

All the resistors used were ± 20 per cent. tolerance except for R15 and R16, which should ideally be ± 2 per cent. high stability types—the closest tolerance I had were ± 5 per cent., and these were used, but I hope to replace them later. You have to watch that you do not wire R15 and R16 to the wrong output valves, as they have different values. To be effective the grid and screen stoppers R19, R20, R21, R22, should be wired directly on to their respective valveholder tags

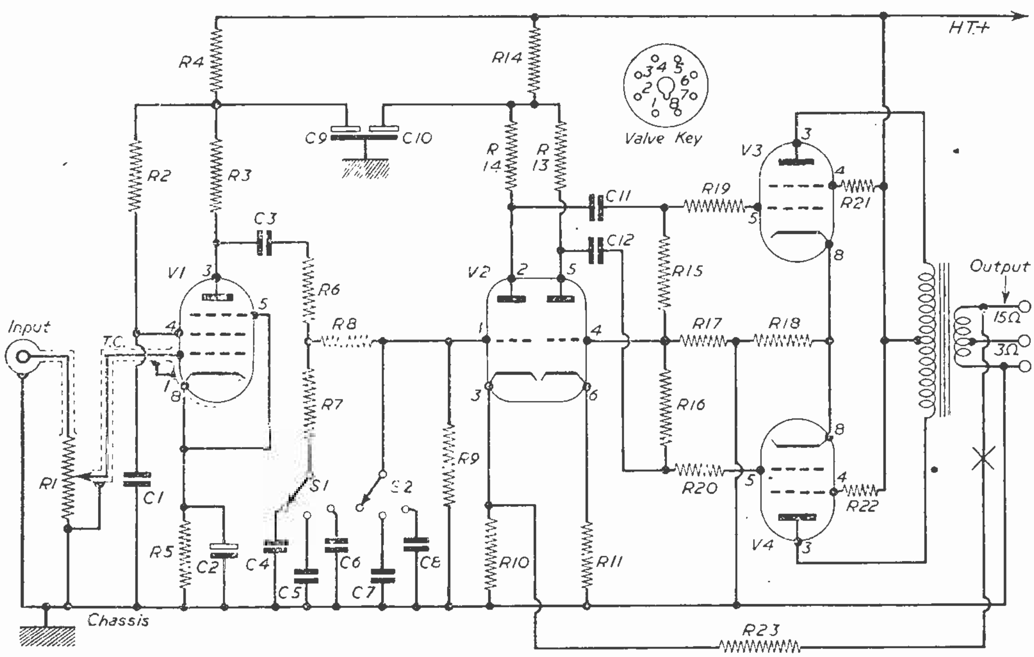

Fig. 1.—Theoretical circuit of the amplifier.

with a short wire-end between tag and resistor—the length of the opposite wire-end is immaterial.

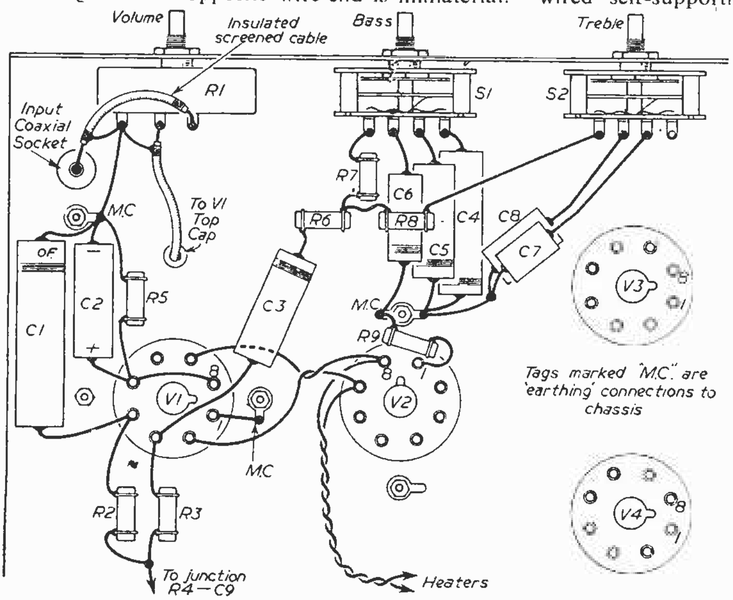

Fig. 3.—Wiring details of V1 and the tone control circuits.

Most of the under chassis components were wired self-supporting between valveholder tags, etc., and where this was not practicable, 3- and 5-point tag strips were used for support.

Negative Feedback

There is a limit to the amount of feedback that can be used when employing the ordinary comparatively inexpensive output transformer, as if this is increased too much there is the danger of oscillation due to phase shift. This oscillation is supersonic and is very hard to detect without an oscilloscope. For this reason R23 should not be lower than 39 K ohm. I actually reduced R23 to 22 K ohm in my amplifier and there was no sign of instability checked on a 'scope. Unless, however, you

(*Concluded on page* 734)

The coupling capacitors C3, C11, C12 should be beyond reproach as regards leakage, and it is better not to trust used ones, unless you have a means of checking their insulation resistance. Incidentally, a very simple way to check this is to connect the capacitor from the H.T. + line via a voltmeter (switched to 250 volts) to chassis. If there is the least sign of a steady reading on the voltmeter, the capacitor should be scrapped.

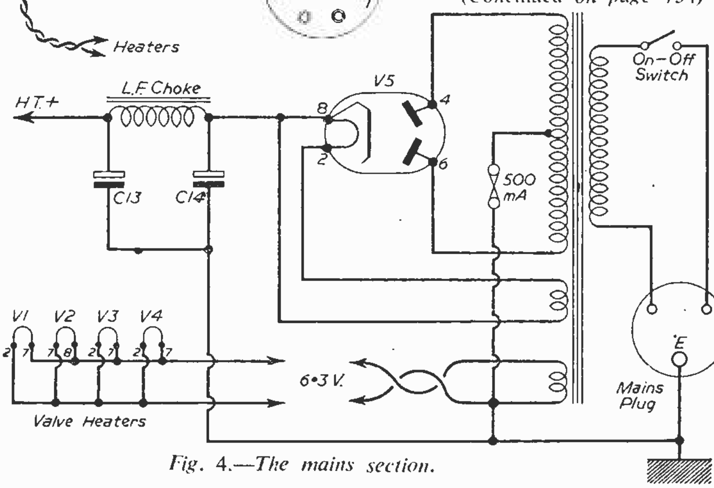

Fig. 4.—The mains section.

COMPONENTS LIST

RESISTORS (All ½ w. ±20% unless stated otherwise.)
R21 22—100 Ω
R18—250 Ω 3 w.
R5 10 11—2.2. K Ω
R19 20—4.7 K Ω
R14—10 K Ω
R4—22 K Ω
R23—39 K Ω
R7—47 K Ω
R8 12 13—100 K Ω
R3 17—220 K Ω
R15—220 K Ω ±5%
R16—270 K Ω ±5%
R6—470 K Ω
R2—680 K Ω
R9—1 M Ω
R1—1 M Ω volume control

SWITCHES
2 S.P. 3-way rotary

VALVES
V1—EF37A or 6J7
V2—6SL7
V3/4—6V6
V5—5Z4

CAPACITORS
C7—200 pF mica
C8—750 pF mica
C6—0.01 μF 350 v. paper
C5—0.05 μF 350 v. paper
C3, 4—0.1 μF 350 v. paper
C11, 12—0.1 μF 500 v. paper
C1—0.25 μF 350 v. paper
C9, 10—8+16 μF 350 v. electrolytic
C13, 14 — 32+16 μF 450 v. electrolytic
C2—50 μF 6 v. electrolytic

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5 v. 2 A.

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Components—Faults and Testing

A CLASSIFIED LIST OF THE MORE COMMON FAULTS MET WITH IN A RADIO RECEIVER, AND THE TESTING OF ORDINARY COMPONENTS

THE basic components of a radio receiver may at times have faults that cause either poor reception, or perhaps complete failure of the receiver. These faults can be classed as under.

Resistors

Open-circuit caused through excessive power dissipation, deterioration, or developing high or low resistance at wide variance from their stated ratings.

Condensers

Short-circuit or D.C. leakage. Open circuit through breaking of internal connections, loss of capacity as in electrolytics through "ageing."

Transformers

Open-circuit windings through excessive power dissipation or bad manufacture, short-circuiting of turns or sections, loose turns causing inductance to vary, or loose laminations of core.

Coils

Open-circuit windings, poor insulating material of formers causing poor Q.

Now all of these components, if faulty, can be replaced, but if one is dealing in repairs to radio receivers, it is as well to be able to check these parts to see whether they are faulty or not.

The purpose of this article is to explain how small and not elaborate test apparatus can be made up to check these components. With one exception, the Megger, all these testing layouts can be easily and quickly hooked up.

Resistors

It is presumed that nearly all readers have a multi range ohm-voltmeter, in which case the values of resistors up to 5 or 10 megohms can be checked, but for very accurate resistance testing a bridge is perhaps best. Fig. 1 gives a "Wheatstone Bridge" for resistance measurement. Here are four resistances in a closed square, with a small D.C. voltage applied across corners A and C. A galvanometer is connected across B and D. The current from the battery divides and through path A B C will be V/(R2+R3) whilst through path A D C we have V/(R1+R4).

The voltage across $BC = \frac{R3}{R2+R3}$ V and across DC $= \frac{R4}{R1+R4}$ V whence $R4 = \frac{R1}{R2} R3$

So that if R4 is the unknown resistance, R3 is variable and can be adjusted so that this condition is complied with, there will be no difference of voltage between points B and D, the galvanometer will not read and the bridge is balanced. R1 and R2 are the ratio arms. If they are equal in resistance then R4=R3, but by making them, say, R2=100R1 we shall balance if R3=10R4. By varying the ratio of R1/R2 we can measure from 1 ohm up to 1 megohm according to this ratio. R3 can be made up in a series of 10—1 ohm steps, 10 of 10 ohms, etc., or it can be a calibrated rheostat. The resistance across the galvanometer is to prevent it being damaged when the bridge is off balance.

Condenser Testing by Bridge Methods

In Fig. 2 a simple bridge for capacitor testing is given. This is known as a Wien bridge. C1 and C2 are the ratio arms, C3 is a calibrated variable condenser and C4 the condenser under test. The oscillator or source of A.F. is switched on and the standard variable capacitance altered until no sound is heard in headphones, then if C1=C2 then C3=C4. If no silent point is reached then the unknown is either larger or smaller than the limits of C3. If so, C1 must be made unequal to C2 so that C3 may be unequal to C4 in the same proportion. That is $C4 = \frac{C2}{C1} C3$. Another type of capacity bridge does not need a calibrated variable condenser (see Fig. 3). The ratio arms here are the resistance arms. R1 should be about 10K ohms. If R2 is 10K ohms and R is 1K ohm, the ratio of

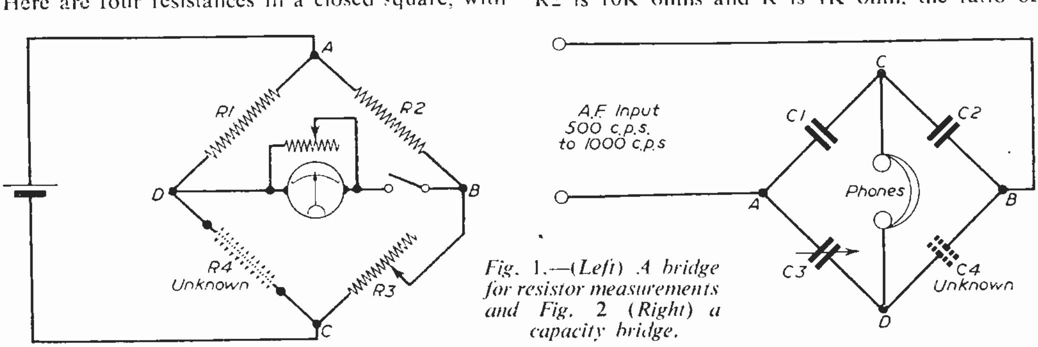

Fig. 1.—(Left) A bridge for resistor measurements and Fig. 2 (Right) a capacity bridge.

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the bridge is variable from 1.1 to 1 down to 0.1 to 1. C is a standard fixed condenser and should be of absolute correct capacity. Here Unknown= $\frac{R1}{R+R2}C$. Thus if C=100pF, capacitances can be measured from 91 pF to 1,000 pF. If R1 is changed to 1,000 ohms the range is 9.1 to 100 pF whilst with R1 at 100,000 ohms the range is 910 to 10,000 pF. For the standard condenser use a silver mica type.

Testing Large Condensers Not Electrolytics

For condensers over .01μF the A.C. method is quite satisfactory. See Fig. 4. Here the current flowing is measured. The capacity is given by

C = 159 I/Vf microfarads.

where V = applied voltage
I = current in milliamps
f = frequency of supply.

Care should be taken that condenser under this method is not short circuited. and that the voltage applied is not too high for it.

Insulation of Condensers

Insulation. especially of paper condensers. is liable to deterioration. A good check can be obtained by testing its capabilities of holding a charge. Place a battery of about 100 volts across it and on removing the battery the condenser should be able to retain its charge for about five minutes. even longer in the case of a high-class condenser. Should there be a leakage, either surface or internally. the charge will leak away. If a high resistance voltmeter set to volts reading was placed across the condenser immediately the battery was removed. it should show a high reading and gradually drop as the charge leaked away through the resistance of the voltmeter. This should be done two or three times. and if the condenser is O.K.. there should be little or no divergence between the maximum readings.

Transformer Tests

The main tests to be carried out on suspected faulty transformers should be for insulation between windings. This should be done with a Megger. Checking voltages on secondaries should be carried out with an A.C. voltmeter with a load across it equal to the normal load. A no-load check should also be taken. This is the magnetising current of the transformer and should not exceed 25 per cent. of the full load. If excessive, it can be that there is insufficient iron in the core or there are short circuited turns.

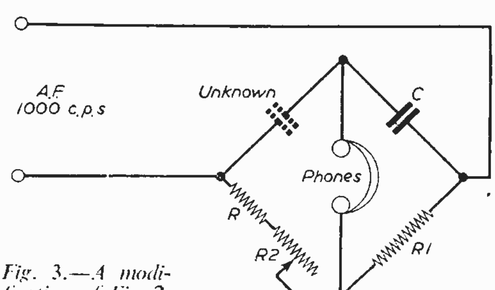

Fig. 3.—A modification of Fig. 2.

A Neon Tester

Fig. 5 shows a comparison tester. A neon lamp is connected in series with a high resistance R across a D.C. supply of 200 volts. The neon lamp will not conduct till the voltage reaches a certain value. The condenser C charges, but the charge is delayed by R. When the voltage reaches the striking value of neon it conducts and partially discharges C. This process goes on. charge and discharge in regular sequence. If the value of C and R cause this to take place hundreds of times a second a note will be heard in the phones. If R is of known value and is replaced by another resistance of the same value, the note will be the same. If the new resistance is higher, note will be lower and if of lower value, the note will be higher. To give an approximation. if the product of C in microfarads and R in megohms is about .001. then a musical note will be heard. For high values of C and R, clicks of discharge frequency can be counted.

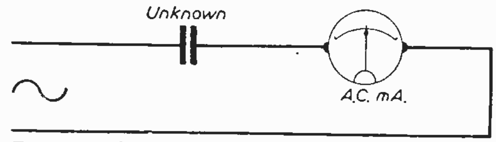

Fig. 4.—The A.C. method of measuring large condensers.

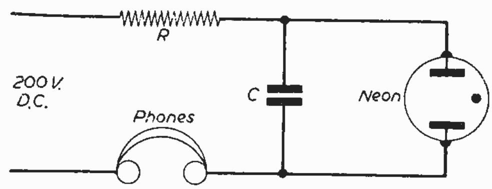

Fig. 5.—A simple neon tester.

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The main feature in this month's issue of our companion paper PRACTICAL TELEVISION deals with the construction of a modern switched TV and F.M. receiver. This will consist of a fully detailed constructional article, and in this month's issue the circuit is explained and the preliminary constructional details are given. All the coils in this receiver are home-made.

An Improved Band III converter, utilising two EF50 valves and one EC52 valve is also described.

The location of faults is well covered in this issue, one article dealing with Simplified Servicing, one with the Oscilloscope and TV Servicing, whilst yet another deals with the location of faults by means of a neon screwdriver. The Servicing article in this issue completes the notes on the K.-B. KV35 receiver.

A correspondent reviews some of the exhibits at the Radio Show, whilst the issue is completed with Telenews, Underneath the Dipole, Readers' Correspondence and Your Problems Solved.

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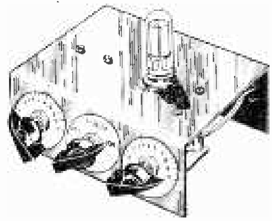

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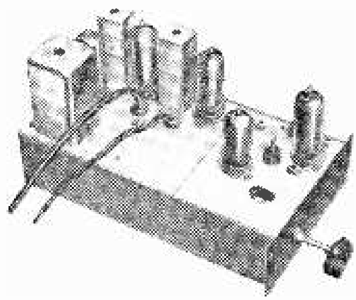

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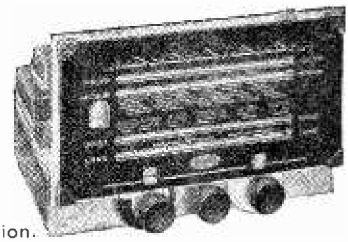

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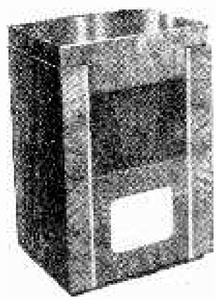

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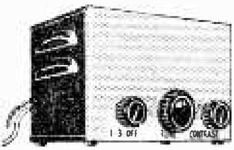

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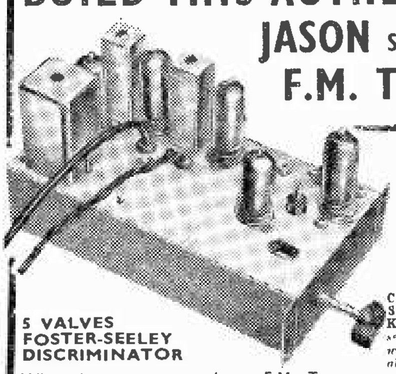

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All About Microphones

AN EXPLANATION OF TYPES AND USES

By J. Brown

THE carbon mike is probably the cheapest on the surplus market, in various forms from button to the Post Office insert type as used on telephones. The latter seem to be in the majority, giving reasonable quality on speech, the response being roughly 200-4,000 cycles per second. The output is quite high, but it has many disadvantages, these being (1) Limited response. (2) Rather noisy in operation, due to the carbon granules (we have to give the mike a shake at intervals to free the granules). (3) Needs a D.C. voltage to polarise the mike, this being 3-8 volts. (4) Needs a transformer with a step-up ratio of 60-1, preferably screened.

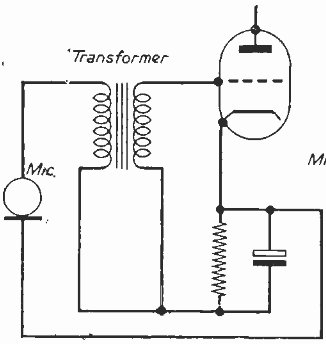

Fig. 1.—Cathode bias is used here as the polarising voltage for a carbon mike.

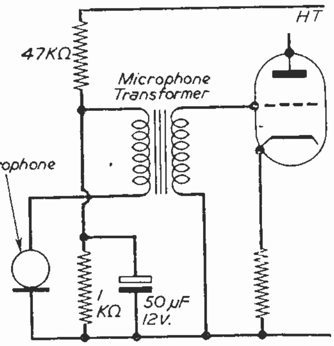

Fig. 2.—A potential divider across the H.T. supply furnishes the polarising voltage here.

The biggest drawback is the D.C. voltage supply. We could, however, use a battery externally This is most inconvenient, so we give three ideas for obtaining this D.C. supply from the main amplifier. Figs 1, 2 and 3 are the easiest ways and they may be built into a circuit.

Fig. 1 shows the supply from the cathode of the 1st audio amplifier, making use of the voltage developed by the bias resistor. Fig. 2 shows the voltage being extracted from a potential divider across the main H.T. D.C. supply, the resistors being about 4 watts. Fig. 3 shows the voltage being borrowed from the cathodes of the output valves, two in push-pull, the voltage being variable by adjusting the 10K resistor. These are all practical ways of obtaining this required voltage, and have all been used with success.

Crystal Mikes

These are in two categories. 1. The floating cell type (Fig. 4), where the crystal cell is suspended inside the mike housing by rubber bands; and 2, the diaphragm type (Fig. 5), where there is a cone fitted to the actual crystal. We have given sketches of these two types. The first mentioned, the floating cell type, is the most expensive, giving a frequency response of 30-10,000 cycles per sec. This is very good indeed, but the output voltage is very low, and we either need a very high gain amplifier or a high gain pre-amplifier stage before feeding to the apparatus with which we intend to use the mike. A circuit, Fig. 6, is given which has sufficient gain for this purpose: the power supply can come from the main amplifier. The quality from this type of microphone is first-class if we have enough gain in the main amplifier. Type 2 of the crystal mikes is the diaphragm mike. As Fig. 5 shows, the crystal cell is fitted to the main body of the microphone, and the little diaphragm is connected to the crystal, similar to the cone on a loud-speaker. This cone collects the incoming sound and vibrates the crystal. The response is slightly lower than the floating cell type, roughly between 40-6,000 cycles per second. Due to the collective action of the diaphragm the output of the mike is quite high and may be fed direct to any reasonably high gain amplifier. There are, however, on the market, as surplus, a large number of crystal inserts. These are actual microphones, being surplus from the well-known Government Medresco hearing aid so far as the writer can understand. The response of these is about 80 to 6,000 cycles, the main accent on the sibilants, letters like S, T, V, etc., that have a higher frequency than letters like the vowels, so with some tone correction these can be used very successfully. A circuit for the tone correction is given in Fig. 7. This can be fitted as part of the circuit, or a value of condenser suitable is selected and fitted. In all cases of using a crystal mike we must have a grid resistor of 1-5 megohms, the lower values giving a slightly less bass response. Again we can suit our individual needs. Before passing on, we should point out that a crystal mike is excellent

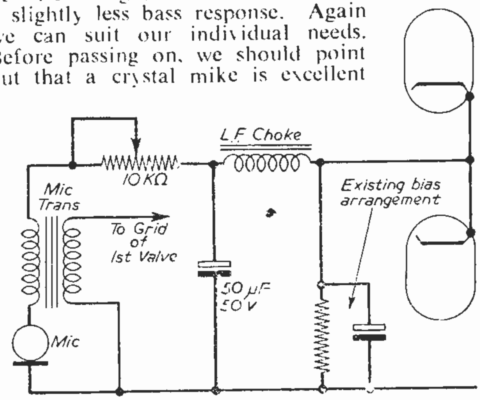

Fig. 3.—Another polarising circuit.

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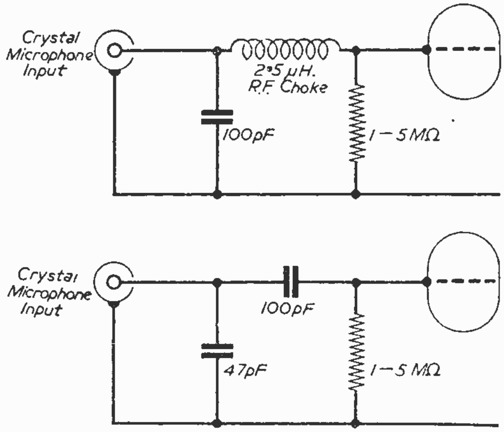


Fig. 9.—Two further matching circuits for a crystal mike.

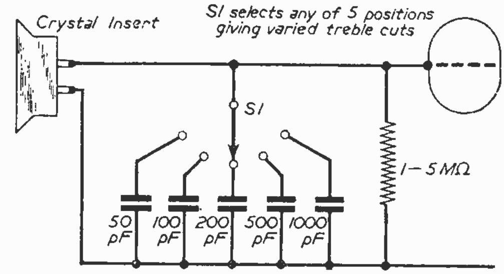
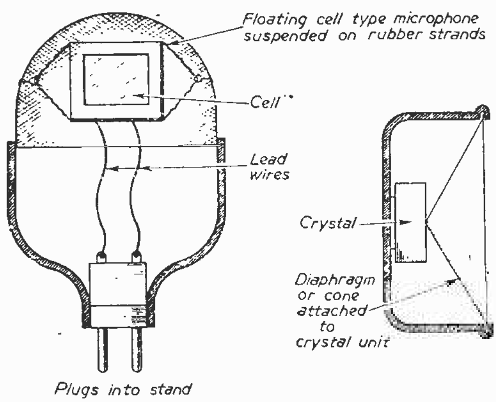


Fig. 7.—A tone correction circuit.

but fragile and must not be abused, and always handled with care, as the crystals will easily fracture. The common symptom is loss of gain. Should this occur the answer is to return them to the manufacturer, as crystals cannot be repaired successfully.

Moving-coil Mikes

These are far from being unpopular, and are again available on the surplus market. Again we need a step-up transformer, the ratio being 100-1 step-up. One essential factor when using a moving-coil is complete shielding of leads and transformer, as hum is very easily introduced. One side of the primary and secondary must be earthed to chassis at the same point, the grid lead to be also screened. As Fig. 8 shows, all leads, etc., are screened, also the mike lead. A moving-coil mike used on a high gain amplifier, if unscreened components are used, can be a real hum maker, and it is better if the amplifier is also earthed, then it should be hum free.



Figs. 4 and 5.—Two alternative forms of crystal mike construction.

Transverse Current Mikes

These are little used these days and may be treated with the similar characteristics as the carbon mike. Ribbon mikes are, however, a different proposition. These require a considerable amount of gain, but the quality of 100 per cent. The price ranges from £8-£50, and they are made in different value outputs from 20 ohms to a value which will match into the grid. Most ribbon mikes have a transformer built in at the bottom of the case, to bring the impedance of the ribbon to a value which is easier to handle, as the impedance of the ribbon itself without this transformer is very low.

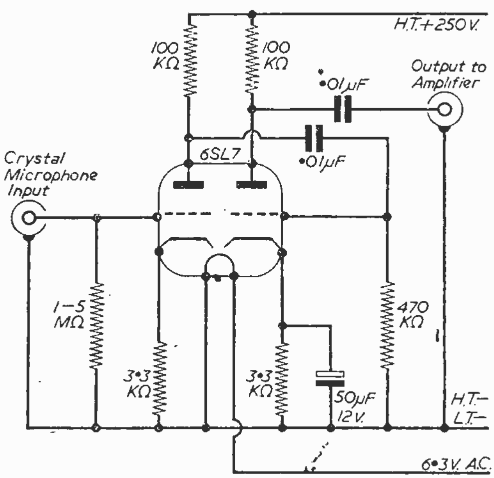


Fig. 6.—A pre-amplifier using a double-triode.

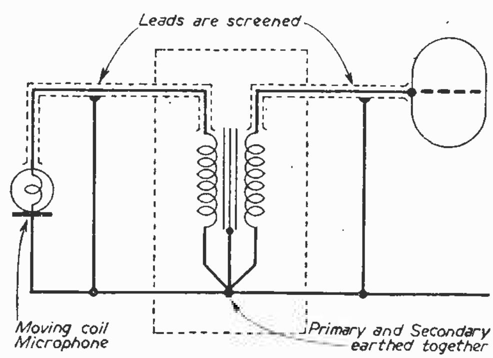


Fig. 8.—Note the screening which is needed with a moving-coil mike.

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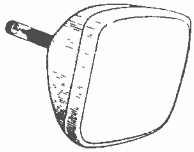

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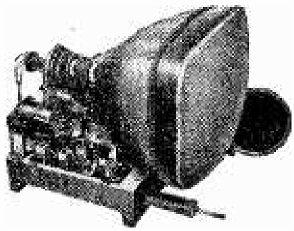

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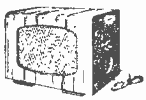

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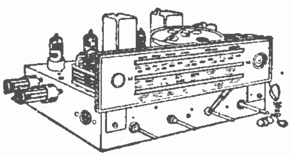

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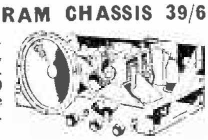

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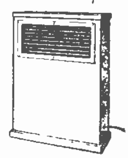

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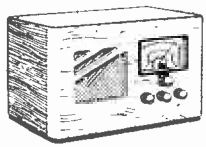

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3A8	3/9	77	3/9	EB34	1 9	EF50	2/9
4D1	2/9	8D2	3 9	EB91	6 9	EL32	6/9
6B8	3 9	8D3	7 9	ECC81	8/9	EL91	3/9
6F12	7 9	12AU7	5 9	ECH42	8/9	PEN45	6/9
6D2	6 9	12BE6	6/9	EF39	6/9	TT11	6/9
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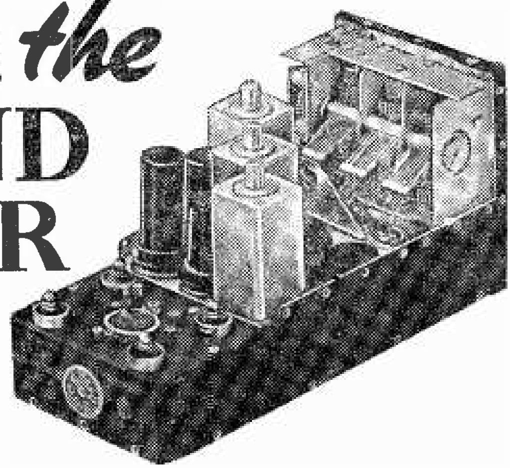
Converting the COMMAND RECEIVER



MODIFICATIONS OF THE BC455 FOR DX USE

By R. E. S. Coulson

(Continued from page 608 November issue)

THE output transformer has an output impedance of 4,000 ohms, so will feed nicely into a pair of H.R. phones. (Try this and you will see the need for two potentiometers.) If, however, it is desired to use a loudspeaker, it is preferable to feed the output into an amplifier, which may consist of a 6V6.

Addition to RF24

The set thus modified, when connected to a suitable power supply (12 volts .9 amps, 300 volts 60 mA) is an excellent receiver for the 40-metre band; many British and European amateur and short-wave broadcast stations can be heard with it. It can be worked also on the most useful DX bands, 10 and 15 metres, by the addition of the RF24. This comes supplied with three valves, SP61s (6.3 volts) and ready to work. All that needs to be done is the wiring up.

At the rear of the RF24 will be found a six-pin Jones plug. The power leads (carrying 6.3 volts 1.8 amps. and 200 volts 10 mA) and the I.F. output are taken through this plug. Connections are given on the circuit diagram (Fig. 3). The I.F. output is taken by about 1ft. 6in. of coaxial to the aerial terminal on the BC455. The coaxial socket on the front of the RF24 may be left, or replaced by a " drop-through "

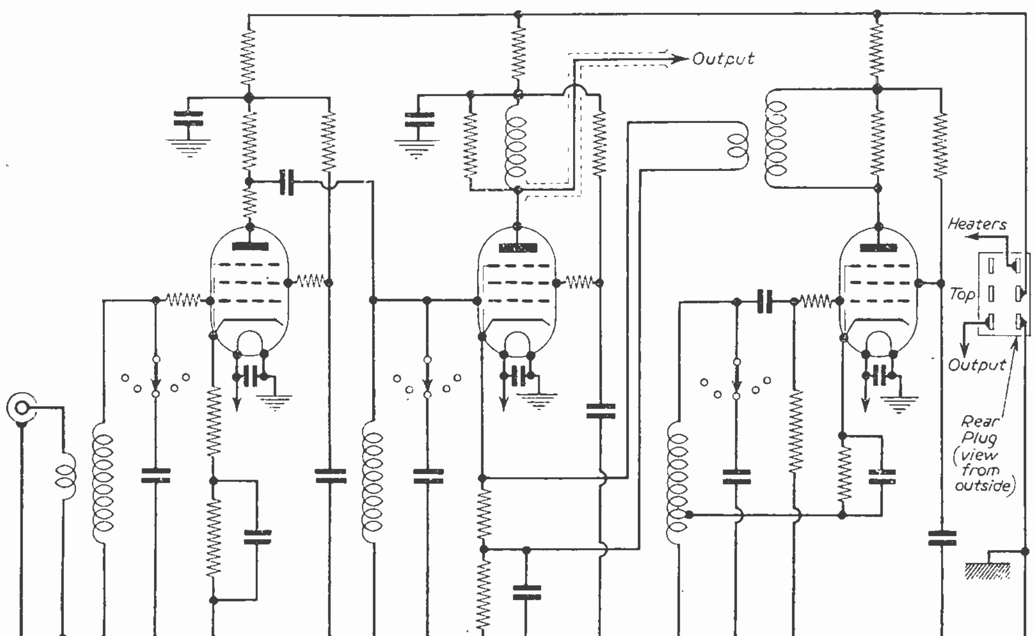


Fig. 3.—The RF24 Unit.

type of normal coaxial socket. A dipole aerial is then connected to the RF24 via the coaxial socket, the power switched on, and the RF24 switched to range 5. The BC455 is then tuned patiently from 7 to 9 Mc/s (over the 10-metre band). When a station is found, the trimmers of range 5 are adjusted to peak it up. The 15-metre band is explored in the same way, with the RF24 switched to range 1, and the BC455 tuned from about 8 to 8.5 Mc/s.

Aerials

Any short-wave receiver performs best on an aerial which has been cut for the band in use. The command set is no exception, and so if one has enough space one can erect some aerials of very high efficiency. The ideals are an aerial for each band, 10, 15 and 40 metres. A fairly good substitute is a dipole for 10 and a 66ft. top for the other two. As an alternative one could press into use the domestic television aerial, or the one normally employed for the reception of the BBC F.M. signals.

It would perhaps be as well to study the article which begins on page 725 in this issue.

LIST OF PARTS FOR FIG 2 (d)

C23—180pF	C35—750 pF
C38—17 pF	R14—100 KΩ
C24—200 pF	R15—20 KΩ
C15C—.05 μF	R16—100 KΩ
C26—100 pF	R17—100 KΩ
C27—335 pF	R18—510 KΩ
C28—34 pF	R19—100 KΩ
C29—.006 μF	R20—2 MΩ
C30—.15 μF	R21—1.5 KΩ
C20B—.01 μF	

Performance

As already mentioned, signals have been heard from many countries, both on C.W. and phone. The sensitivity seems to be better than a lot of factory made receivers, as I have heard amateurs discussing conditions over the air and saying that "the ten metre band seems to be bad": on turning to that band I usually find it "wide open" and have heard some of my best D.X. then. One day I heard a GB2 calling CQ on top of a QRP CN8, also calling CQ DX. That GB2 has a well-known commercial short-wave receiver and lives only about 12 miles away from me.

Additional Notes

It may be found that the gain of the RF24 is too high, in which case a third gain control may be fitted. This is best carried out by removing the name plate of the RF24 and cutting a ⅜in. hole in the front panel where it was fixed. It should have a value of about 10KΩ.

It is regretted that we are unable to suggest any further modification in the case of this particular receiver.

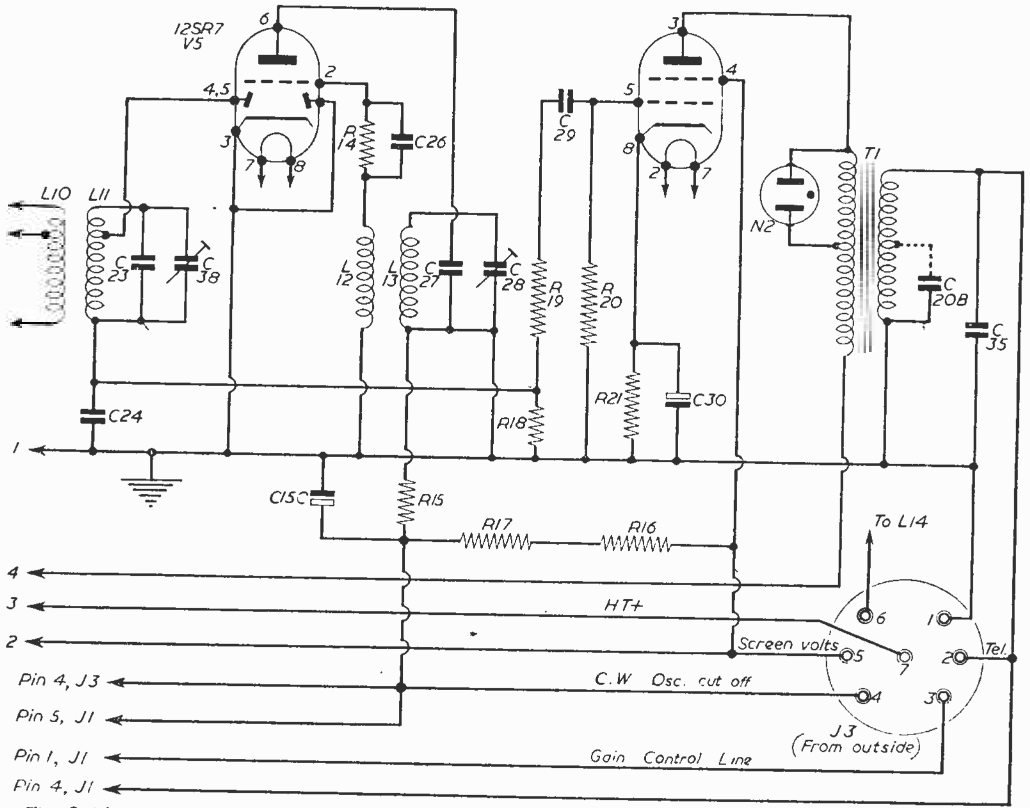


Fig. 2 (d).—Detector, B.F.O. and output stage. A list of parts is repeated above, for this section.

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VALVES.—EF80. Three required. Mullard, **19/-.** Alternative, **10/-** ea

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RESISTORS.—Kit of 15. All labelled, **5/-.** Any value separately, **4d.**

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OUTPUT TRANSFORMERS.—Partridge. P3667. For 6,000 and 8,000 ohms. **52/6.** Gilson WO696A for 8,000 ohms. **47/6.** Gilson WO-696B for 6,000 ohms. **47/6.**

OUTPUT TRANSFORMERS—ULTRA LINEAR.—Gilson WO710/8K. **52/6.** WO892. **62/6.** Partridge P4014. **98/6.** P5302. **95/-.** Elstone OT ML. **45/-.**

PLUGS AND SOCKETS.—Elcom. 6-pin Chassis Socket S06. **4/3.** 6-pin Flex Plug S06T. **5/6.** 4-pin Chassis Socket S04. **3/3.** 4-pin Flex Plug S04T. **5/-.** Bulgin P340. **4/6.** P350. **4/3.**

VALVES.—EF86 Mullard. **24/4.** Our alternative. **15/-.** ECC83 Mullard. **19/-.** Our alternative. **10/-.** EL84 Mullard **16/-.** Our alternative **12/-.** EZ80 Mullard. **11/10.** Our alternative **8/6.** EZ81 Mullard **11/10.**

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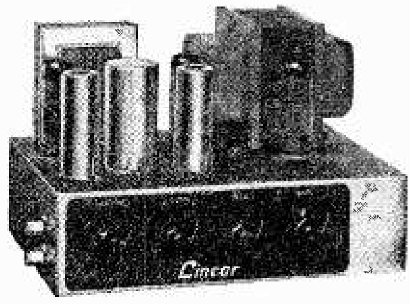

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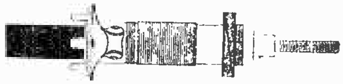

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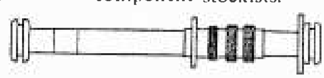

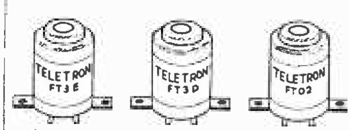

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Inter-station Noise Suppression on F.M. Receivers

METHODS OF OVERCOMING A DIFFICULTY IN HIGH-QUALITY RECEIVERS

A FREQUENCY-MODULATED receiver, as long as it is tuned in accurately to a station, will have no background noise. Unfortunately, between stations the input voltage will consist of random noise which, if a limiter is used, will be too weak to operate the limiter enough to cut it out, but the noise will be sufficient to cause a certain amount of irritation. This is due to the fact that under these conditions, the limited functions as an amplifier, and

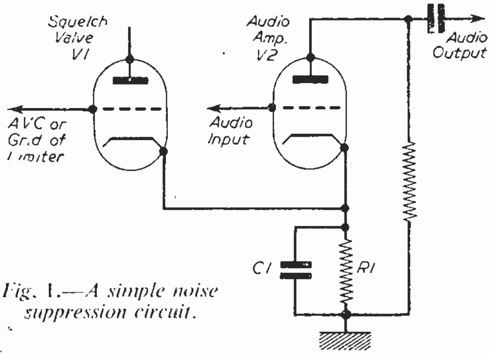

Fig. 1.—A simple noise suppression circuit.

these amplitude modulated voltages produce a loud hiss in the speaker. There are several methods of suppressing this inter-station noise. The basic idea behind these suppression systems, involves the use of a valve that is maintained at cut-off point as long as sufficient signal voltage is being received. When the input signal decreases, as one tunes off the station, the valve will conduct. The current through the valve is then made to flow through the audio amplifier cathode resistor and biases this valve to cut-off point. This condition is maintained until the signal strength of the receiver again increases (as when tuned to a station). Fig. 1 gives a simple arrangement of this. In this circuit V1 is the suppressing or squelch valve and V2 the audio amplifier. Both valves have a common cathode with resistor R1 and condenser C1. As long as V1 is maintained at cut-off by a negative voltage on its grid, V2 functions as usual, but removal of the voltage on grid of V1, or a decrease of it, will bring V2 to cut-off point, because of the higher voltage across R1. This cut-off lasts until V1 again has a negative voltage applied to its grid. Valves capable of high current flow should be used. Triodes are shown in diagram, but pentodes can be used.

Another Method

In a frequency modulated receiver there are several points where the required negative biasing voltage to control the squelch valve, may be obtained. One point is the grid circuit of the limiter stage. In Fig. 2 the grid of the squelch valve is directly connected to the grid circuit of the limiter. The negative voltage developed here is sufficient, with a signal, to keep the suppressing valve V2 at, or beyond, cut-off. During these periods the section of the audio amplifier operates normally. As soon as the negative voltage is removed from the grid of the suppressing valve, a large current flows through R1 and biases the audio amplifier to cut-off. This suppressing valve should have a high mutual conductance, in the range of 8 to 10,000 micro-ohms, so that it is capable of large currents with comparatively small negative volt changes on its grid. R2 and C1 form a filter to prevent I.F. currents from reaching the suppressing grid (V2).

An Alternative

As mentioned previously, there are other points from which this required negative biasing voltage can be obtained. In Fig. 3 it is the D.C. voltage available at the discriminator that is utilised for control. If we examine the individual polarity across the two discriminator resistors, we notice that point A will always be negative with respect to point B, as long as a signal is being received. It should be noted that we are only referring to the voltage appearing across the lower resistor and not across both resistors, as for the audio output. The voltage obtained from point A consists of an audio component due to the frequency

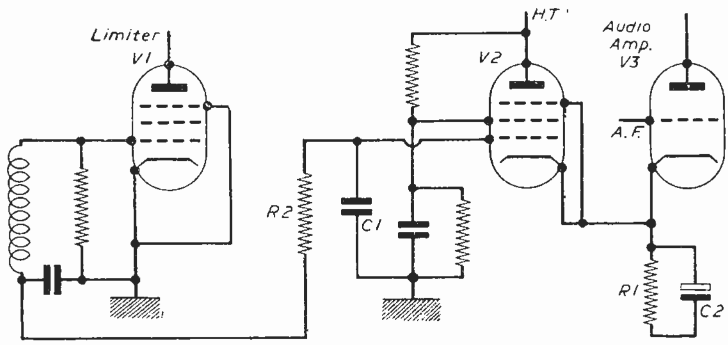

Fig. 2.—An alternative to the arrangement in Fig. 1.

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shift of the signal and a D.C. component arising from the magnitude of the signal. Whilst the signal possesses sufficient amplitude to operate the limiter at saturation, the negative voltage present at point A will be strong enough to keep the suppressing valve V2, at cut-off. This will permit the audio amplifier V3 to function normally. When, however, the signal is tuned out, the voltage at point A drops, V2 begins to conduct and the audio amplifier V3 is stopped from functioning. R1 is a resistor common to both V2 and V3. A filter circuit is put in between point A and the grid of V2 to eliminate the audio component of the voltage at point A and thus present a D.C. voltage to V2.

It must be appreciated that these inter-station suppression circuits will not be needed in a receiver using a ratio detector, where the signal noise between stations is fairly low. These circuits are very useful in the type of frequency modulation receivers using limiters and discriminators.

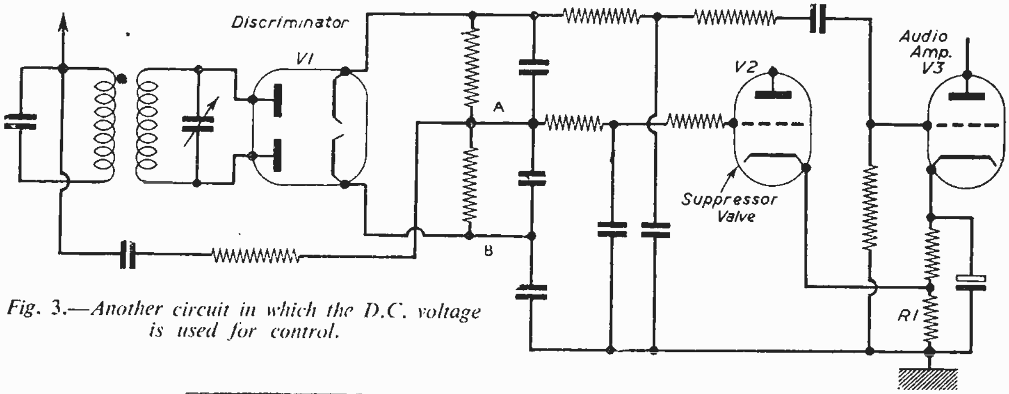

Fig. 3.—Another circuit in which the D.C. voltage is used for control.

Recent Solar Activity

CONSIDERABLE interest, largely aroused by the inauguration of the International Geophysical Year, has been shown by the public in the recent solar activity. In order to see this in its proper perspective it is necessary to obtain a general background picture of the Sun's behaviour.

It has been known for over a century that solar activity rises and falls in an approximately 11-year cycle. By 1850 it was also realised that the Sun strongly influenced the variations in the Earth's magnetic field, the activity of which closely follows the solar cycle.

The most obvious manifestation of the Sun's activity is the appearance of sunspots. These are small, disturbed areas on the Sun which, being cooler than the adjacent surface, show up by contrast as dark spots. The life of a sunspot may be anything between a few hours and several months.

The Sun rotates about its own axis in just over 27 days (as seen from the Earth) and so a spot lasting for a passage of the disc will be seen for about a fortnight.

Sunspots vary greatly in size and frequency during the solar cycle. At times of minimum activity the Sun may be spotless for as many as 200 days in a year, while at maximum there may be more than 20 groups visible at once, many consisting of several invidual spots.

The larger groups are easily visible to the naked eye when the Sun's light is cut down by fog or when viewed through a dark glass.

Solar flares are shortlived, sudden increases in the intensity of the surface brightness in the neighbourhood of sunspots and can be normally seen only in the light of particular wavelengths, for example, the hydrogen line in the red part of the Sun's spectrum.

Flares are very common at peak solar activity, the frequency even rising to an average of a flare every two hours for considerable periods.

Most flares are small and of short duration, having a life lasting a quarter of an hour or so. The individual influence of such a flare is negligible, but in the case of big flares (the longest-lived of which have lasted about 7 hours) their ultra-violet radiation affects the ionosphere, or electrically charged layers lying some 80 miles above the Earth's surface.

Communication Affected

As radio waves are reflected by the ionosphere, disturbances caused by solar radiation interfere seriously with radio communications. These sudden short-wave fadeouts are coincident with flares (this has been known for more than 20 years), but there is also a secondary effect which may occur a day or so after a large flare, due to a stream of corpuscles from the neighbourhood of the flare reaching the Earth.

If sufficiently intense, the effects give rise to world-wide magnetic and ionospheric storms which may last for a few days and cause serious and prolonged disruption of radio signals.

At any maximum of the solar cycle, therefore, continued periods of fairly frequent disturbances can be expected.

The International Geophysical Year has been timed to coincide with such a period of activity so that the effects on the Earth can be assessed. The disturbances at the beginning of July and September were caused by several medium-sized sunspot groups and associated large flares.

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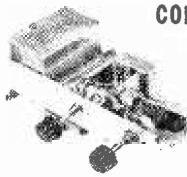

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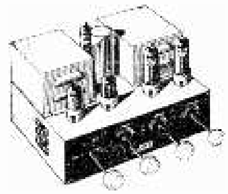

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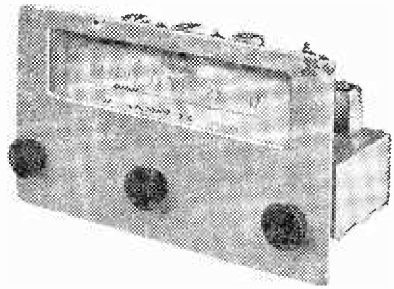

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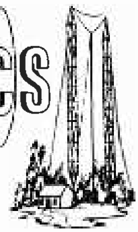

MORE ABOUT AERIALS

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

THE keen beginner is likely to retreat into the line of least resistance and erect dipoles for each band he desires to cover. There is a limit to this, of course, as a dipole for topband requires some 265ft. of wire. Moreover, an array of dipoles for each band is liable to occupy space on a grand scale, and to cost a tidy sum for the feeders for each dipole as well. Further, there is no special merit in a dipole aerial, and it does not guarantee good results on the band for which it is cut. In fact no aerial will guarantee good results, and unless "other factors" are carefully considered no aerial is likely to give good results.

It is as well to examine some beliefs and superstitions concerning aerial systems, in order to establish some firm facts about them. First the question of radiation efficiency. Let it be firmly established that any aerial whatsoever, if efficiently fed, will radiate all the energy, with the exception of that energy consumed in losses in the resistance of the aerial and the coupling system. To reduce this to absurdity, if the energy is not radiated or lost in R.F. losses it can only be returned to the transmitter, and therefore has not been fed to the aerial! Thus an efficiently fed aerial—apart from R.F. losses in insulation and resistance—radiates the R.F. energy, and it does not matter if the aerial is an inch long or a mile long—the available energy is radiated. However, before a topband aerial an inch long is pressed into service, it is well to point out that inevitable resistive losses in the coupling system would absorb 99.999 per cent., or thereabouts, of the available R.F. energy. The tiny difference would be radiated. In fact a superconductive aerial coupling system might enable even a very short aerial to radiate a good proportion of R.F., so that an efficient topband aerial might only be a foot or so long. What is not realised is that this also applies to reception, and but for circuit losses, a very short aerial is about as good for reception as a halfwave dipole. However, here again the circuit losses become so huge if impossibly short aerials are used, that a practical aerial has to be of a "reasonable" length. In fact an aerial must be a "reasonable" fraction of a halfwave dipole, and by the time an aerial is only a tenth of a wavelength long, it is already rather "short."

In many millions of homes an outside aerial of, say, 30ft. is a rarity, and indeed many broadcast sets operate with only a few odd feet of wire as aerial. Nobody stops to consider that when receiving on the long waves an aerial of around some 2,500ft. represents a half-wave dipole, and that even a "better than average" domestic aerial represents something like one hundredth of a wavelength. By comparison this is using a foot of wire or so for topband reception, or equivalent to a few inches of wire on 10 metres! Clearly there is some sizeable fly in the ointment, for even under ideal conditions a few inches of wire is virtually useless on 10 metres, while the "proportionally equivalent" long wave aerial serves quite satisfactorily. The idea that a large aerial gets a "better grip" on the ether seems to have some substance. Or

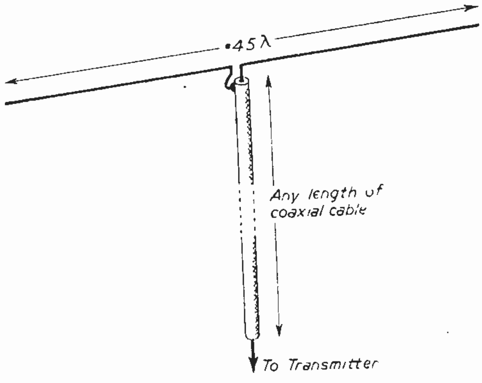

Fig. 1.—The simple coax-fed dipole. The unbalanced feed is not altogether satisfactory.

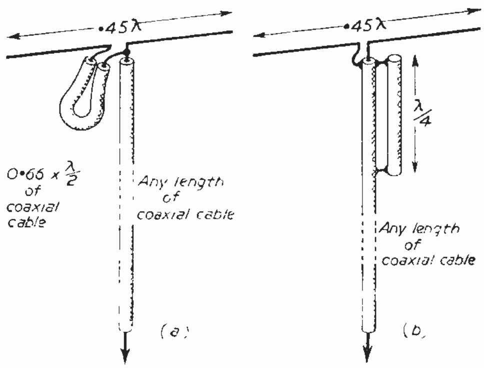

Fig. 2(a).—One method of balancing the feed to a coax-fed dipole. The length assumes that solid insulation coax is used.

Fig. 2(b).—The "bazooka" method of ensuring balanced feed. The quarter wave section may be the outer sheath of a piece of coaxial cable.

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rather that a "reasonable" length of wire is a useful aerial on almost any wavelength, regardless of whether it is a microscopic fraction of a half wavelength or not.

An Explanation

The facts behind the above reasoning or intuitions are as follows. Consider aerials in free space, to avoid any nonsense about ground reflections. Now if we take halfwave dipoles and feed them with the same amount of R.F. power, then the field strength at a given point at the same distance from the dipoles will be the same. That is to say, whatever the wavelength (within reason) the same amount of R.F. power is equally well radiated by a halfwave dipole. Thus if we were in free space, 10 watts to a 160-metre halfwave dipole would produce at, say, 100 miles a given field strength. Similarly a 10-metre dipole fed with 10 watts of 10-metre R.F. will produce exactly the same field strength at 100 miles as we have from the 160-metre transmission. It should be noted also, that at 100 miles the 10-watt signals will be good signals, with a solid field strength of over 100 microvolts per metre. The essential point is that halfwave dipoles fed with the same amount of R.F. radiate in precisely the same way, and if fed with R.F.

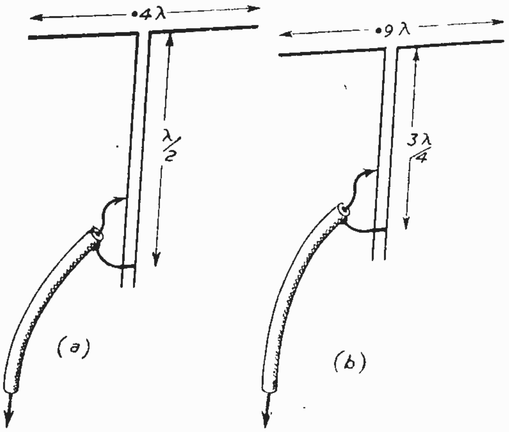

Fig. 3a.—A tunable stub enables a balanced feed to be assured, and also permits adjustment for multi-band operation.

Fig. 3b.—The tuning stub set for operation on the second harmonic.

at the frequency for which they are cut, will produce the same field strengths at the same distances. Thus, if "economy of wire" is a point, it would seem that a VHF transmission only needs a small aerial to produce the required field strength, and that VHF is ideal for communication . . . at any rate in free space!

However, a shock is in store for us when under the above conditions we use a halfwave dipole for reception. Thus with a 160-metre dipole on the 160-metre transmission we find the signal voltage developed across the grid of our receiver is 16 times that of the 10-metre receiver using a 10-metre dipole, despite the fact that the R.F. field strengths are the same. That is, our signal intercepted on 10 metres is 24 db or 4 S points down on the signal intercepted by our 160-metre dipole on the 160-metre transmission, despite the fact that the field strength of the two signals is the same.

Clearly our large 160-metre dipole has a "better grip" on the ether for 160-metre transmissions than a 10-metre dipole has for 10-metre transmissions! Also this is no small difference, but the actual voltage to operate our receiver has fallen off to one sixteenth, exactly the ratio of the lengths of the aerials concerned! Moreover, the power ratio is, of course 16, or 256 times, so on 10 metres we have intercepted just 1/256th of the energy intercepted on 160 metres. Of course, the textbooks go into this in a little more highbrow fashion and substitute "effective capture area" for "getting a grip on the ether." But the net result is the same, we need a modest 2,560 watts, say 2½ kilowatts radiated on 10 metres, to give the same effect on our receiver as a 10-metre dipole, as a modest 10 watts radiated to a 160-metre dipole and receiver on the 160-metre wavelength! Somebody should surely be complaining that in view of all this it should be difficult not to work fabulous DX on topband, and impossible on 10 metres! However, this is not so, as ionospheric and other matters interfere to confuse the issue which, in free space, is crystal clear.

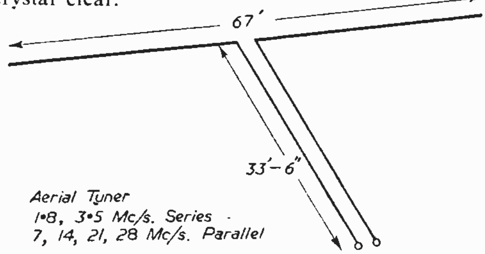

Fig. 4.—The 40-metre dipole, which is usable not only on harmonics of 7 Mc/s., but on the lower frequency bands as well.

No present-day amateur guide bothers to explain the actual vast "fall off" in capture area or "ether gripping" properties of a dipole with frequency. It is perfectly true that the signal voltage developed by a half-wave dipole falls off directly with the wavelength of operation, and that the power intercepted falls off as the square of the length of a halfwave dipole! A little quick thinking will reveal that a halfwave dipole on the long waveband is collecting something like ten times as much signal voltage, and hence 100 times as much signal power as an amateur using a halfwave dipole on top band. It is now clear why even a very "short"—electrically speaking—aerial on the long-waves gives quite a respectable signal. Even at 1 per cent. efficiency it would deliver as much power to a receiver as a full halfwave dipole would on 160 metres. Moreover, the long wave stations on the broadcast band operate with hundreds of kilowatts rather than

(Continued on page 729)

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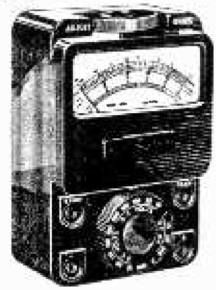

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the 10 watts of the amateur upon 160 metres, so that even with aerial efficiencies that actually are minute fractions of 1 per cent., the receiver still has a large actual R.F. input applied to it. It also becomes clear why in the early days of radio there was a mad rush to the longer and longer waves, and the amateurs were relegated to the "useless" wavelengths below 200 metres. Fortunately for the amateurs, "other considerations" intruded, and the shorter wavelengths proved to be useful for very long distance communication through the agency of ionised layers.

Influence of Frequency

It is salutary to remember that in fact a receiving dipole intercepts less energy as the frequency increases. Thus on the VHFs, where the radiation from a dipole is precisely the same in free space

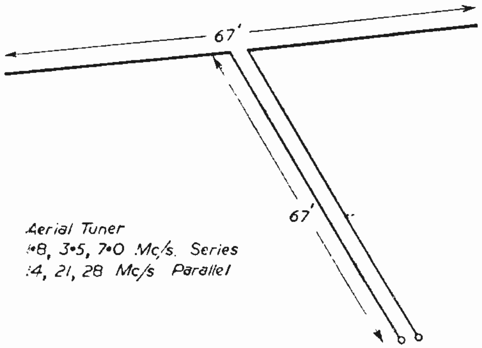

Fig. 5.—This alternative version of a centre-fed 40 metre dipole is also usable on all the usual communications frequencies.

as for any other dipole at any other frequency, the energy intercepted by a receiving dipole is minute. Thus at 1 metre it intercepts one hundredth of the energy, and one tenth of the voltage is generated for the receiver that would be intercepted on 10 metres. Thus a large receiving aerial array is needed in order to make up the 20 db difference from the dipole to dipole case on 10 metres. This is why beginners on the VHF bands may radiate a readable signal easily enough, but run into difficulties on reception. A dipole or simple Yagi is scarcely good enough. This difference in behaviour of aerial arrays on reception and transmission may account for the "one way" effects noted where a signal is transmitted and read at a distant station, but the other station is not heard, and transmission is called "one way." Obviously even a simple dipole will radiate effectively on the VHFs, but intercepts such a tiny amount of energy from incoming signals, that reception is just not possible. Moreover, the well-known difficulties with building sensitive low-noise VHF receivers and the rapid attenuation with distance complicate the VHF picture. Thus the "advantage" of the VHFs in that multiple element high-gain aerial systems may be built compactly is unfortunately offset by the fact that it is upon such frequencies that large high-gain aerial systems are essential, in order that the receiving end can intercept a useful fraction of the incoming signal. In fact, for "average" results on almost any band it is necessary to occupy a fair space with the aerial system, in order to intercept a reasonable amount of energy at the receiver! As we have seen for transmission, a halfwave dipole radiates effectively whatever the frequency, so that even on VHFs the tiny dipole *is* an effective radiator.

While the above facts may be somewhat new to many, they do at least accord with the "intuitive" view that a large aerial "gets a better grip" on the ether. While this intuition is largely borne out in practice, it is actually not fundamentally true. Thus the real crux of the matter is the operating frequency, as even a tiny aerial is ideally just as effective a receiver or radiator as a half-wave dipole at the frequency of operation. This in practice is only an ideal conception, as with very short aerials the effect of tiny resistive losses becomes of astronomical importance. Thus, when to radiate effectively with only a few watts of R.F. power it is shown that this involves R.F. currents of thousands of amps in the wire, it is clear that even a fraction of an ohm will consume virtually all the power fed to the aerial, and, as is found in practice, virtually none is radiated. However, if the ideal "very short" aerial is fed by a circuit free from losses, it would radiate effectively and about as well as a full-sized halfwave dipole. However, practically one should not expect near miracles, even if these might be realised by superconducting components and ultra low loss dielectrics. An analysis of beam arrays shows that a "super-gain" compact beam array of high gain and very sharp directivity could be achieved if one is prepared to envisage currents of millions of amps circulating in the elements for modest input powers! Needless to say, "super-gain" arrays of this nature are unlikely to be realised. Similarly, when very short aerials are fed in an attempt to obtain radiation, the R.F. current in the aerial rises to very high values. When one is concerned with aerials that really are short, such as the whip aerials used for mobile topband use, then halving the length of the aerial just about quadruples the losses. Thus the tip for mobile operators is to use as tall a whip as possible, or to operate on as high a frequency band as possible, if effective radiation is desired. But for other reasons, 10 metres would be a very much preferable band to topband for RAEN mobile use, and topband "mobileers" could refer to back issues, where the importance of a little extra height in mobile whip aerials has been discussed. This shows conclusively that any striving for efficiency in the transmitter on topband operation is very secondary to increases in the height and radiation resistance of the whip radiator.

Some Examples

The newcomer may very truly object that he is not worried about mobile operation just now, but is interested in some form of aerial so that he can commence operations upon some band or other. The usual aerial suggested is a coaxial fed dipole (Fig. 1). This is not altogether as simple as it appears, as while a coax feed is regarded as the last word in efficiency, this is sometimes a delusion. Briefly, the trouble with

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coax is that it is an unbalanced feeder, and the centre of a dipole needs a balanced feed. The coaxial "bazooka" is one means of providing a balanced feed (Fig. 2b). The halfwave length of coax provides a phase reversion section so that the two halves of the centre-fed dipole are fed correctly. Without some such device the unbalance of a simple coax feed may cause R.F. currents to travel on the outer sheath of the coax and thus cause a variety of troubles.

Correctly used, the coax feed is useful, in that even harmonics are not efficiently fed, so that combined with the screening provided by the

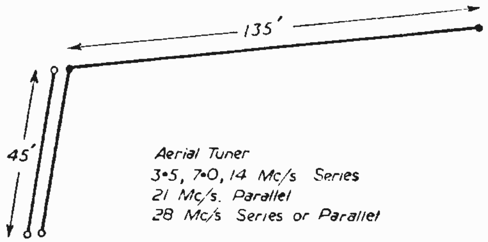

Fig. 6.—The Zepp fed aerial, which is a useful performer on all the usual DX communication bands.

cable, harmonic and TVI troubles are largely eliminated. For this reason a coaxially fed dipole is more or less a "one-band" device, although third or odd harmonic operation is possible. Thus a coax fed 40-metre dipole might also serve as a radiator for 21 Mc/s as well.

To avoid the uneconomic necessity of having separate aerials and feeders for each band is thus a problem with coaxially fed dipoles. One could have a plug and socket system to plug one main feeder into a number of dipoles, although this would still require "bazookas" to obtain symmetrical feeding of the dipoles. The stub of coax is unsightly and awkward, and is also quite an expensive item when several aerials are used. One can retain the convenience of coaxial feed, and get multiband operation by using a tunable matching stub Figs. 3 (a) and (b). The "tuning-up" of the stub on several bands and the transfer of the matching point may be effected in a few seconds, and enables a single aerial to operate with coaxial feed on several bands. Small clips or tapping points fixed at the experimentally determined positions enable the point of connection for each band to be accurately located. Moreover the tuning facility offered by adjustments of the shorting link in the stub enables the top to be resonated exactly on each band, so that good matching to the coax feed may be obtained. To indicate resonance on preliminary tuning-up tests, a low power bulb may be tapped across the shorting stub. Do not put the bulb in series with the stub, as it will absorb power excessively, and not necessarily give a good or accurate resonance indication. However, if the bulb is a low power flash-lamp type, good indication will be given if it is either shunted by a piece of wire, or—what is the same thing—clipped directly across the existing stub. This "loose coupling" of the bulb enables the stub to be tuned without disturbing the correct matching points, and the bulb may even be left permanently in position. The stub, of course, may be made from bare wires with feeder spreaders at intervals, so that the tuning short may be moved up and down for adjustments.

For "multiband" operation, centre-fed dipoles are quite practical. As previously explained, a 40-metre dipole may be centre-fed and operated upon its harmonics, so that it may be used on 7, 14, 21 and 28 Mc/s. However, as has been previously explained also, such a centre-

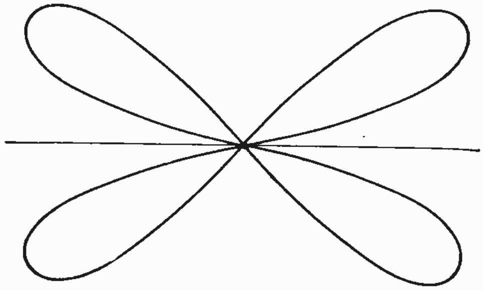

Fig. 7.—The approximate free space polar diagram of the Zepp aerial of Fig. 6, when operated on the higher frequency bands.

fed 40-metre dipole may be tuned up also on 80 metres and upon topband, and will radiate efficiently. Two popular versions are shown in Figs. 4 and 5. Despite the repeated "news" that a 40-metre aerial of this type will operate perfectly happily on 80 metres and topband, it still comes as a surprise to many. A little thought, of course, will show that the Fig. 4 aerial is actually a halfwave overall on 80 metres if we include the feeder length as well, so there should be no surprise that it tunes and loads up easily on 80 metres! Moreover, with recollections of our early discussions, these aerials are just as efficient radiators as full wave dipoles on 80 and 160 metres, and in fact have almost identical polar diagrams to the full length aerials!

The Zepp

One further old faithful standby aerial is the Zepp, and Fig. 6 shows the dimensions of one "sure fire" performer for all bands, 80 to 28. For topband use, the feeders may be tied together and the whole system tuned up Marconi fashion against ground or a counterpoise. Note that the system is a "long wire" on the H.F. bands, and will have a polar diagram roughly as shown in Fig. 7 on 21 and 28 Mc/s. A "long wire" is after all an aerial several half waves long . . . the antithesis of a "short" aerial. The long wire, in addition to the main lobes sketched roughly on the diagram, also has several minor lobes, depending upon length, and generally provides a fair coverage in many directions. Many leading DX workers use such aerials. However, one point to note is that the height of the aerial is quite important, both for the H.F. DX bands and the lower frequency bands. The effort to obtain, say, a 45ft. high aerial, over the customary 30ft. of many aerials, is well worth while.

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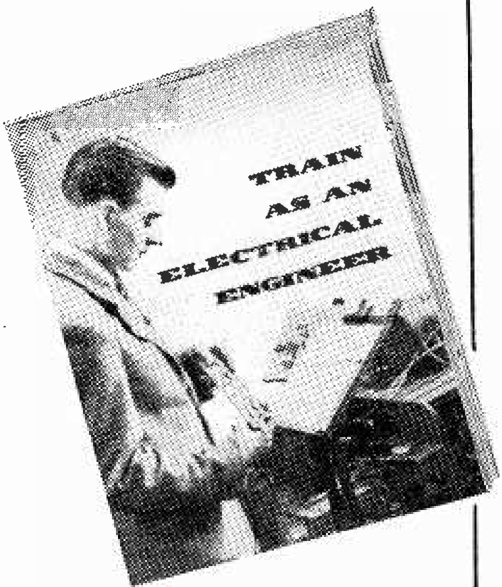

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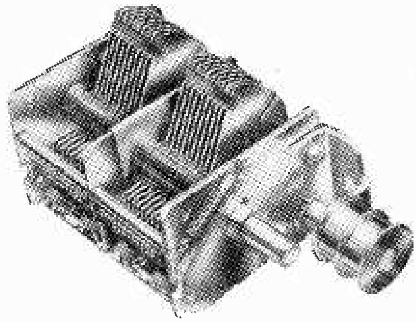

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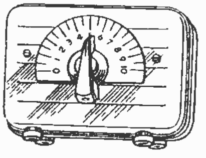

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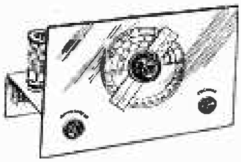

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Open to Discussion

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

Musical Frequency and the Satellite

SIR,—I was very interested to read your article in "Round the World of Wireless" on "Standard Musical Pitch," describing the service given by two short-wave stations for musicians, etc.

At about 10.35 p.m. (G.M.T.), on Tuesday, October 8, I was listening on an ordinary domestic receiver for signals from the Russian satellite. I had listened previously without success, and I did not know that the satellite had ceased to transmit at the time. Imagine my surprise when there, clear as a bell, was an interrupted note sounding right on the satellite's frequency. I left my tape recorder on and then later the note changed. After 20 minutes recording I switched off.

To-night, when I was replaying the recording, as I couldn't understand what I had been receiving when the satellite was silent, I was amazed to hear a voice announcing that it was station WWV broadcasting the 440 c.p.s. and 600 c/s. tones as you stated in the article.

The satellite has been transmitting on approximately 20 and 40 megacycles/sec., and WWV broadcasts on 20 megacycles/sec. as one of its frequencies. Do you not agree, therefore, that many people, like myself, who thought they were listening to the satellite's signals, have been listening to WWV station? This seems especially true since domestic receivers cannot differentiate between the 20 Mc/s of WWV and the 20.005 Mc/s of the satellite transmitter. I think that this disappointing fact should be made known.—John A. Hawkins (Tamworth).

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

A New Component Suggestion

SIR,—I wonder if manufacturers of radio wire, tapes and similar materials would please consider making:

1. A conducting wire with an improved magnetic path all around it, such as a plastic insulation containing Ferrox cube dust or powders of various kinds for radio-frequency and Stalloy dust, Mu-metal, or radio-metal, etc., for audio frequency purposes.

2. Plastic tapes containing various ferrous powders for interleaving coil layers when using ordinary insulated wires.

3. A plastic solution and/or cements concentrated with ferrous dusts for painting over layers of coils or for impregnating purposes and other such uses.

4. An insulated ferrous alloy wire wound around a current conducting wire, or may be you have some better ideas.

The advantages are obvious. Litz wire having each strand insulated with Ferrite plastic is bound to be much more efficient. Any shape of coil, torroidal, etc., can be wound to any desired size diameter or form and it carries with it the correct amount of ferrous dust. Bulk or overall dimensions are bound to be reduced since all the Ferrite is just where it is wanted and all wiring is automatically suitably spaced for best efficiency. In most cases cores and laminations would be dispensed with. And there are other useful applications for such wires.

There are no patents. My idea is freely given. Please, manufacturers, let me know when you have anything like it, I want some. Comments are welcomed.—R. F. GRAHAM (Bedford).

A Transistor Tester

SIR,—A point of interest concerning the Transistor Test Set (October, 1957), is the lack of provision I have made for the safety of the meters. Fundamentally, of course, the unit is complete, but provision for short-circuited transistors, or accidental shorting of the terminals while switched on, might avert the price of a new meter, microamp or milliamp, or possibly both. This has been pointed out to me by a reader, and I feel that my recommendations to him may be of interest to other readers.

A short circuit between base and emitters might well ruin the microammeter, since if the variable resistance R was set at a low value, the current flowing would be high. With R at a maximum, i.e., 10KΩ, the maximum current that could flow would be about

$$I = E/R \quad I = \frac{1.5}{10^4} \text{ amps} = 1.5 \times 10^2 = 150\mu A.$$

This could not, of course, damage the microammeter. Thus before testing a transistor it would be wise to keep R at a maximum and reduce it to a minimum, when it is clear that there is no base/emitter short. The milliammeter may be protected by a series resistor in the collector circuit. A collector/emitter short would cause a heavy current to flow through this meter.

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Since the full scale deflection is 10 mA. it is clear that a resistor could be switched in initially to limit the maximum possible current flowing to 10 mA. The instrument would thus never pass more than this value. Assuming a collector/emitter short, the resistor required to limit the collector current to 10 mA would be $R = E/I$ $R = 1.5 \times 10^{2} = 150\Omega$. A 150Ω resistor then with a shorting switch can be connected into the collector circuit, either between the collector and the milliammeter or between the milliammeter and the battery.

Instructions for testing a transistor under these conditions would be:

1. Set R to maximum. Switch in 150Ω resistor.
2. Connect up transistor. Switch on.
3. If collector current well below 10 mA, and base current well below 150μA, reduce R to a minimum and short 150Ω resistor.
4. Test transistor as instructed in article.—B. G. Wilkinson (Exeter).

Beginner's Course

SIR,—At last I see you have given us what has for long been wanted. As a complete tyro on radio, I have read dozens of books which are labelled for the beginner, but I can't understand half of them. I don't want to know all about megohms and milliwatts, all I want to do is to make a set, with a fair idea of what I am doing. The Beginner's Course seems the answer, so long as it goes on to decent sets and does not stop at the crystal set. I should like to thank you on behalf of many beginners for this new series, which, I am sure, fills a long-felt want.—H. R. BERTIN (N.W.5).

Tone Formant Wanted

SIR,—I recently completed an electronic organ, in which the output from the generator and dividers is a reasonably good saw-tooth. I have made a number of tone formants for flute, oboe, etc., but have been unable to get a really good tibia tone—something comparable with a pipe organ. I wonder if any reader has found a suitable circuit and would be willing to pass it on? I think this is one of the most fascinating of the electronic hobbies and offers unlimited scope to the keen amateur.—E. M. WATTS (N.W.).

Correspondent Wanted

SIR,—I am thirteen years of age and attend grammar school and would very much like to correspond with amateurs of my own age. I am interested in wireless, especially short wave.—DAVID COO, 279, Louth Road, Scarthoe, Grimsby, Lincs.

Ex-Service Equipment Variations

SIR,—It was with interest and some amusement that I read Rev. C. H. Arnold's letter with special reference to his remarks concerning F.M. and F.M. feeder units. He mentions the "373" I.F. strip conversion which was described recently in PRACTICAL WIRELESS, by "Mark Time." In the article your contributor states that there are *seven* wires leading to the power-plug as follows: red and black H.T., brown and grey heaters, and three yellow leads for AVC and bias.

I have two of these units and both have *eight* leads to the power-plug, the extra wire being blue. There was no circuit diagram with either of these units and I would like to know, therefore, what the blue is for and whether it has any part in the final conversion.—J. POLDEN (Sussex).

R.109A

SIR,—I wonder if there are any readers who have any gen about working the receiver R.109A off A.C. mains.—D. E. JONES, 6, Talybout Road, Llanruist, North Wales.

Indicator Unit 255

SIR,—Could any reader give me some information on the Indicator Unit No. 255? I wish to make a "scope." I have been unable to pick up or buy literature from dealers selling such on surplus equipment.—F. R. CROSSLEY (4, Steele Avenue, Staveley, Chesterfield, Derbyshire).

A Peculiar Fault

SIR,—Reading the letter sent in by Mr. Trail reminds me of the unusual behaviour of a German civilian radio receiver which we had in our barrack room when I was stationed in G.H.Q., B.A.O.R., more than ten years ago.

One evening, while we were listening to the American Forces Network on one of its wavelengths, someone walked into the room, went over to the set and spun the tuning knob. The pointer came to rest by sheer coincidence on the other A.F.N. wavelength and we heard about half a dozen words of the programme repeated. We tried it several times and the same thing happened. Afterwards we found that we could go to the set any time and do this if the same programme was being radiated by the two stations simultaneously.

What could cause a time lag of about five or six seconds? It may be worth while investigating even after all these years, to see whether any of our readers stationed in Germany have experienced it, also.—E. YEATES (Bromsgrove).

A PUSH-PULL GRAMOPHONE AMPLIFIER

(Continued from page 708)

have such a means of checking, it is safer to have R23 with the higher value. If you want to use an output transformer with only a 3 ohm secondary winding, the feedback will obviously have to be taken from this, and then you can safely reduce R23 to 22 K ohm because you will be getting reduced feedback anyway.

The completed amplifier should be checked first of all with the feedback disconnected at "X" in the circuit diagram, and it should be perfectly stable in operation. The feedback is then connected up, and if there is a high-pitched whistle, the connections to the output transformer secondary winding should be reversed, as one way round, positive, instead of negative feedback is applied. This is the only setting-up operation required.

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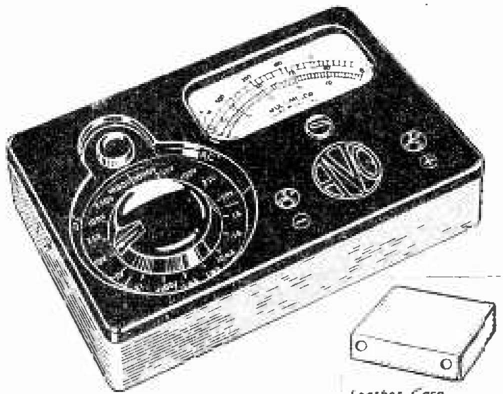

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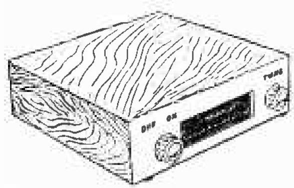

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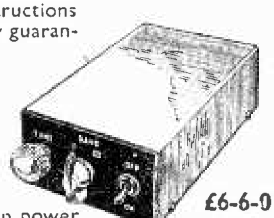

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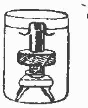

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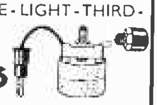

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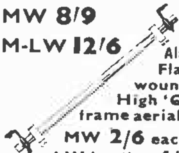

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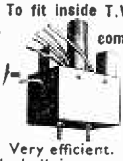

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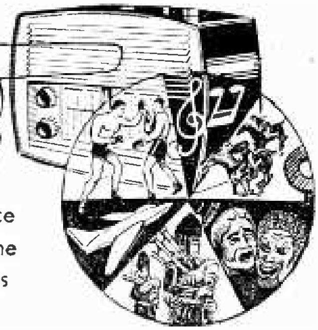

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

A Fall in Listeners

A LARGE fall in wireless listening figures, even if less catastrophic than was at first reported, gives cause for thought and arouses serious reflection. What are the reasons? Leaving aside television competition (the worst effects of which may only be temporary and may not last beyond the novelty stage of the new medium) and keeping strictly to radio broadcasting, my own reflections are as follows:

Thousands have grown sick and weary of constantly being "talked down to"; they are tired of comedians and some others summoning them, and the whole nation, to the microphone with a portentousness worthy of more important things and with a signature tune that grows more nauseous with every weekly repetition; they are sick of the endless "credits" at the end of each show, every word of which is in the "Radio Times"; they are annoyed with much poor material at the peak hours of broadcasting; they are weary of the repetitiousness of announcing and of many programmes; they resent the weather forecasts, a high percentage of which are very untrustworthy, and they consequently feel frustrated, "taken for a ride," taken too much for granted. They think, and rightly, that things could, and should, be much better than they are.

Whether television will succeed in keeping all those who are at present turning to it for relief and change is at least debatable. But if the fall in blind radio listening gives its purveyors a good rousing and shaking-up, much benefit should accrue.

French Revolution

Sardou's late Victorian pastiche of sex and history—with probably more of the former than the latter—"Madame Sans-Gene" (real name Catherine Hubscher) made good entertainment, though it was presented without conviction or historic colouring. The "effects," Marseillaise sung *not* by revolutionary mobs, firing, "down with the aristocrats," etc., can be discounted as they are the standard background to all French Revolutionary stories. Miriam Karlin played the laundress Katherine, who marries Sgt. Lefebre and who, when that unworthy is ennobled, becomes Duchess of Dantzig and twists the easily twistable Napoleon round her little finger, with some charm and a realisation of the character. But Noel Johnson, as Napoleon, was never for one moment either a Corsican by birth or an Emperor by usurpation, though we were grateful that he didn't play the part in pidgin-English. The remainder of the cast were: R. Hurdnall, R. Delgado, T. Martin, Kathleen Helme, Violet Loxley, Virginia Winter and M. Hayes. Translators, Norman Ginsbury and John Sand. Producer, Wilfred Grantham. But Corno di Basetto's description of the play, sixty-odd years ago, as "Sardooledum" is definitive.

The Egoist

On the other hand, Jean Morris's adaptation of Meredith's beautiful novel, "The Egoist," was much more satisfactory. To start with, of course, the Englishman was a much greater writer than the Frenchman. The acting made the story and the characters sound a bit too much like Sunday evening Trollope, but it was very enjoyable, none the less. Cast: Lydia Sherwood, Peggy Thorpe-Bates, Hestor Paton Brown, P. Wyngarde, Hilary Mason, Clare Austin, C. Hobbs, F. Windsor, W. Fox, R. Willett and T. Martin. Producer, Mary Hope Allen.

Birds in Britain

Birds in Britain, edited and introduced by James Fisher, is a delightful programme, taking us back to the charm and fascination of the things that matter and which are all around us if we take the trouble to look for them. The last one I heard was of the birds of St. Kilda. Mr. Fisher is an expert at such things, nor must we forget the producer, Winwood Reade.

Alistair Cooke

Alistair Cooke, on gramophone records, "played, sung, whistled and talked about some of the music that has given him pleasure"—albeit lowbrow—in a charming quarter of an hour.

Third Listening

Mary Hope Allen's adaptation of Henry James's novel, "The American," made stimulating and entertaining "third" listening. David Knight, Rachel Gurney, Gladys Young, Roger Delgado and Kathleen Helme headed a long cast. But oh! those American accents!

Famous Trial

"The Trial of Madeleine Smith" was a dramatisation of a famous trial for murder exactly one hundred years ago. Consisting almost entirely of three characters, the prosecution, the defence and the narrator, it lacked dramatic variety in consequence. Three other members in the cast, including the accused girl herself, were very minor. The story of the trial, concluding with Madeleine's acquittal, was exciting enough. It was instructive to note the omissions in the defence the instant the prosecution seized upon them. Cast: Bill Crichton, Ian Stewart, James McKechnie, Claire Isbister, Helena Gloag and Edith Macarthur. Play by John Gough.

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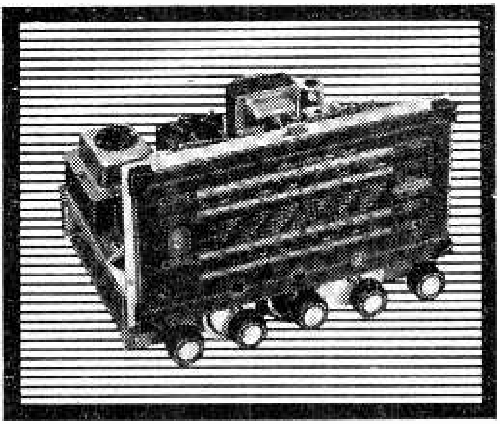

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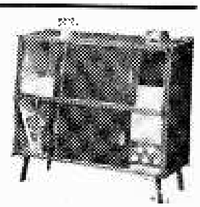

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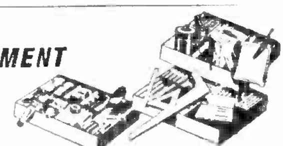

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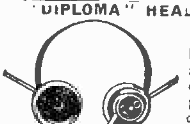

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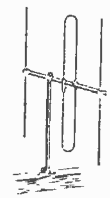

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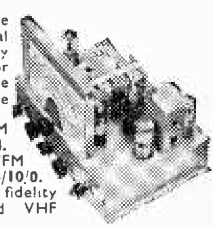

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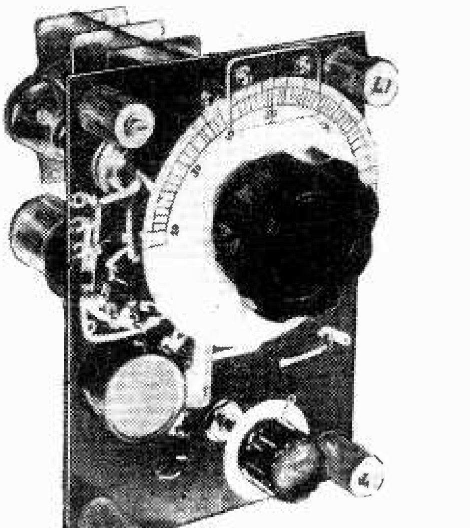

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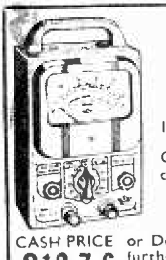

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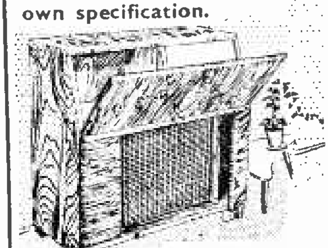

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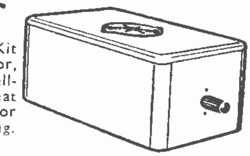

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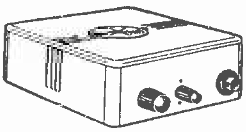

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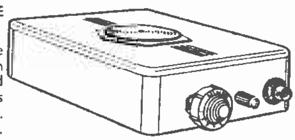

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AMATEUR WIRELESS AND WIRELESS MAGAZINE

STRAIGHT SETS

Battery Operated

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Mains Operated

Two-valve : 2/6 each
Consoelectric Two (D, Pen), A.C. AW403

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.

No of Blueprint

SHORT-WAVE SETS

Battery Operated

One-valve : 2/6 each
S.W. One-valver for American AW429*

Two-valve : 2/6 each
Ultra-short Battery Two (SG, det Pen) WM402*

Four-valve ; 3/6 each
A.W. Short Wave World-beater (HF Pen, D, RC, Trans) AW436*
Standard Four-valver Short-waver (SG, D, LF, P) WM383*

Mains Operated

Four-valve : 3/6
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) WM391*

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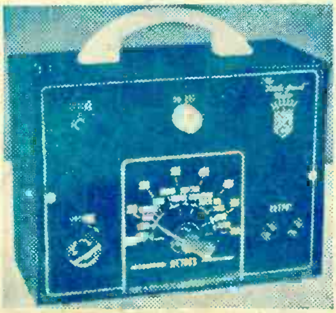

47/6

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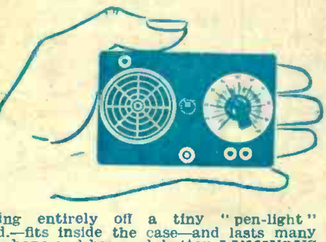

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