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MAY 1955

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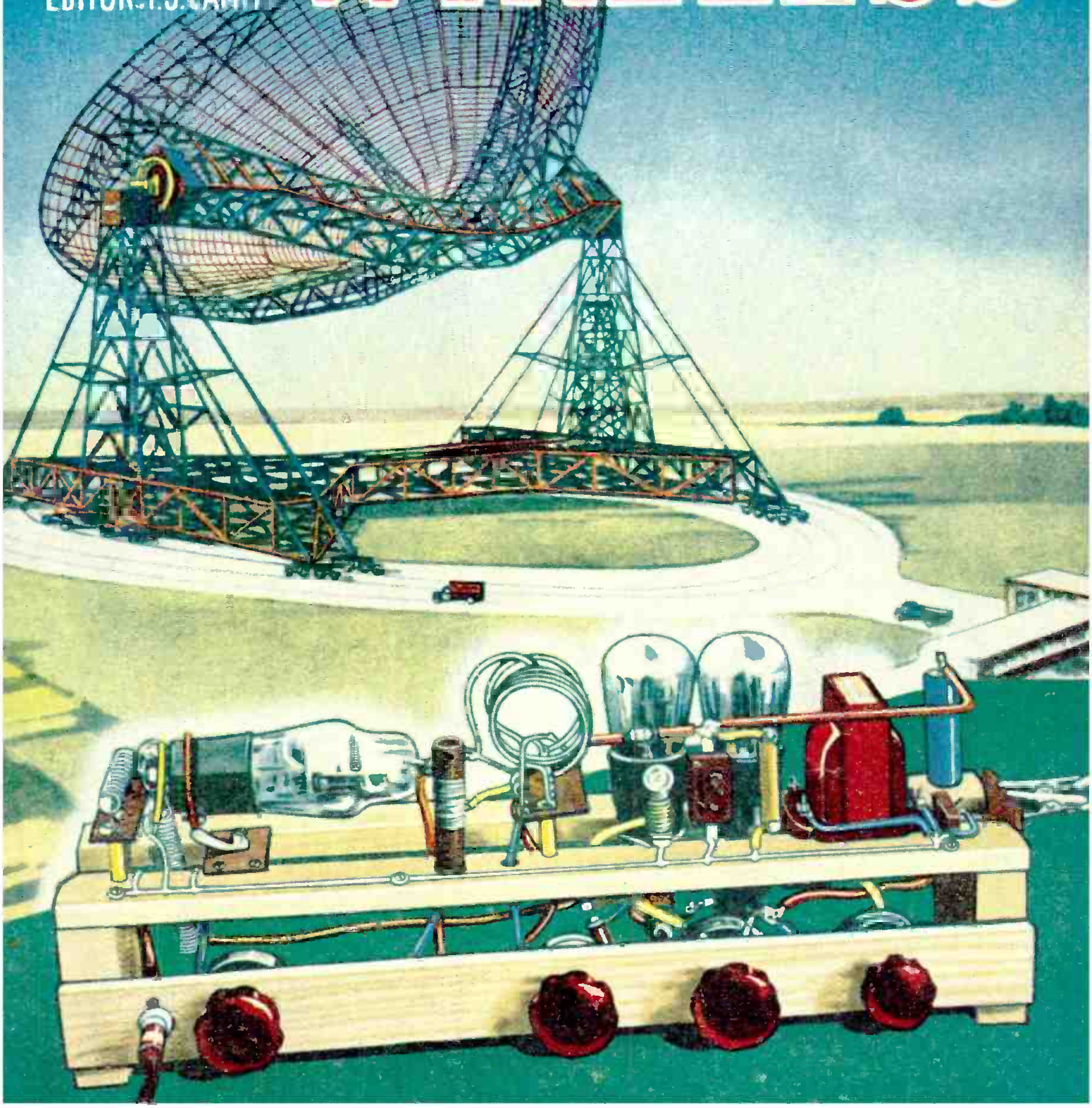

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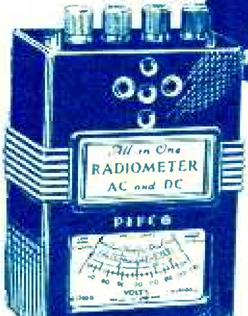

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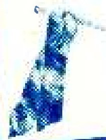

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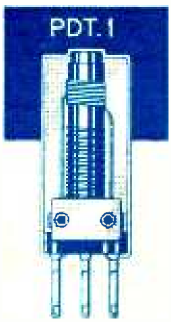

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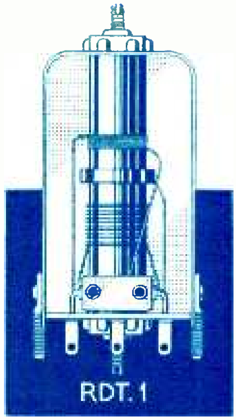

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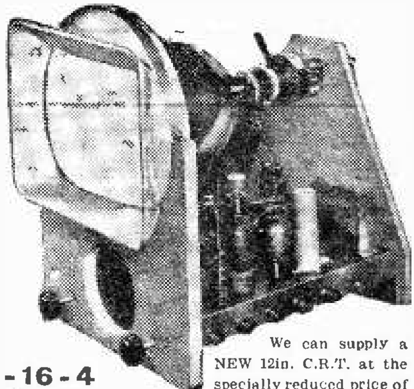

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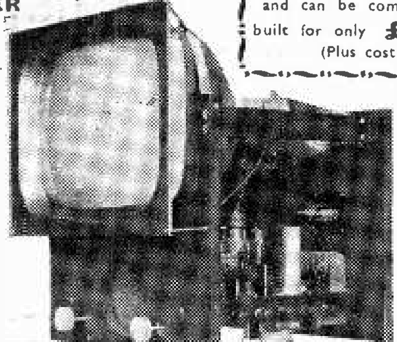

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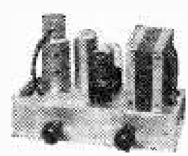

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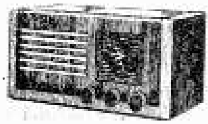

Latest type Superhet Circuit using 4 valves and metal rectifiers for operation on 200/250 volts A.C. mains. Waveband coverage — short 16-50 metres, medium 180-550 metres, and long 900-2,000 metres. Valve line-up 6K8 freq. changer; 6K7 IF, 6Q7 Detector AVC and first AF, 6V6 output. The attractive cabinet to house the Receiver size 12in. long, 6½in. high, 5½in. deep can be supplied in either WALNUT or IVORY BAKELITE or WOOD.

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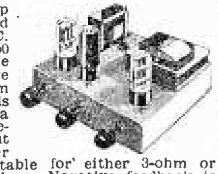

Valve line-up 6SL7, 6V6 and 6X5. FOR A.C. MAINS 200/250 VOLTS. The output Valve is of the beam type and feeds 4 watts into a specially designed output Transformer which is suitable for either 3-ohm or 15-ohm Speakers. Negative feedback is applied from the secondary of the output Transformer over the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

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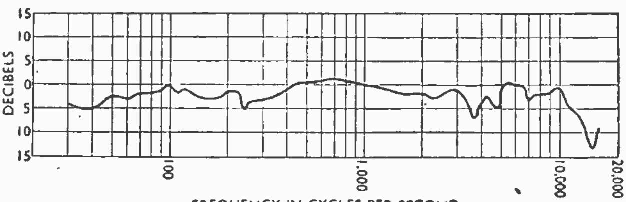

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AMMETERS Moving Coil (EX-GOVT.) G.E.C. 0-5 amps, 2in. scale, **11/9**.

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 40, 50, 100, 120, 150, 200, 230, 300, 400, 500, 1,000 (.001 mfd.), 2,000 pfd. (.002 mfd.), **6d.** each; **3/9** doz. One type.

MIDGET MAINS TRANSFORMER. Manufacturer's Surplus. Primary 220/240 v. Secs. 220-0-220 v. 60 mA., 6.3 v. 2 a. Only **11/9**.

VOLUME CONTROLS with long (¼in. diam.) spindles, all valves less switch, **2/9**; with S.P. switch, **3/9**; with D.P. switch, **4/6**.

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

EX-GOVT. SMOOTHING CHOKES.
250 mA, 10 H 50 ohms **14/9**
250 mA, 10 H 100 ohms **14/9**
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150 mA, 6-10 H 150 ohms Trop. ... **6/9**
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50 mA, 5-10 H 200 ohms... ... ... **2/9**
L.T. type 1 amp. 2 ohms **2/9**

EX-GOVT. METAL BLOCK (PAPER) CONDENSERS
4 mfd. 500 v., **2/9**; 4 mfd. 1,500 v., **4/9**; 4 mfd. 2,000 v., **7/9**; 6-6 mfd. 400 v., **5/11**; 8-8 mfd. 500 v., **6/11**; 4 mfd. 400 v., plus 2 mfd. 250 v., **1/11**; 8 mfd. 500 v., **5/9**; 15 mfd. 500 v., **6/9**.

EX-GOVT. E.H.T. SMOOTHERS
.02 mfd. 8,000 v. cans, **1/11**; .25 mfd. 4,000 v. Blocks, **4/9**; .5 mfd. 2,500 v. Blocks, **3/9**; .5 mfd. 3,500 v. cans, **3/3**; 1.5 mfd. 4,000 v. Blocks, **5/9**; .1 mfd., plus .1 mfd. large Blocks, 8,000 v., **9/6**.

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

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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 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape Deck preamplifier. For A.C. mains input of 200-230-250 v. 50 c/cs. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate), with green crackle finish, and point-to-point wiring diagrams and instructions. Exceptional value at only £4/15/-, or assembled ready for use 30/- extra, plus 3/6 carr.

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RF26 UNITS BRAND NEW, CARTONED. Only **39/6**. Carr. 2/6.

EX-GOVT. VALVES (NEW)

	Each		Each		Each
IT4	7/9	6SN7GT	9/9	AC5PenDD	9/9
IR5	7/9	6V6G	8/9	EF36	5/9
IS5	7/9	6V6GT	7/9	EB91	8/9
3S4	7/9	6X5GT	8/9	EF91	7/9
5Y3G	9/6	8D2	2/11	EL33	9/6
5U4G	10/6	807	7/11	MS/Pen	5/9
5Z4G	9/6	12A6	7/9	SP4	5/9
6F6G	7/9	12K7GT	10/6	SP41	1/11
6K7G	5/11	15D2	4/9	SP61	2/9
6K8G	9/9	25Z4G	9/6	VU120	2/11
6SK7Met	7/9	35Z4GT	10/6		
		EBC33	7/9		

SPECIAL OFFER. Ex-Equip. Goodmans 3½in. P.M. Speaker with Battery pentode output trans., **12/9**.

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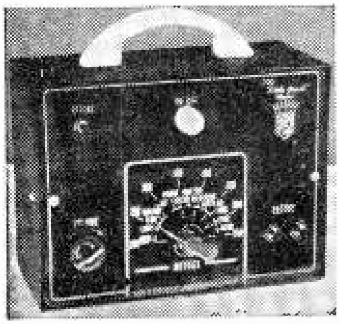

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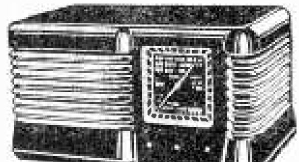
Build this exceptionally sensitive twin-triode radio. Uses unique assembly system and can be built by anyone without any radio knowledge whatever in 45 minutes. Handsome black-crackle steel case with specially made black and gold dial with stations printed. Size of radio only 6½in. x 5in. x 3in. Covers all medium and long waves, uses one only all-dry battery which lasts many months as H.T. Consumption is only 1 to 1.5 m.a. Ideal for bedroom, garden, holidays, etc. **Complete Kit only 49/6. Post Free** (sent by return with full set of clear, easy-to-follow plans). **All parts sold separately.**

MAINS VERSION WITH SPEAKER 89/6 Post Free.

A.C. Mains only. Twin-triode mains version with speaker, completely hum-free, with exceptional tone, optional negative feedback. Very low consumption. **Complete kit with speaker, etc., 89/6 Post Free** (with full set of clear, easy-to-follow plans). **All parts sold separately. READ THESE TESTIMONIALS.—Mr. Carter, of Worcester, writes:** *"Just a few lines to let you know how pleased I am with the midget portable radio. I was surprised at the number of stations I could get with a clear performance. The price was a real bargain."* **Mr. Norton, of Oxted, writes:** *"Yesterday evening on the medium waveband, I counted 32 separate stations: I am very pleased with the set, which is well worth the money."*

CAN BE BUILT FOR ONLY 97/6



AMAZING VALUE . . . ! Complete kit of 3 valves, plus metal rectifier, A.C. Mains set, only 97/6. **Terrific new circuit,** with optional negative feedback circuit giving beautiful tone. Covers all Medium and Long Waves. Ready to use chassis (Punched, etc.). Every component tested before packing. Cabinet size 12in. x 6in. x 5in. For A.C. Mains 200/250 Volts. **Complete kit with valves, speaker, cabinet, etc., only 97/6,** plus 2/6 Post and Packing. (Sent with full set of clear, easy-to-follow plans.) **All parts, cabinet, speaker, etc., sold separately.**

READ THIS TESTIMONIAL.—Mr. Beckwith, of London, W.3 writes: *"Thank you for the radio which I received safely. I must say that I was rather surprised and very pleased indeed with the performance. I do not think there is anything on the market to beat it! the tone is perfect, reception very clear, and the stations just roll in. Up to now I have received about 20 stations and all very clear. I may add that I think for the modest price charged I am more than satisfied."*

GOOD QUALITY AMPLIFIER 85/-

A.C. Mains, amplifier with optional negative feedback. **Complete Kit, 85/- Post Free.** With tone control. Beam tetrode output, 3/4 watts. Excellent frequency response. For A.C. Mains, 200/250 volts. Complete Kit, 85/- Post Free. (Sent with full set of clear, easy-to-follow plans.) **All parts sold separately.**

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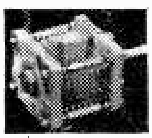
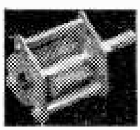
BARGAINS!!! THE BEST COMPONENT "BUY" POSSIBLE



CERAMIC VARIABLE CONDENSERS, split stator, plated vanes, spaced .035 ball bearings butterfly 15/15 P.F. extended spindle each **2/6**



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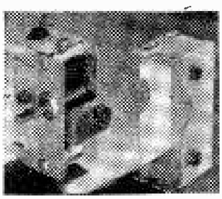

50 pF VARIABLE CONDENSERS in Screening Case. 3¼in. x 1¾in. x 2¼in. Spacing 040. Only each **1/-**

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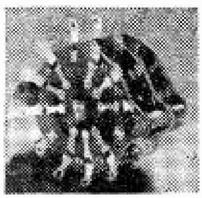

WAVE CHANGE 2-wafer, 6-pole, 3-way Switches. each **1/3**

Standard ¼in. Spindles

BRAND NEW POTS

POTS 100K, ¼ spindle...........each **1/-**

POTS, 1 meg., ¼ spindle......each **1/-**

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HUMDINGER POTS, 100 ohm. Miniature wire wound.........each **2/-**

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BAKELITE SQUARES, polished, 4in. x 4in. x ⅛in. .... each **6d.**

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ERIE RESISTORS, 47K, 2-watt. **ERIE RESISTORS,** 1,200 ohm, ½ watt, 2 watt 150K 1 watt 22K 1 watt, 70K 1 watt; price 2 watt, **3d.**; 1 watt, **2d.**; ½ watt, **1d.**

PAXOLIN RESISTOR PANELS, with fixing brackets. Size 4in. x 3in., contains 1-10w. 5K 2-5w. 120K 1-47K 1-56K, 5w. Brand new ....each **1/9**

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SLEEVING, various colours, 1 mm. and 1.5 mm. Permanoid, Peribraid—in coils of 144 yards..............per coil **8/6**

VALVEHOLDERS, B9G, Paxolin doz. **4/-**

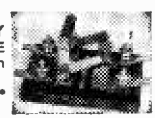
VALVEHOLDERS, UX5. Amphenol..................................doz. **5/-**

STAND-OFF INSULATORS, miniature, 1 inch .... only doz. **2/-**

FERRANTI M. AMP. METERS, 0-150 flush square, 2in.............each **7/6**

FERRANTI M. AMP. METERS, 0-5 mA, square, 2in................each **9/-**

30-AMP. ONE-WAY DOUBLE POLE Charging Switches on ½in. Ebonite Base, ex Admiralty...... **9d.**



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This Rectangular Wide Deflection Teletube with Aluminized Screen and external Conductive Coating, operates at 16 kV. It is fitted with an improved tetrode gun assembly giving excellent overall focus and minimum astigmatism.

Brimar have developed powerful valves suitable for use with existing or future types with larger screen areas

6CD6G/50CD6G (AC/DC)—Line Output Valves with a peak current of ½ amp. and plenty of power in hand for wide angle scanning.

6U4GT—Efficiency Diode—The high working peak heater to cathode potential renders a separate highly insulated heater supply unnecessary.

R19—E.H.T. Rectifier—A replacement for the American 1X2A but with higher Ratings.

RM5—H.T. Rectifier—A worthy successor to the RM4, with a rating of 300 mA. This rectifier has a reserve of power and should be used initially in equipment so that additional valves may be added if required without redesigning the power supply stages.

Valves for the BAND III CONVERTOR
(for 6 volt operation).

***ECC84**—Consists of two separate high slope triode units designed for use as a V.H.F. cascode amplifier.

***ECF82**—is a triode pentode frequency changer featuring a high slope triode and a high slope pentode with a high input impedance.

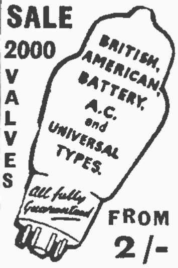
6BW7—The 6BW7 is recommended in areas where extra sensitivity is required. It has a slope of 9.3 mA/V with anode and screen voltages of 180v.

** The PCC84 and PCF82 are .3amp equivalents of these types and are suitable for equipments where series connected valves are used.*

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

Great Britain's Valve Mail-Order House

SALE 2000 VALVES



FROM 2/-

1B4	9/6	6BH6	11/-	6X4	10/-	75	9/6				
1C6	9/6	6BJ6	11/-	6X5	8/6	76	8/6				
1G4	8/6	6BW6	10/6	7A7	10/6	77	10/6				
1LN5	6/6	6C4	8/6	7B7	11/6	78	10/6				
1LA4	9/6	6C5	9/-	7C5	10/-	41	10/6				
1P5	9/6	6C8	11/-	7C6	10/6	42	10/6				
1R4	9/6	6D6	9/-	7H7	10/-	45	10/6				
1R5	10/-	6F6	10/-	7N7	10/6	46	10/6				
1S4	10/-	6F7	9/-	7Q7	11/-	50L6	11/-				
1S5	10/-	6F8	11/-	7R7	11/-	53KU	12/6				
1T4	10/-	6G6	9/-	7S7	12/6	57	9/6				
1T5	10/6	6G3	9/6	7V7	10/-	58	10/-				
1U5	10/-	6H6	5/-	7Y4	10/-	19	10/-				
1V	8/-	6J5	7/6	8A1	11/6	32	8/6				
2A6	9/6	6J6	12/-	8D2	11/6	33	9/6				
2A7	11/-	6J7	8/6	9D2	6/6	35	9/6				
2X2	6/6	6K6	10/6	12AL5	8/-	35L6	10/6				
3D6	9/-	6K7	8/6	12AT7	10/6	35Z4	11/-	9006	7/6	50Y6	8/-
3S4	10/-	6K7/M	9/6	12H6	6/6	35Z5	12/6	0Z4	6/-	71A	2/-
5U4	10/6	6K8	11/6	12J5	8/-	37	9/-	01A	3/-	884	21/-
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5Z3	11/-	6L6	11/6	12SH7	8/6	84,6Z4	9/6	1LN5	6/6	955	4/-
5Z4	10/6	6N7	11/-	12SJ7	9/6	117Z6	8/8	2A6	2/-	957	10/-
6A6	9/-	6Q7	12/6	12J7	11/6	117N7	17/-	2A7	3/-	117Z6	7/-
6A8	12/6	6R7	7/9	12K7	11/6	210Lf	6/6	6A7	11/-	1299A	7/-
6AB7	2/-	6R7/M	7/9	12SK7	10/-	805	30/-	6AG7	19/-	1625	9/6
6AC5	9/-	6SA7	9/6	12SL7	12/-	807	9/6	6AK7	19/-	DD207	4/-
6AC7	8/6	6SG7	9/6	12SQ7	10/-	866A	9/6	6AK6	9/6	EF6	17/6
6AG5	9/6	6SH7	8/-	12SR7	9/-	954	5/6	6E5	11/-	HL1320	5/-
6AL5	9/6	6SJ7	9/6	12Y4	9/6	955	6/6	6F32	6/-	MSPen	5/-
6AK6	9/6	6SK7	9/6	12AX7	9/6	956	6/6	6SF5	14/-	OM4	5/-
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6BE6	8/9	6W5	11/-	73	10/6	Post 9d.		48	4/-	VP23	3/-

Continued here w. British Types next month !!! Post 9d

DEMOBBED VALVES MANUAL 2/6

Giving equivalents of British and American Service and Cross Reference of Commercial Types with an Appendix of **B.V.A. Equivalents** and Comprehensive Price List. We have still some Valves left at very old Budget Rates (33⅓%) which are actually sold at the old price. (1951 rate.)

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

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

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

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5T4	12/10	14A7/12B7	15/-
6A3	9/-		
6X4	10/-	14B3	10/-
7B8	10/-	24	17/6
7C7	9/-	39/44	10/-
7V7	10/-	46	10/6
10D1	5/-	58	10/-
11D5	11/7	84/6Z4	9/6
12SC7	9/-	866A	5/-
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PIFCO

All - in - one Radio - meter A.C./D.C. Tests everything in Radio. Complete with Test prods.
29/6.
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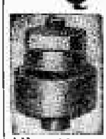
Q-MAX



Chassis Cutters with Keys

The easiest and quickest way of cutting holes in sheet metal. The cutter consists of three parts: A die, a punch and an Allen screw. The operation is quite simple. Prices incl. key: ⅜in., 12/4; ⅝in., 12/4; ¾in., 13/4; 1in., 1⅛in. and 1¼in., 16/- each; 1⅜in. and 1½in., 18/- each; 1¾in., 19/9; 2 3/32 in., 31/9; 2½in., 36/9; 1in. square, 24/3. Post 1/-.

7/6 **REDUCED FROM 21/-** **7/6**

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

EX-GOVT. LIGHTWEIGHT HEADPHONES

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

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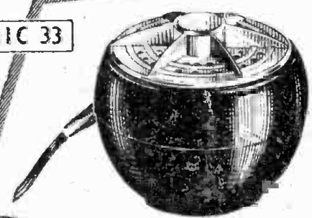
at reasonable prices

For tape and disc recording, P.A. and amateur radio.

MIC 33

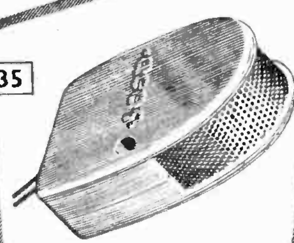


A crystal hand or desk omni-directional microphone for the high quality public address and tape recording field, incorporating a specially designed acoustic filter giving a response flat from 30 to 7,000 c/s.
RETAIL PRICE £2 - 10 - od.

MIC 36

A handsome omni-directional instrument of high sensitivity and a substantially flat response from 30 to 7,000 c/s. Alternative models, with or without switch, are available with suitable adaptors for floor or table stands or for hand use.
RETAIL PRICE: £3-3-od. without switch or £3-8-o with switch.

MIC 35



A general purpose hand microphone of robust construction with substantially flat response from 50 to 5,000 c/s. Suitable for recording apparatus. Public Address equipment etc.
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PRACTICAL WIRELESS

EVERY MONTH
VOL. XXX1, No. 583, MAY, 1955

EDITOR : F. J. CAMM

23rd YEAR OF ISSUE

COMMENTS OF THE MONTH BY THE EDITOR

Interference: Compulsory Suppression

TWO new sets of regulations relating to electrical interference on radio and television will come into force on September 1st this year. They give the Postmaster-General power to control interference of radio and television caused by refrigerators, domestic and industrial appliances which are driven by small electric motors, such as vacuum cleaners, hair driers and drills. These are the common sources of interference with radio and with television.

The regulations lay down the requirements which must be complied with by manufacturers, assemblers and importers of all electrical refrigerators, and by users of new and old electric motors. It should be explained, however, that the introduction of electric motor regulations does not mean that everyone using a vacuum cleaner, hair drier or other domestic electric apparatus will have to fit a suppressor at once. The Postmaster-General states that "only a proportion of these appliances cause interference," and he hopes that in such cases the owners of the appliances will co-operate by having the trouble put right when it is pointed out to them by the Post Office. The new powers will be used only where it is necessary for the Post Office to insist on an appliance being put right because it causes interference and the owner will not voluntarily have a suppressor fitted.

The Postmaster-General hopes that there will be a progressive extension of the current practice of certain manufacturers who produce appliances incorporating suppressors or who provide for an easy addition of a suppressor if it proves necessary. The question of making the regulations for small motors apply to manufacturers is to be reviewed during the next two years.

The standards laid down in the regulations, that is the limits of interference and the frequency ranges over which they are to apply, have necessarily been based on data derived from existing sound and television broadcasting services, for which they are designed to give adequate protection in areas of moderate field-strength, provided the receiving installation, which includes the aerial system, is satisfactory. The standards are also expected to give adequate protection to the proposed frequency-modulated V.H.F. sound broadcasting service in Band 2 (87.5 to 100 Mc/s) and to go some way towards eliminating interference in the higher range of frequencies (Band 3) to be used for the new I.T.A. television service.

Attention is drawn to the importance of earthing in accordance with the regulations laid down by the I.E.E. for the electrical equipment of buildings. For many appliances where earthed metal work is present, exposed metal work should be earthed, and earthing is even more important when interference suppressors are fitted to an appliance, the only exceptions being all-insulated, double-insulated appliances and those used in earth-free situations.

RADIO SALES

ACCORDING to Brema Retail Market Survey, sales of radio receivers and radiograms were consistently higher in 1954 than in 1953, and for the December quarter for 1954 were the highest recorded since the war. In January of this year, 122,000 radio receivers and radiograms were sold. Whether the new hire purchase restrictions will cause a recession in trade will not be known until the next Brema Report. The Chancellor, in re-introducing the hire-purchase restrictions, blamed hire-purchase, particularly of wireless and television sets, for the present inflationary trend. The fact is that the total volume of hire-purchase business is relatively so small a part of our expenditure on goods within the country that it cannot possibly have the result or the effect attributed to it by the Chancellor.

"BEGINNER'S GUIDE TO RADIO"

EVER since this series commenced in May, 1953, until its termination with issue dated March, 1955, there has been a constant demand for the twenty-three issues containing the series. All back issues have now been absorbed, but readers will be pleased to know that in view of the heavy demand it has been decided to reprint the series in book form. It will, of course, be some months before the book is ready, and an announcement will be made herein when it is published.—F. J. C.

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Round the World of Wireless

By "QUESTOR"

V.H.F. Wavelength

THE BBC anticipates that by December the North-East of England will have its own V.H.F. wavelength and Home, Light and Third programmes.

Sound Children's Hour Goes to Sea

THE aircraft carrier H.M.S. *Bulwark*, at sea in the Channel, will be the setting for a "live" broadcast in Children's Hour on May 26th. A team of BBC commentators and engineers with John Lane, the producer of the programme, will join the ship for an exercise during which listeners will hear commentaries from on board and from aircraft that have been flown off. The broadcast has been arranged with the full co-operation of the Admiralty.

Laundry by Radio-telephone

HIDDEN in a maze of side streets on the fringe of Shepherd's Bush is the first special laundry service in this country to use radio. Wigmore Laundries, Ltd., the pioneers of this new idea, have installed Pye radio-telephones in two of their vans and a car.

From the moment the vehicles leave the depot each morning they are in constant touch with the head office, from which orders are frequently sent diverting them to other places as fresh requests are received from customers wanting immediate attention.

First Stage Finished

ON Saturday, February 12th, Sir Charles Westlake, chairman of the Uganda Electricity Board, and members of the board's staff visited the site of work near Jinja to see the final stages in the construction of the 132,000-volt transmission lines which have been built to carry power from Owen Falls to Kampala and Tororo.

The lines have a route length of 114 miles and are the first stage in the development of a grid transmission system for Uganda, and maybe for the whole of East Africa.

Broadcast Receiving Licences

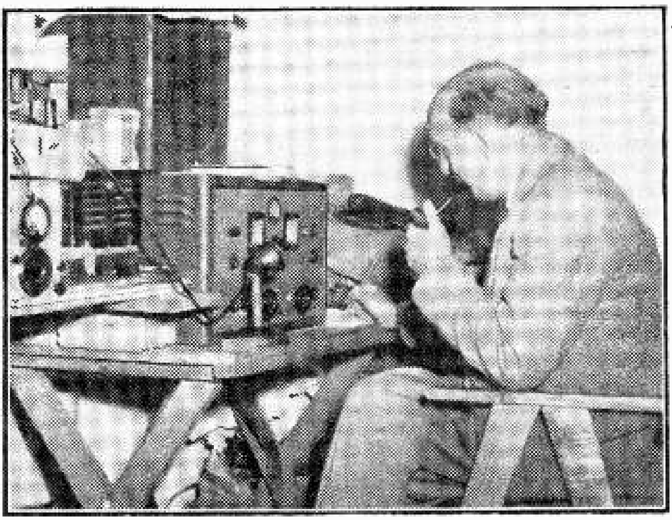
THE following statement shows the approximate number of broadcast receiving licences issued during the year ended January, 1955. The grand total of sound and television licences was 13,903,950.

Region	*Number*
London Postal ...	1,480,941
Home Counties ...	1,428,047
Midland	1,164,308
North Eastern ...	1,536,153
North Western ...	1,185,041
South Western ...	956,631
Wales and Border Counties	597,879
Total England and Wales	8,349,000
Scotland	1,028,157
Northern Ireland ...	219,021
Grand Total	9,596,178

Mr. W. R. Fletcher, B.Sc.

MR. W. R. FLETCHER, B.Sc. (Eng.), A.M.I.E.E., has been appointed Engineer-in-Charge at the Brookmans Park transmitting station.

Mr. Fletcher joined the BBC in 1936 as an assistant maintenance engineer at the Lisnagarvey (Northern Ireland) transmitting station. He has served at a number of the Corporation's transmitting stations, and in 1944 became a senior maintenance engineer at the BBC's overseas transmitting station at Rampisham, Dorset.



Mr. Clyde Hickin, a radio amateur, monitors flood calls by short-wave radio at his home in Sydney. (See "'Hams' Keep Lines Open.")

"Hams" Keep Lines Open

INVALUABLE service was given in the flooded areas of New South Wales by amateur radio operators who kept communications open over hundreds of square miles. "Hams" throughout New South Wales and Queensland—some of them transmitted from Army ducks and other vehicles—relayed messages to officials from the districts in distress, maintaining constant contact.

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Cambridge Photographer Uses Radio-telephone

A WELL-KNOWN Cambridge photographer, Mr. Nye, the proprietor of Messrs. Bruce, has recently installed his car with Pye radio-telephone.

Mr. Nye can thus help his staff with any technical problems that may arise while he is out and so eliminate possible hold-ups. Savings in time and petrol are considerable.

Light Programme Controller

MR. H. ROONEY PELLETIER succeeded Mr. Kenneth Adam, who has resigned, as Controller of the BBC Light Programme from April 4th.

Mr. Adam has been Controller of the Light Programme since December, 1950.

Obituary

MR. C. P. LOCKTON, M.Sc. We learn with deep regret of the death of C. P. Lockton, M.Sc.(Tech.), chief engineer of Chloride Batteries, Ltd., on Sunday, February 20th.

Born in 1903, Cedric Philip Lockton was educated at Berkhamsted School, Herts, and at the Manchester College of Technology, where he studied electrical engineering under Professor Miles Walker. In September, 1924, he was engaged by the Chloride Electrical Storage Co., Ltd., as assistant to the chief engineer. In October, 1949, he was appointed chief engineer to the company, which shortly afterwards changed its name to the present one, and held this position at the time of his death.

DONALD MACADIE, M.B.E. We regret to announce the death of Donald Macadie, M.B.E., the inventor of the AvoMeter.

Mr. D. Macadie.

He was born in the county of Caithness in 1871, came to London at an early age and joined the Edison-Bell Phonograph Company, later transferring to the National Telephone Company with whom he worked as an engineer in Liverpool and Nottingham. In 1932 the M.B.E. was conferred upon him and he retired from the Post Office in the following year at the age of 62.

Equipment for Atomic Plant

THE Marconi Wireless Telegraph Co., Ltd., are to supply an industrial television equipment to the United Kingdom Atomic Energy Authority. This will be used at the Windscale plutonium factory at Sellafield, Cumberland.

Licences for Models Controlled by Radio

SOME changes have been made in the licence issued by the Postmaster-General to control models by radio.

In future persons licensed to operate radio-controlled models will be only required to check the frequency of the transmitter as often as may be necessary to ensure that the sets operate only within the authorised radio frequency bands. In addition, the controlling apparatus may be operated by anyone, provided it is done under the personal supervision of the licensee.

Installation for the "Southern Cross"

THE fitting of a wide range of radio communication equipment and electronic aids to navigation on board the new 20,000-ton Shaw Savill passenger liner *Southern Cross* has been completed by members of the technical staff of the Marconi International Marine Communication Co., Ltd., at Belfast. The *Southern Cross* was launched by Her Majesty the Queen in August last at the yard of Harland and Wolff, Ltd.

Mr. Nye replies to a query from his office by radio-telephone. (See "Cambridge Photographer Uses Radio-telephone.")

Radio Economy

BBC Director-General Sir Ian Jacob has ordered a "cut down" in sound radio programmes due to the increasing popularity of television and the approach of an alternative TV programme in the autumn.

The single television programme is believed to have a larger audience than the Home, Light and Third programmes combined.

Pye/Polygon Agreement

PYE, LTD., announce that they have formed an association with the Polygon Record Co.

Mr. Alan Freeman will be conducting the business of the Polygon Record Co. (1954) Ltd. from 66, Haymarket, London, S.W.1. This is also the address of the Nixa Record Co., Ltd.

Children's Requests

MORE than 54,600 requests were received by the BBC in connection with the Sound Children's Hour Request Week.

Gramophone Programmes Assistant

MR. DOUGLAS LAWRENCE has been appointed Assistant Head of Gramophone Programmes, succeeding Mr. Thurstan Holland, who became Second Assistant to the Light Programme on November 17th, 1954.

"Perfect" Reception

THE new Frequency Modulation radio receivers, which are claimed to bring "perfect" reception to the listener, are expected to appear on the market soon and will cost about 25 guineas each.

Dealers in London and South-East England will be the first to receive them.

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Radio Controlled Models

DETAILS OF SOME CRYSTAL STABILISED CONTROL TRANSMITTERS

By F. G. Rayer

THE output of a self-excited transmitter with a given number of valves is greater than that of a crystal-controlled transmitter with the same number of stages, but the latter has the advantage of maintaining frequency accurately. This can be a very important factor with home-built equipment. The tunable, self-excited type of transmitter will continue to operate even if set outside the permitted model control band. The constructor of such a transmitter therefore requires a frequency-meter or other means of checking frequency, so that the transmitter may be suitably adjusted. With crystal-controlled equipment, this is not so, as the transmitter will not operate upon frequencies other than that for which it is designed. The most popular model control band is from 26.96 to 27.28 Mc/s, and tunable equipment may easily operate outside this band, possibly without the user's knowledge. Stray capacities in wiring, and the influence of the aerial, may put a transmitter outside the permitted band. When this is so, harmonics may in some cases cause television interference over a wide area. With tunable transmitters, some accurate means of ascertaining frequency is therefore essential. If no such means be available, the transmitter may best employ a crystal for frequency stabilisation, since correct frequency operation may thereby be automatically assured.

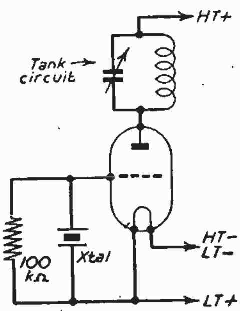

Fig. 1.—Simple crystal oscillator stage.

The simplest type of crystal oscillator is shown in Fig. 1, and is generally most satisfactory. Other circuits exist, some making use of regeneration to increase output. These, however, have the disadvantage that in some cases the stage can be made to oscillate upon frequencies other than those desired, and some of the advantages of crystal control are thus lost.

Since it is not feasible to produce very thin crystals, the crystal will be of lower frequency than the signal to be radiated, which may conveniently be 27 Mc/s (approximately 11.11 metres). This difficulty is overcome by having a crystal frequency which is a multiple of the frequency to be employed in the completed transmitter. For example, crystals with a frequency of 13.5 Mc/s, 9 Mc/s or 6.75 Mc/s would be suitable, as these figures may be multiplied to achieve 27 Mc/s. In the case of ex-service or other crystals which may be to hand, these can be used if multiplication gives a figure between 26.96 and 27.28 Mc/s. (Crystals of very low frequency are not very suitable, since additional stages would be required for multiplication.) If a crystal is to be purchased, one for 9 Mc/s is convenient.

In the interests of portability, battery-type valves are usually employed in model control transmitters. These have very low anode currents and gain, compared with mains valves, and it is, therefore, necessary to employ extra stages. For example, at least three valves will usually be required, though a higher output could be achieved with a single mains-type valve. The circuits given are not, therefore, suitable for use with mains equipment. For 2-volt operation, ordinary triodes, pentodes and power valves are satisfactory. For "all dry" equipment, B7G or octal valves can be used, those intended for output purposes being best in all stages.

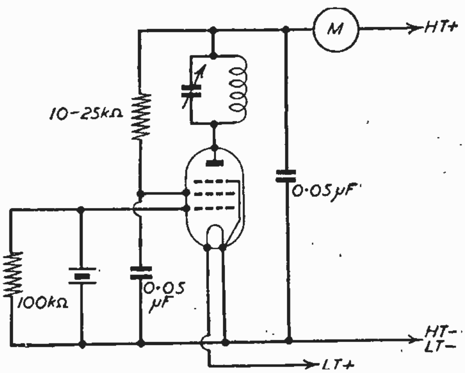

Fig. 2.—Circuit for pentode with meter included.

Tuning Adjustment

With the circuit in Fig. 1 no oscillation will be obtained until the tank circuit is tuned to the frequency of the crystal. A meter should be included in the H.T. circuit, and a fall in anode current will show that the valve has commenced to oscillate. The tank tuning condenser is thus adjusted until anode current is at minimum. For a 9 Mc/s crystal the tank coil may consist of 12 turns of 20 s.w.g. wire on a ribbed former 1½in. in diameter, the winding occupying 1½in. The condenser can be 100 pF. In

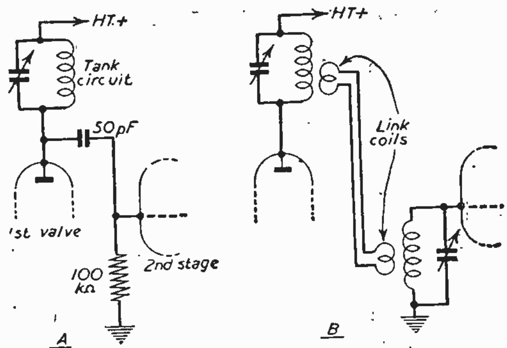

Fig. 3.—Two common types of coupling arrangement.

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the interests of efficiency, "miniature" coils are best avoided. The condenser capacity should also be small.

A pentode may also be used, as shown in Fig. 2. In each case the 100 k. resistor provides a D.C. grid path and enables bias to be generated. A slight increase in efficiency can be obtained by adding a short-wave H.F. choke in series, or by using two 50 k. resistors in series to reduce capacity.

Small detector or L.F. type valves can be used if the H.T. is at least 90 volts. If the crystal is of an active nature it is also possible to tune the tank circuit to a harmonic, to obtain some, or all, of the necessary frequency multiplication. But with low activity crystals, small valves, or low H.T. voltages, this cannot be done as the stage will not oscillate. If so, the necessary frequency multiplication must be achieved in later stages.

A single valve, using the circuits in Figs. 1 and 2, can be used to energise or excite a transmitter, or to act as a frequency standard by which a tunable transmitter may be adjusted.

Multiplication and Driver Stages

The crystal-controlled stage may be coupled to a subsequent stage by means of a condenser, as shown at "A" in Fig. 3. The value of the coupling condenser is not critical, but should not exceed 100 pF. A mica condenser is required. A choke may be added in the grid circuit as mentioned.

A second method of coupling is shown at "B" and is particularly convenient when the crystal-controlled stage is built as a small separate exciter unit for the transmitter.

In both cases the grid circuit will be operating at the same frequency as the tank or anode circuit of the first stage, which will usually be that of the crystal, for the reasons given.

To obtain frequency multiplication the anode circuit of the second stage is tuned to the required harmonic or multiple—e.g., 27 Mc/s. Though variable tuning will be employed to find resonance, this does not mean that the transmitter can operate off frequency. Conversely, as tuning is adjusted, the output will vary in power, but remain stable in frequency. The anode circuits of such stages are thus merely adjusted for maximum output, as shown by a field-strength meter or loop and bulb.

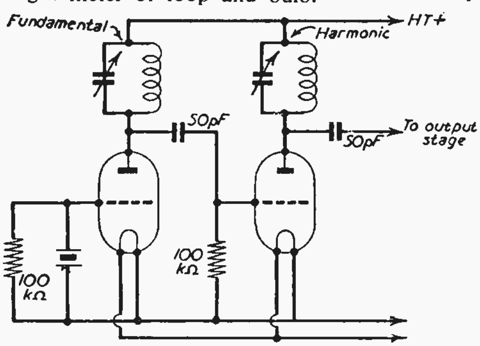

Fig. 5.—Oscillator and doubler circuit.

A number of push-pull or Class B battery valves exist, and can be used to keep the overall number of valves down. It is feasible to use such a valve as crystal-controlled oscillator and frequency multiplier, exactly as if two separate valves were present.

A further type of push-pull oscillator circuit is

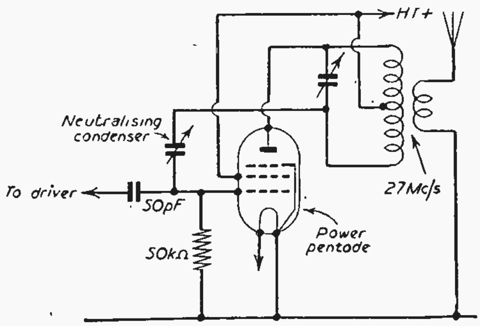

Fig. 6.—Neutralising the output stage.

given in Fig. 4, and can give a somewhat greater output than a single valve of conventional type. Such valves may also be used in output stages, to obtain a greater output to energise the aerial, when H.T. voltages are low.

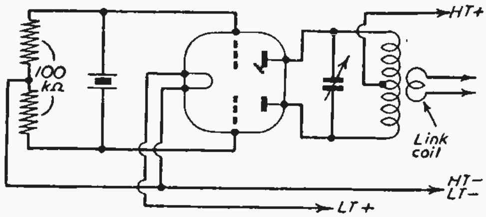

Fig. 4.—Push-pull oscillator circuit.

A complete oscillator and doubler or multiplier circuit is shown in Fig. 5. The anode circuit of the second valve will be tuned to a multiple, as explained. Here, a coil consisting of 10 turns of 20 s.w.g. wire, ¾in. in diameter and 1⅜in. long, tuned by a 75 pF condenser, may usually be employed for 27 Mc/s. Exact coil details will depend upon stray capacity in the circuit, valves, etc. If subsequent trial shows that the frequency tuned is too high, the number of turns may be increased. If, however, it is too low, a turn or so may require to be removed from the coil.

Self-supporting coils may often be employed, and should be of such inductance that resonance is obtained with only small values of parallel capacity. The reduction in output resulting from small, inefficient coils, or excessive tuning capacity, can easily be observed with a field-strength meter.

Output Stages

A small output stage is shown in Fig. 6 and can give about 1 watt anode dissipation. Triodes may be used, or valves in parallel or push-pull. Since both grid and anode circuits are tuned to, or operating upon, the same frequency (27 Mc/s), it is necessary to employ some form of neutralisation to avoid self-oscillation. This can be done as shown. The neutralising condenser is of very small value, and adjusted until any tendency to self-oscillation is removed. Its purpose is to cancel out self-capacity in the valve.

If a loop or meter shows that the transmitter will still radiate when the crystal-controlled valve is withdrawn from its holder, then back coupling is causing oscillation. Interference between the coils

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in different stages, or lack of correct neutralisation, may cause such oscillation. It should be eliminated by the appropriate measures, since it means that the transmitter can operate upon other than crystal-controlled frequency, exactly as can the simple, tuned type of transmitter.

The early stages of such a completed circuit are primarily concerned with frequency stabilisation and multiplication. For this reason it must be remembered that they will contribute little to the final output of the transmitter. For example, three valves used as shown in Figs. 5 and 6 would result in a transmitter having an output similar to that of a single valve of output type, in a self-excited circuit. The range of such a transmitter depends upon the aerial and receiver, and would be sufficient where no great range is required. In practical construction, all tuning condensers should be panel operated, and a meter should be included for measuring the anode current.

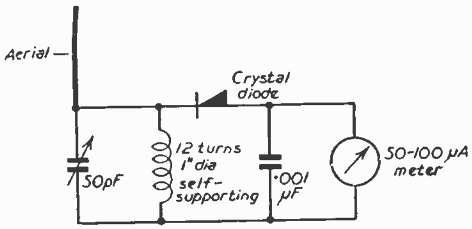


Fig. 7.—A simple field strength meter.

Optimum Adjustment

Final adjustment is best undertaken when the actual power radiated is measured, by means of a meter such as that in Fig. 7. In this way the effect of any adjustment can be seen at once, as can the improvement in signal strength resulting from the use of longer aerials, etc. The meter can, initially, be quite near the transmitter, and have a very short aerial—about 6in. to 12in. Afterwards, it may be removed to a greater distance, its readings being reported by a helper.

In adjusting equipment such as that described, the first tank circuit is tuned for minimum anode current. There will generally be no need to move the meter to the anode circuits of subsequent stages, to check tuning here, as a reading on the field strength meter should be readily obtainable. When this is so, the multiplier and aerial circuits are tuned for maximum output. Any change to the aerial will make re-tuning of this circuit necessary. Finally, all circuits should receive a very careful adjustment for maximum radiated output.

When the transmitter is correctly tuned, the receiver is tuned to it, for maximum response. Final adjustments should be at full range. For C.W. control, the H.T. circuit of the transmitter may be keyed or switched. If no helper is available to do this, one of the various ex-service clockwork switching devices may be used to avoid frequent return to the transmitter to switch on and off.

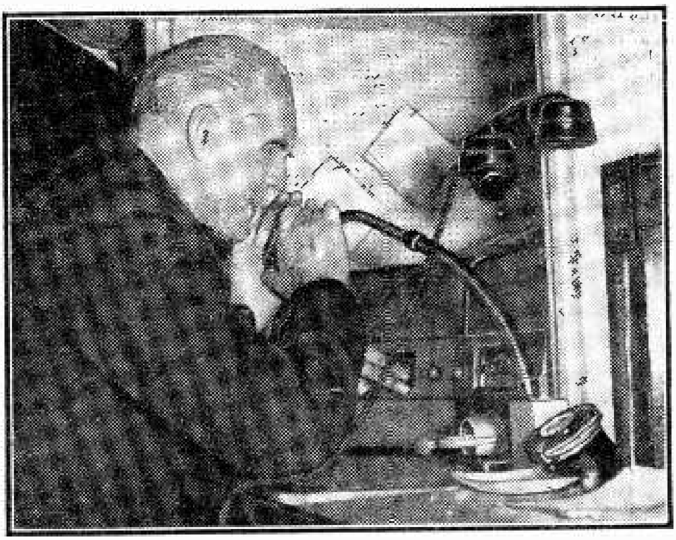
The field strength meter should at all times be carefully tuned for maximum response. It may subsequently be used as a frequency meter, if the condenser has a dial and pointer. If so used, a "standard" aerial must be fitted, such as provided by a rod 12in. long. Any change in aerial length, or in the coil or wiring, would upset calibration. The meter should not be near a super-regenerative receiver, or a reading may be obtained from the latter, thereby confusing results.

Radio-controlled Taxis

THE use of Radio is increasing in the industrial field and already many districts have their own radio control installations for public transport services. This avoids much petrol waste by enabling the control centre to direct a driver to a new fare point, and also enables speedy repairs to be effected as the drivers are in constant touch with their headquarters. An ex-Service venture recently introduced a fleet of taxi-cabs in the London area, and these have been provided with a radio control link. All the drivers, numbering over 150, are ex-Service men, are owners of their cabs, and each is a shareholder in the parent company. The control centre is equipped with two stand-by transmitters and can handle 3,000 calls a day.

Inauguration

To inaugurate the service, Sir Ian Fraser, O.B.E., the well-known blind M.P. and President of the British Legion, officially opened the control centre, and spoke a goodwill message over one of the microphones to all the drivers who were patrolling throughout London.



Sir Ian Fraser opening the new service.

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Building an 8 Valve Super-Het Radiogram

FURTHER DETAILS OF THE NEW RECEIVER

By S. A. Knight

(*Continued from page 234 April issue*)

IMPORTANT points in the wiring of this set are as follows: R22 and R23 *must* be wired close to the appropriate tag of V4 and R7 must be at the opposite end of the A.V.C. lead feeding to V1 and V2, as shown in Fig. 3. The lead from VR2 and VR3 sliders to S5A *must* be screened, and coaxial type lead is recommended; in addition, it should be earthed only at the controls end; R39 and R40 *must* be wired close against the valveholder pins involved; heater runs should be tucked well down in the chassis "corners" and should be twisted fairly tightly together; the leads from the anodes of V2 and V3 to the respective I.F. transformer pins should be kept close to the chassis and short; and finally, space R21 clear of other parts, as this resistance runs warm.

A five-way lead feeds the magic-eye valve; this lead is not screened and may be any length within reason. R16 is wired on the base of this valve.

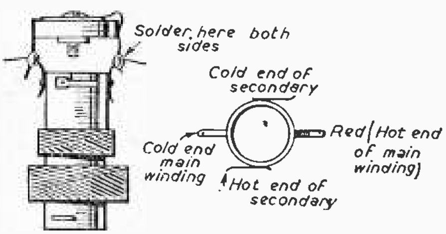
Neatness and care is paramount, especially with the midget valveholders employed, and the small type of iron is recommended for soldering.

It should be pointed out that the components specified in the list (resistances and condensers) are as used in the prototype, but alternatives are permissible provided they are reliable and of similar physical size, rating, etc. For example, Morganite "T" resistors may be used, and condensers by Hunts, etc., substituted for those specified as available. It is essential to avoid ex-Government condensers, particularly waxed paper types.

The pick-up filter (if used) and Gram. volume control are separate circuits and are not mounted on the main chassis, but more will be said of this later on when cabinet mounting is discussed.

Fixing feet for the chassis are provided as the photographs show by means of two strips of brass or steel (about ½in. by 1/16in. is suitable) bent into wide "U's" and bolted to the chassis front and rear faces. Again, the exact depth of these feet will depend upon the cabinet fixing employed.

Above chassis, two similar strips are bent to form protective "handles" and to act as stiffeners, being fixed to the scale bracket at the front and to the chassis at the rear. These give a final support to the scale assembly and enable the job to be inverted



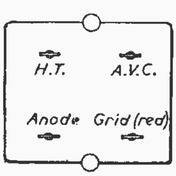


Fig. 7.—*Trimmer fixing and top view of a coil showing the connections, and left, underside of I.F. transformer showing connections.*

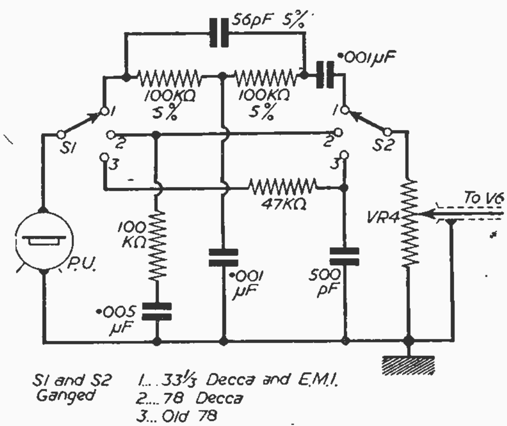


Fig. 8.—*A three-position equaliser network for use with a crystal pick-up.*

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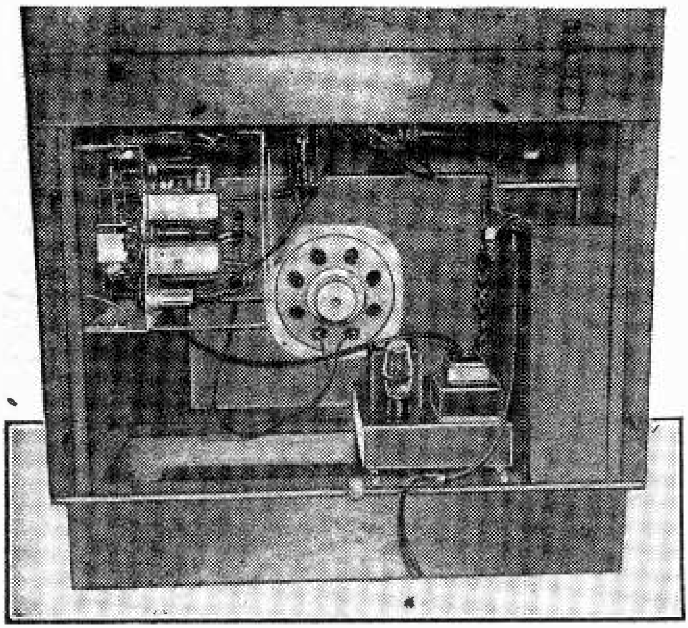
without damage. Suitable fixing holes will be found ready drilled in the scale assembly bracket.

Power Chassis

The power unit is built on a chassis measuring 10in. by 8in. by 2½in. deep, but this size is not critical in any way and any size of this order will serve. It should, however, be of firm construction, and 16 s.w.g. aluminium is recommended.

No wiring diagram is given of this unit as the circuit of Fig. 1, and the photographs are sufficient working guides. The six-way lead from the receiver terminates in a plug which fits a socket mounted on the power chassis; a 12-pin plug and socket were used on the original design, pairs of tags being joined, but a 6-way may be used directly, although the Bulgin 8-pin type is very suitable. For the heater wires in the connecting lead, 14/0076 flex is used, particularly for the PX4 run. Thinner wire will cause a voltage drop. For the common earth connection a heavier wire still is suggested.

The mains on-off switch is a separate control, and is not mounted on the power unit or the main chassis. It will be discussed again later on. The 500 mA. cartridge fuse is mounted in a clip above chassis for convenience in replacement.



A rear view of the completed radiogram.

Checking and Alignment

When the set and power unit have been assembled, wired and checked, the power unit should be connected to the main chassis by means of the six-way cable and a further check made to ensure that no cross connection has been made in this cable. With the valves then plugged into their proper holders, the receiver may be connected to the mains supply, the transformer tapping being set to the appropriate voltage.

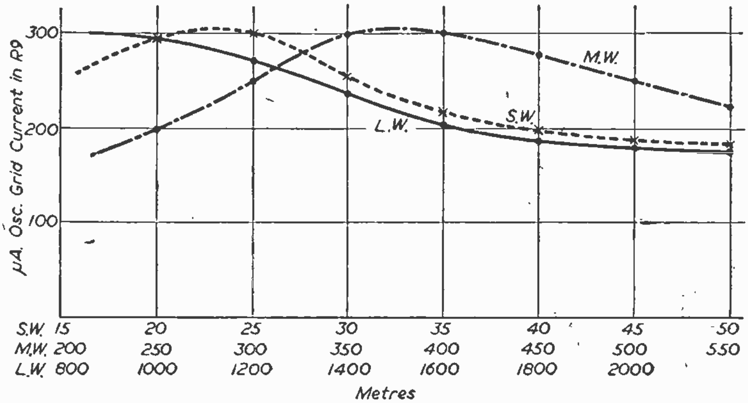


Fig. 9.—Oscillator amplitude curves.

For the present time, the magic-eye tuning indicator may be omitted from its holder or, if it is decided to use this as an alignment aid, it may be taped to one of the stiffening rails. When the valves have warmed up, a voltage check should be made against the figures given on page 273, the set being switched to medium waves. Some small differences will almost certainly be found, but the table gives the general order of voltage to be expected at the various points. If the main rail voltages are about 300 and 220 volts on either side of R21, the others will be correct also; R21 may require adjustment in some cases to drop the supply to the proper order of 220 volts on the R.F. end of the set. Differences of 10 per cent., however, are permissible.

Now switch the receiver to Gram. and check that the pre-amplifier V6 now receives H.T. voltage and that its grid is "live." For the present, of course, the pick-up and equaliser network are not in circuit. With the tone controls set to about mid-positions, adjust VR1 on the power pack for minimum hum in the speaker; this setting is not critical, but a definite minimum point will generally be found. The hum level is extremely low for all settings of this control and its final position calls for care.

Now switch back to Radio and ensure that there is no change in

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the hum level. Alignment proper may now begin.

Alignment

A signal generator (or 465 kc/s fixed aligner) is necessary for the I.F. alignment of this receiver, although the R.F. coils may be aligned on actual stations without any difficulty.

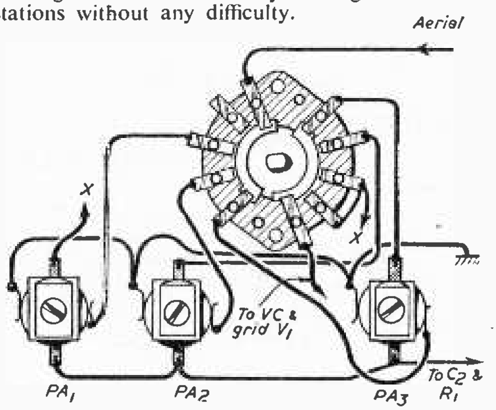

Fig. 10.—Layout of R.F. compartment showing coil switching.

As an output indicator the magic-eye may be used, or alternately, a milliammeter may be wired in the earthy end of VR1 volume control. For a modulated signal, of course, the actual speaker output may be used, but for more accurate results, an A.C. meter (about 10 volts) can be wired across the speaker speech coil. In all cases, alignment is made for a maximum reading, or closing of the tuning eye.

With the signal generator set to 465 kc/s and injected into the grid of V3, tune the trimmers of IFT2 for maximum output, keeping the input as low as possible consistent with a workable output. Then transfer the generator to the grid of V2 (pin 2) and set IFT 1 similarly; then recheck IFT 2. When satisfied that the transformers are properly peaked, seal the trimmers with small blobs of wax. Care should be taken to ensure that the signal generator output is screened right up to the input grid points and properly terminated or instability may result as the circuits come into line.

The following notes are now divided for signal generator and station alignment of the R.F. sections of the set respectively.

1. *Generator alignment.* All trimmers about half-settings, padders similarly. Inject the signal at the grid of V1 and align at the following frequencies (on the generator and receiver dial) in the order given :—

L.W. 850 m. (350 kc/s). Trim T9 and T6 for maximum putput. 1,800 m. (166 kc/s). Trim P2 for maximum output. Repeat the above until no improvement can be obtained. Transfer SG to the aerial socket and trim T3 at 350 kc/s.

M.W. 200 m. (1,500 kc/s). Trim T8 and T5 for maximum output. 500 m. (600 kc/s). Trim P1 for maximum output. Repeat in order. Transfer SG to the aerial socket and trim T2 at 1,500 kc/s.

S.W. 20 m. (15 Mc/s). Trim T7 and T4 for maximum output, rocking gang slightly while setting the former. Note : There are two positions for T7 which give an output ; use the one with least capacity. Check that the scale is correct at 45 m. (66 Mc/s). Transfer the SG to the aerial socket and trim T1 at 45 m.

2. *Station Alignment.* The alignment is not difficult on medium and long wavebands by this method, but is not so easy on short waves. On medium waves, use the Light (247 m.) and the Third (464 m.) as the check points. On long waves, the 1,500 m. Light may be used, but it is better to use two stations at the ends of the scale if possible. Paris on 1,829 m. is suitable, and any other around 1,200 m. will do if it can be definitely identified.

It sometimes happens that additional padder capacity is required, particularly on the medium waveband. This can be readily obtained by means of a parallel capacity to the adjustable padder ; a silvered-mica type should be used for this purpose.

A view of the motor-board layout.

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Oscillator Voltage

For those who wish to check on the oscillator amplitude, curves of grid current in R9 plotted against wavelength (set properly aligned) are given in Fig. 9. These are obtained from a microammeter (500 μA full scale) inserted in the bottom end of R9, the set then being tuned through each waveband and the meter reading noted. The optimum current is from 200 to 400 μA and it will be seen that reasonably level curves are obtained. Excessive current should be avoided, this being generally worse than low current (below 200 μA) and leading to whistles as well as a reduction in gain. Damping resistors R12 and R11 should not normally require adjustment, and if the current follows the curves given roughly, no changes need be made to them. The coupling coils of the oscillator inductances are already wound from resistance wire (on MW and SW) by the manufacturers and, with the additional resistances, give excellent results from this point of view of amplitude constancy over the bands.

Gramophone Use

As mentioned in an earlier article, the prototype of this receiver used a B.S.R. changer with crystal turnover pick-up, and the equaliser shown in the main circuit diagram is suitable for both L.P. and 78 recordings. For other types of pick-up (such as moving coil or iron) the manufacturer's recommendations regarding any equalisation should be followed. In this respect, the gram. volume control VR4 may require adjustment in value to load the pick-up properly. The bass response of this receiver is very good and care should be exercised in the mounting of a changer unit to avoid the possibility of acoustic feedback leading to rumble.

For those who require an equaliser suitable for three-speed use, a modified circuit is given in Fig. 8. This may be used if desired in place of the single circuit already given. VR4 should be raised to 500 kΩ in this case.

Cabinet Mounting

The photographs show the general cabinet mounting adopted for this receiver. The exact form depends upon the constructor, but the general back view and motor-board layout of the prototype should provide the main points of design. Messrs. Elpreq Co. can supply the cabinet illustrated, and many others of similar design. The gram. volume knob is mounted just to the right of the record player, with the magic-eye above it. If a switched equaliser is used, this could be mounted below the other control. White knobs, appropriately engraved, are used and the escutcheon supplied with the J.B. scale is painted white or cream to match.

Valve	Anode	Screen	Cathode
V1	200	95	2.5
V2*	205	95	2.5
V3	210	165	3
V7	95	60	2.3
V8†	290	—	35 40

* Osc. anode 100 volt.

† Anode voltage measured between anode and filament.

Bias voltage measured across R1 in power unit.

VOLTAGES TABLE.—Measured with receiver switched to M.W. on 1,000 Ω/v. meter, 500 v. range except for cathodes.

BOOK RECEIVED

WIRELESS AND ELECTRICAL TRADER YEAR BOOK : Radio, Television and Electrical Appliances, 1955. 26th Edition. Published at 12s. 6d. (Postage 6d.) (with a reduction to subscribers to WIRELESS AND ELECTRICAL TRADER) by Trader Publishing Co., Ltd., Size 8¾in. x 5½in. 304 pages. Bound paper boards.

THE Wireless and Electrical Trader Year Book, which was first published in 1925, has become the most important reference book to the radio and electrical industries. It is the standard guide for all connected with sales or service and of great assistance to overseas buyers wanting to contact British sources of supply.

Features of the 1955 edition include condensed specifications of nearly 300 current commercial television receivers and information on valve and cathode ray tube base connections, with over 300 valve base diagrams. These alone are invaluable to radio and TV service engineers.

For ease of reference the Year Book is divided into sections printed on distinctively coloured paper and each section is now separated by a stout card, with thumb index, giving details of contents.

One of the principal aims of the Year Book is to assist traders to keep abreast of the constant changes in the names, addresses, telephone numbers and products of the firms engaged in the radio and electrical industries. The directory sections incorporating these revisions together with the carefully selected technical information and other practical data, make the Trader Year Book an invaluable time-saving reference book for every retailer and business man in the industry.

Principal contents include :

Directory of Principal Trade Organisations ; Legal and General Information ; Wage Rates ; Radio Receiver I.F. Values ; Valve Base Connections Diagrams ; Mains Voltages ; Addresses of Electricity Boards ; Television Information and Data ; Receiver Specifications of 1954/55 Models ; Trade Addresses ; Wholesaler Directory ; Proprietary Names Directory ; Classified Buyers' Guide.

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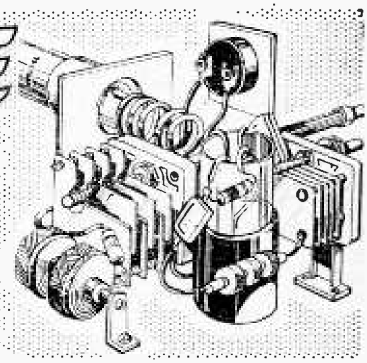
SHORT-WAVE SECTION



SHORT-WAVE NOTES AND NOTIONS

By A. W. Mann

SCANNING the pages of short-wave club magazines some years old, the writer read with great interest the brief comments of a well-known and recognised overseas expert DX listener, whose pre-war log entries totalled 60,000 and post-war ones 63,000.

Obviously, to achieve such totals over a period of years calls for careful and consistent listening, knowing when and where to listen according to time of the day and season of the year, and being able to devote a considerable amount of time to searching.

It also calls for a good receiver and an efficient aerial system.

This does not mean that the receiver must be one of the high-priced communication type, or that the aerial system should be of text-book specification with an elaborate matching network. Proof of this is to be found in this listeners later comments for he says, " I have always used baby type receivers and ordinary aerials as distinct from beams, etc."

All this bears out the author's contention that providing one can devote sufficient time daily to world wide DX listening, success can be achieved with inexpensive equipment on both amateur and short-wave broadcast bands, if intelligently used.

When one studies sections devoted to listening—post reports on DX heard, it is interesting to note that whilst many reporters use commercial communication type receivers, a percentage achieve results of equal merit using home-constructed T.R.F.s, straight regenerative, superhets and converters and adaptors either mains or battery operated.

It would appear that within reason it matters little what type of apparatus is used providing it is efficient. Things do not, however, work out so easily in practice, for in some instances as in the case of wide coverage receivers, one must compromise.

Types of Apparatus

Two of the best DX enthusiasts who achieved really outstanding results, specialised in one instance on the amateur 'phone bands and in the other on the short-wave broadcast bands. The former used a battery-type converter feeding into a mains-type broadcasting superhet. The other, a home-constructed battery T.R.F. and simple superhets.

Their monthly report on DX heard were not confined to a fraction of a column, but to a complete monthly article covering activities in their respective spheres, later to be followed by details of QSL cards received. This, of course, was previous to the war when the short-wave bands were free from the senseless jamming which we have to tolerate nowadays.

Whip Aerials

Regular readers may recall my remarks concerning the unsuitability of whip aerials for use in conjunction with straight regenerative receivers. This is because the aerial is mounted in a rubber base and consequently sways in the wind and this will cause spill-over if regeneration is used to the limit when tuned to a weak transmission. Unless whip aerials are rigidly mounted a stage of R.F. is desirable.

Indoors

There is no reason why this type of aerial mounted in a rubber base should not be used indoors. When the author installed the relay-controlled doublets in the roof space, a 12ft. whip was also included. The rubber base was fastened to the rafters. As the down lead to the living-room had to be arranged as unobtrusively as possible, low-loss principles could only be applied in part. This arrangement, including down lead, totals 40ft. It appears to be a good non-discriminating short-wave aerial.

Misleading Tests

Fortunate in many ways is the short-wave listener who has a small workshop or box room fitted up as a listening post. In several instances the receivers used in such places are capable of delivering considerable loudspeaker output.

Under the circumstances care, and some consideration for others, should be exercised when turning up the volume control. What may appear indoors to be reasonable volume may prove somewhat beyond all reason when heard out of doors.

The R1116 double-superhet battery-driven receiver, for example, does not, with A.V.C. operating, provide terrific loudspeaker output, especially in a small room of the 12ft. by 6ft. kind. Its output is, in fact, less than that of the 1224 type receiver. If, however, the R1116 is tried out in conjunction with a good aerial in the average size living-room, those who have never used one under those conditions will find that it is capable of providing more than sufficient volume and a high signal-to-noise ratio. Test your new receiver in the living-room first, if your listening post is a smaller room.

Scope for Listeners

The latest short-wave allocation book to hand lists a total of 1,725 allocated frequencies between 133.3

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metres and 11.5 metres. Thus there is ample scope for listeners on these bands. Jamming, however, at present blots out many low-power DX transmissions.

Directional Aerials

In the author's experience it has been found that when using some types of communications superhets the quick response of the A.V.C. system levels out the gradual gain as a rotary aerial is operated. In such instances it is advisable to switch out A.V.C. until maximimum gain is obtained.

In other cases, due to slower A.V.C. action, increasing gain is noted as the aerial system is rotated. When using right-angle relay-controlled doublets, noticeable gain of from three to four R points is obtained on weak signals when the aerials are switched and with A.V.C. in operation. While these effects centre on delay voltages of different A.V.C. systems, it should be understood that prevailing reception conditions have some bearing on the degree of gain obtainable, as the writer outlined some years ago in an article describing a series of tests which he had carried out some time previously. In the case of switched doublets the gain is not gradual but instantaneous, and thus beats the A.V.C. effect by a fraction of a second or so.

In my opinion a rotary aerial system is a real asset, especially when used with simple regenerative receivers. The gain on rotation is progressive, and one can, as it were, obtain "on the nose tuning" for on further rotation, after reaching a certain point, the signal strength begins to fall.

With right-angle doublets, however, we have a compromise arrangement, but for all that one of the best methods available where rotary beams cannot be used. This applies especially in the case of indoor directional systems.

Personal experience with the indoor relay-controlled directional doublet system recently described by the author of this article, has proved several things, and it has been decided to make them a permanent addition to the various aerials in use.

Theory and Practice

Text books tell us that the doublet is most efficient at the frequency to which it is resonant. This is correct. Some text books also add that it is quite efficient over a wide band of frequencies outside the resonant frequency. Thus, while a doublet is most efficient at the frequency to which it is cut, it is by no means to be implied that it is a one frequency aerial. I mention this because many have been misled into thinking that way.

There are, of course, limits beyond which a doublet ceases to function as a doublet, and in remarking on efficiency we are concerned with operation within those limits.

Doublet Tuning

Transposed feeder lines, twisted feeder lines and open feeder lines may be used with doublet aerials. Transposed and open lines when used with this type of aerial can be used in conjunction with aerial tuning units most effectively.

Some text books strongly advise against attempts to tune doublets which include twisted feeders, due to the high distributed capacity of such feeders making resonance tuning difficult.

From recent experiments it would appear that these remarks apply to weatherproof twisted feeders for outdoor use and electrical flex. Using plastic-covered flex, however, with his indoor system, the writer experiences no difficulty in resonance-tuning the aerials. Obviously, the post-war plastic flex has a lower distributed capacity, and the simple tuner used tunes sharply and enables a good match to be achieved without complication. The tuner will be described in a future article.

Tuners and Plug-in Coils

Recently the writer had the opportunity of examining a pre-war marine type battery T.R.F. of Dutch manufacture. This covered a very wide range and was fitted with a coil turret of sound design and precision manufacture.

Present-day coil turrets and packs are many times smaller but most efficient. Many constructors, however, still prefer plug-in coils in spite of the inconvenience of coil changing. There are a number of most efficient plug-in coils available, at reasonable prices.

The cheapest on the market at present are of sound design and have been a stock line in many amateur supply shops for some years. Unfortunately, the range covered does not include the 10 metre and 160 metre bands. Inquiring as to the reason for this we were informed that the manufacturers did not consider that the demand would justify the additional coils being made available. Checking through short-wave listener publications, and club members' reports, shows that the average amateur band listener covers everything from 10 metres to 160 metres, and that others find the shipping bands interesting. Added to this is the fact that at least two well-known firms provide a full range from 10 metres to long wave broadcast.

Aids to DX Listening

While a great circle map, a good atlas and a gazetteer of the world are all useful aids to the short-wave listener, the usefulness of the Solariscope does not seem to be appreciated generally.

During the past few months the author has been using one. This instrument, which is supplied complete with a series of charts covering 12 months, enables one to check time differences and the light and darkness paths between the receiving station and transmitting station tuned to or to be searched for at any time throughout the 24 hours. It has considerable educational value and in addition provides the listener with a better idea as to the effects of light and darkness relative to transmission and reception.

Forty Metres

The 40 metres amateur phone band used to be a very popular one with both listeners and transmitting amateurs. The encroachment of commercial broadcasters and jamming stations left but little space for those who had most right to this band. Consequently it has been more or less deserted by amateurs. I was pleased to hear a north London amateur phone and several others using the band one recent Sunday morning.

Amateur phone stations cannot compete with powerful broadcasters, and it would seem that to attempt to do so would be wasted effort. It is to be hoped however that those who have deserted this most interesting band will return in considerable numbers with a view to retaining this band which is after all allocated to them, and a recognised amateur band.

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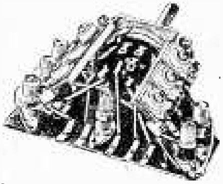

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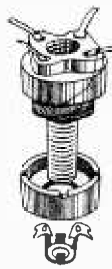

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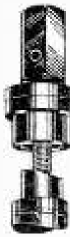

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Mullard D.L.93.

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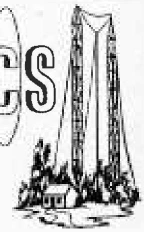


OVERTONE CRYSTAL CIRCUITS

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

DUE to the difficulty of grinding crystals for operation on fundamental frequencies much above 7 megacycles (although fragile 14 Mc/s fundamental crystals do exist) the production of higher frequencies directly from a crystal oscillator stage is of interest. This is of even greater interest nowadays than in the past, for V.H.F. transmitters, if operated by chains of frequency multipliers from a fundamental crystal, have an inordinate number of stages. Also, V.H.F. receivers using crystal controlled frequency changing for stability cannot use an indefinite number of valves. Accordingly, means of extracting harmonic energy directly from a crystal stage are now of importance.

An early circuit giving harmonic output was the Tritet as shown in Fig. 1. While the crystal oscillates on its fundamental, harmonic output may be extracted in the anode circuit by tuning the anode tank to the required harmonic. The cathode tuned circuit is

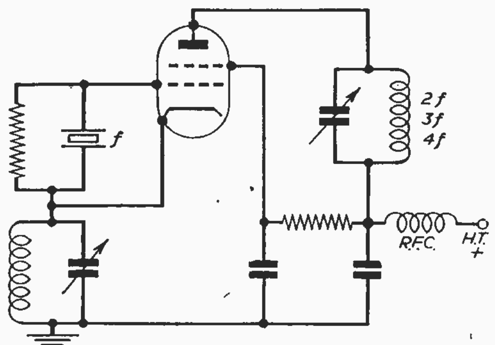
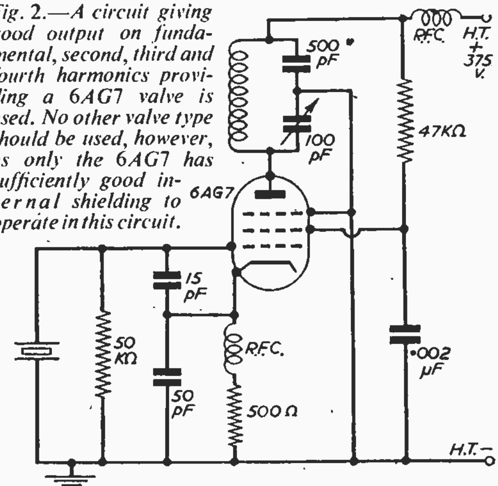


Fig. 1.—The Tritet Circuit. A circuit often previously used for good harmonic crystal output, although fundamental output is liable to give high crystal current with most valve types except the 6AG7.

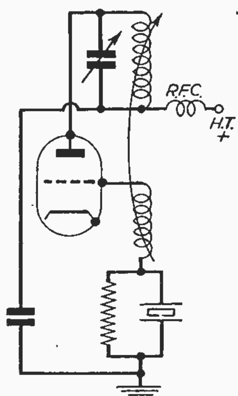
adjusted to some frequency higher than the crystal fundamental, as tuning the cathode circuit to crystal frequency results in excessive crystal current and crystal fracture with popular tubes such as the 6L6, 6F6 or 6V6 frequently employed in this circuit. The Tritet, in fact, will give excellent second and third harmonic output, and can often be squeezed to give a watt or so of fourth and even fifth harmonic. The writer has used a Tritet with a 7 Mc/s crystal quadrupling to drive directly an 807 P.A. to 30 watts or so input on ten metres. However, crystal heating, and chirp due to crystal overloading, are bad features of the Tritet when used with the valve types mentioned.

A circuit forming a "capacity tap" analogue of the Tritet is fairly popular in the States for operation on crystal fundamental, second, third and fourth harmonic output. The circuit of Fig. 2 shows the "preferred" values for this circuit, which is reliable and effective, *provided* that the oscillator tube is a 6AG7. The 6AG7 has exceptionally good internal shielding, and is capable of quadrupling with good

Fig. 2.—A circuit giving good output on fundamental, second, third and fourth harmonics providing a 6AG7 valve is used. No other valve type should be used, however, as only the 6AG7 has sufficiently good internal shielding to operate in this circuit.



output, but without excessive crystal current. Due to the good shielding of the 6AG7, loading effects are not reflected back into the crystal circuit, and keying is chirpless even when multiplying the crystal frequency four times. This circuit would no doubt be popular over here, but for the fact that supplies of the 6AG7 are difficult, so that they are virtually unobtainable.



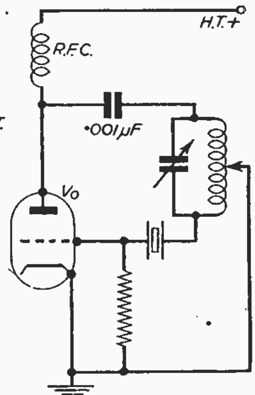


Fig. 3.—A "reaction coil" type of overtone oscillator where the crystal replaces the feedback capacitor.

Fig. 4.—A "Hartley" type overtone crystal circuit. V_0 = 6C4, ½6J6, ½12AT7 or ½12AU7.

The 6AG7 circuit described is in fact the most successful of the "conventional" oscillator circuits. However, for the newer circuits, the principle of operation is different. The older circuits have the crystal oscillating at its fundamental, while multiplying the fundamental in the anode circuit. The newer "overtone" circuits utilise the crystal actually oscillating at a mechanical overtone frequency. The quartz crystal is in fact a mechanical oscillating system, and can oscillate in harmonic modes which are odd multiples of the fundamental. Thus the modes are three, five, seven and so on, times the fundamental frequency. These harmonic modes also utilise the series resonance of the crystal, whereas the usual circuit favoured for conventional circuits in amateur practice utilise the parallel mode for fundamental operation. Consequently the actual overtone frequency is not exactly a multiple of the usual parallel resonance fundamental. This difference is only a few Kc/s even at 144 Mc/s, but should be noted. Moreover, the overtone frequency is slightly *lower* than an exact multiple of the parallel fundamental oscillation frequency.

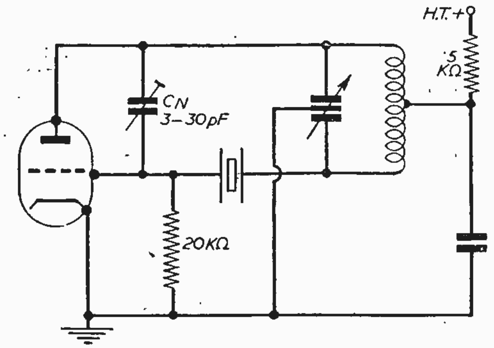


Fig. 5.—The neutralising condenser CN permits of neutralising the deleterious effects of the crystal capacity, so that higher overtones may be achieved. Circuit devised by F3GG.

Low Impedance

The crystal in the series mode presents a *low* impedance at resonance, unlike the high impedance of the parallel mode. Consequently the oscillator circuits for overtone operation utilise rather different principles from the more familiar crystal oscillator circuits. Usually the crystal forms a coupling element, which permits oscillation when the coupling is of low enough impedance. Thus oscillation occurs at the overtone frequency where the crystal has a low impedance. If this seems an alarming description, Fig. 3 shows an early type of "overtone" oscillator. The circuit is in fact identical with the familiar capacity-controlled reaction circuit, but with the crystal replacing the reaction condenser. The crystal only presents a low impedance at the overtone frequencies, so that oscillation takes place only when the tuned circuit is tuned to an appropriate overtone frequency. However, it is also true that the crystal will oscillate on its series fundamental mode if the circuit is tuned to the fundamental. Generally the tuned circuit is arranged to tune to the third harmonic so that the crystal oscillates at three times its fundamental frequency.

A more popular version is the circuit of Fig. 4. This is virtually a Hartley type oscillator with the crystal again acting as "reaction condenser." This circuit allows of easy adjustment of regeneration conditions, as the coil tap may be readily adjusted to provide optimum conditions. If too much regeneration exists, the circuit may self oscillate without the crystal controlling oscillation. With too little regeneration, the circuit may not oscillate promptly when H.T. is applied. Moving the tap towards the grid end of the coil reduces regeneration, while moving it nearer the anode end will increase regeneration. Usually the circuit is employed using one half of a 12AU7 or 12AT7 as the oscillator, with the second triode section as a doubler or tripler. By this means, when using the third overtone, six or nine times crystal frequency may be obtained with one miniature double triode. In fact, a watt or so of R.F. may be obtained, quite adequate for driving a further doubler for a 145 Mc/s TX, and adequate in any case for driving a multiplier in a V.H.F. crystal converter circuit.

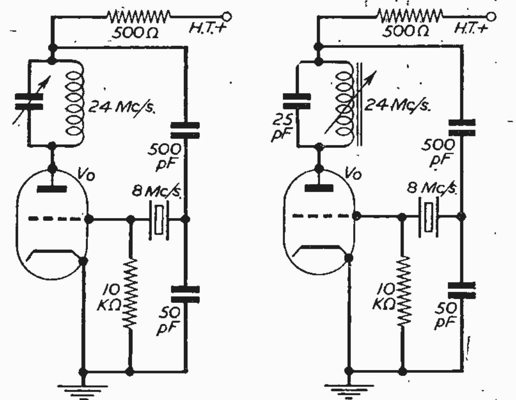


Fig. 6.—A Colpitts "Capacity Tap" version of the circuit of Fig. 4.
V_0=6C4, ½6J6 or ½12AT7.

Fig. 7.—A slug-tuned version of the Colpitts type overtone crystal oscillator.

Higher Overtones

While these overtone circuits are perfectly adequate for tripling or third overtone operation with most crystals, some difficulty will be experienced if higher overtone operation is attempted. This is not only because most crystals are not specially processed for good overtone operation, and in the usual holders have difficulty in "perking," but also because of the crystal capacity. At the higher frequencies the crystal capacity provides enough capacity for self-oscillation of the circuit, so that crystal operation is erratic. Generally, the circuit self-oscillates with a rough self-excited tone, and shows no disposition to crystal operation. Many circuits have been devised, a few of some complexity, for balancing out the crystal capacity, so that pure crystal control can be achieved. Generally these circuits are not too easy for general operation. However, one "neutrodyne" circuit of some interest has recently been published by J. Lollieux in the French amateur publication *Radio Ref.* J. Lollieux (F3GG) has arranged to

(Concluded at foot of page 294.)

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On Your Wavelength

BY THERMION

The I.S.W.L. Open Letter

THE I.S.W.L. has sent an open letter to all members commenting on my paragraph in the February and March issues. I gather that as a result of those paragraphs several members have written to the League which seeks reply to my criticisms by means of this open letter. This reviews the position and the correspondence, and in order to allay any criticism the open letter explains how the League is run. But surely the members already knew this when they joined? Do people join the I.S.W.L. blindly without being told how the organisation is run? It would seem so from this letter, which says that "Thermion's main preoccupation was the matter of finance." Their reply is: "We have never issued an audited balance-sheet because the cost of employing a firm of chartered accountants would be more than we could afford." With a membership, presumably, of some thousands, the revenue must be considerable, and bearing in mind that the league is not a trading concern, an audit by an independent auditor would *not* be expensive. The audit would, in fact, merely be concerned with the revenue from subscriptions, easily ascertainable from the receipt book, checked by the bank passbook, and also with outgoings such as postage and expenses. I offered to appoint an accountant who would have conducted this audit quite cheaply. The league countered by expecting us to pay the fee. An audit at this stage, however, might be more complicated since it would be necessary to go back not only for the past year (audits are annual affairs) but to the commencement of the club.

They answer my criticism that the league does not hold annual general meetings nor elect its officers annually by stating that "by its constitution, the league is an international organisation and so effective general meetings of the membership are impossible." Rubbish! I am amused that the league should self-style itself as "international," but in any case it is quite possible to adopt the procedure of similar organisations where postal ballots are conducted. The various officers are nominated and ballot forms circulated to members. Is that "impossible"? Again: "Presumably the meetings would have to be held in London." Nonsense again. Other organisations vary the venue of their annual general meetings, and in the cases where they are always held in London there has never been any difficulty in getting delegates from foreign countries to attend.

The letter informs us that the league's council as it stands consists of the three section editors of "Monitor" (a duplicated publication) and the league chairman, in addition to the secretary/treasurer. The next paragraph is amusing as well as surprising: "How were we elected? The answer is simple—we weren't. Peter Bysh offered to take over the very arduous duties of hon. secretary and treasurer from Frank Baldwin; you can appreciate that not many members would be willing to give up almost every evening and week-end on league business as Peter does." How is it possible to say so without asking the members? It is obviously wrong for one man to have to give his entire leisure in this way. What would happen if he were taken ill? We are told that Mr. Bysh also runs the Q.S.L. Bureau "and has borne the brunt of negotiations between the league and outside bodies. The three editors volunteered to write the various sections of 'Monitor' and were automatically incorporated on the Council.". If the members of the I.S.W.L. are satisfied with this bureaucratic autonomy, I certainly should not be. The "council" can do as it likes without reference to the members. For example: "The chairman was appointed by the council from the general membership."

I am glad to note that the league has "seriously considered the matter of holding elections, but have decided that they would take too long to carry through." Why? Because "we should have to ask for nominations in the 'Monitor,' wait the six weeks for surface mail from overseas members to arrive and then print the list of nominations in a later issue. Members would be asked to vote and, again allowing for overseas votes to reach us, it would be September before the results would be announced." Why do it through the "Monitor"? Indeed, the rules could provide for biennial elections to take care of the envisaged delays.

Here is a further statement from the letter: "We don't publish a list of members chiefly because of the work it would entail to compile a complete list from our file cards, but also because of the difficulty of keeping it up to date." This excuse simply will not hold water, for presuming that the league has 5,000 members (I believe the membership is much less) such a list could be typed out from properly-kept index cards in three evenings. Most clubs issue lists of members each year and every member knows that between each issue new members will be enrolled.

The letter informs members that Eric Alban, the ex-chairman of the league, was never treasurer of it as he states, but chairman and editor, and that the league was formed in 1946 and not 1947. Also, we are told that council meetings are held once a year, not three times yearly. How an organisation with such a small self-appointed council can operate an international organisation by meeting once a year I do not know. The league certainly could not run by "council" members keeping close touch with each other by correspondence and private visits throughout the year.

Some readers have pointed out the membership fee is practically absorbed by the production of the journal and in postage, and that they have therefore no money left to place the league on a proper footing. This amounts to an admission that the league is trying to run an international organisation on a shoestring. It cannot, therefore, be efficiently run, and the gravamen of my criticisms has been on that score. I maintain with vigour that members of such organisations have a right to a say in the conduct of the club's affairs.

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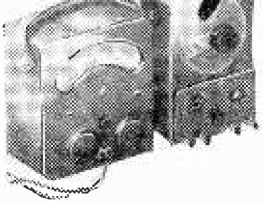
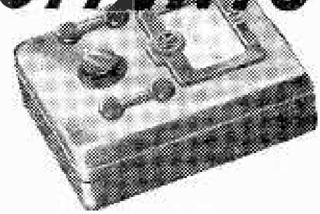


Using TEST INSTRUMENTS



Part 5 of a New Series of Articles Dealing with the Practical Application of Standard Test Equipment

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

(*Continued from page 210 April issue*)

WE have already seen that the current registered on a milliammeter flowing through a resistor of unknown value can be used as a direct indication of its value.

It will be interesting to enlarge on this in the following way. Let us look again at the ohmmeter circuit at Fig. 16. When the terminals A and B are shorted the variable resistor Rv can be adjusted to produce f.s.d. on the milliammeter M. If we assume that a 3-volt battery B is used, then the circuit resistance to produce f.s.d. on a 1 milliampere meter will require to be 3,000 ohms. In such a case Rv would probably possess a maximum value of 5,000 ohms to permit ample scope to zero the meter.

Now when the short-circuit between the terminals A and B is removed, the meter will obviously return to zero current, but if a resistor of unknown value is connected between the terminals the meter will again deflect but not to full scale, since the extra resistance will reduce the current.

Let Ru represent the value of an unknown resistance, Id equal the f.s.d. current of the meter, Ir equal the current reading with Ru included, and R equal the meter circuit resistance excluding Ru, then :

$Ru = (R \times Id/Ir) - R.$

For example, if the instrument embodies a meter having a f.s.d. of 1 milliampere, and a 3-volt battery is used, and the introduction of an unknown resistance reduces the current reading to 0.5 milliampere, then :

$Ru = (3{,}000 \times 1/0.5) - 3{,}000$, or $Ru = 2{,}000$ ohms.

From this we can clearly realise that by increasing the internal resistance of the instrument, adjusting it to a higher voltage range, for instance, and using an external battery to match the range used, very high resistances can be very easily measured. It is, of course, necessary to know the f.s.d. current of the meter, and then calculate the resistance against the current scale of the meter.

Conversely, the meter may be shunted to achieve a more accurate assessment of low value resistances. If we refer back to the worked example, but this time suppose that the milliammeter has been shunted to read 10 milliamperes f.s.d., then a 200-ohm resistor will produce the same extent of needle deflection. In other words, by MULTIPLYING the current range of the meter by a factor of 10 we have effectively DIVIDED the resistance range by the same factor.

Isolate the Component Under Test (12)

If we use our multi-range meter on the ohms range to assess a resistive value while the component is still connected in the circuit, we must always recognise the possibility of a false reading as the result of the shunt effect of some other resistive element in the same circuit. Fig. 17(a) illustrates this possibility, in which R1, R2, R3 and L1 of T1 might easily represent a circuit network in a TV set or broadcast receiver.

By connecting our ohmmeter as shown in an endeavour to measure the value of R2, we are actually measuring the resistance of R2 in shunt with the series combination comprising, R1, R3, and the resistance of the transformer winding L1—this can be more readily realised by looking at Fig. 17(b).

To avoid any error of this kind occurring it is essential to disconnect completely one side of the component under test as shown in Fig. 17(c). The same applies, of course, to transformers, chokes—in fact, to any part that it is desired to measure resistively. Needless to say, the possible error will increase in proportion to the value of the resistance under test.

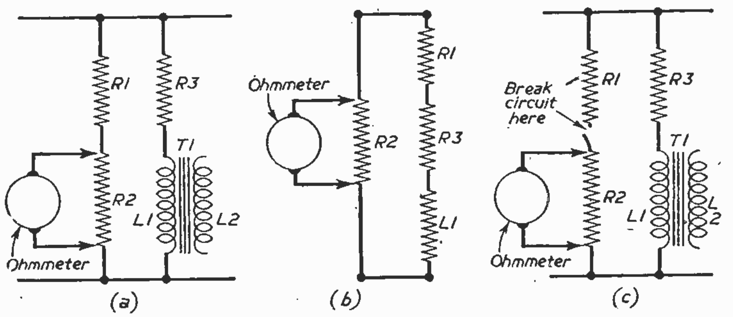


Fig. 17.—An ohmmeter connected across a resistor in a network such as (a) will not measure the true resistance as is clearly shown in (b). The resistor should always be isolated from the internal circuit before testing (c).

Beware When Testing the Resistive Value of an Inductor (13)

Receiver service data usually includes the resistance values for transformer windings, chokes, field coils, etc., provided they are not of an extremely low value which, anyway, would be more or less impossible to test by using an ordinary ohmmeter. It must be stressed at this point that values given for such components are average values only, and that the values do tend to deviate between specimens of the same component by as much as 5 to 10 per cent.

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It is most important to know this fact because if, say, a line-output transformer is suspected as being responsible for a lack of E.H.T. in a television set, we may feel inclined to prove our suspicion by properly disconnecting the transformer from the circuit and comparing the resistance of the various windings against the data provided in the service-sheet. We might well discover that the resistance readings so obtained satisfy the tolerance of the component, and as a result eventually conclude that some para-normal disturbance is responsible for the apparent paradox that the circuit checks perfectly normal and yet it fails to work.

This is not really a paradox and it is not the result of para-normal disturbances: it simply means that we have overlooked the possibility of one or two adjacent turns short-circuiting in one of the transformer windings to reduce severely the *inductance* of the transformer without modifying by any easily measurable degree the resistance value of the winding.

Here, then, is the limitation of a normal resistance check so far as an inductor is concerned. Incidentally, this fact can be clearly proved by coupling a short-circuit turn to a line-output transformer.

Checking Insulation (14)

It is often possible to perform a useful check of capacitor insulation by using an ordinary ohmmeter connected across the capacitor in the usual way: for this test the highest resistance range should, of course, always be used. Unfortunately, many multimeters are not sufficiently sensitive to provide a reasonable indication of insulation. For measuring the insulation of capacitors and inter-winding insulation of transformers, where a slight leakage may cause severe circuit disturbances, we can successfully adopt the method depicted in Fig. 18. Here is shown our multimeter adjusted to a voltage range to correspond to the H.T. line voltage in the receiver from which the capacitor was taken. The capacitor is connected in series with the meter, and as we have already seen, such procedure enables extremely high resistance values to be detected with very little trouble.

Apart from this, the test also advantageously subjects the capacitor to a voltage equal to the voltage it is subjected to under normal working conditions. Under this condition, then, an elusive insulation fault is liable more readily to be revealed; so far as capacitors are concerned, however, it is important not to exceed the working voltage under any circumstances.

Consideration of the test voltage must also be given if it is desired to check the cathode-to-heater insulation of a valve or picture-tube. If we apply between these electrodes a potential in the region of, say, 300 volts, the insulation might well be provoked to fail by reason of the test itself, for let it be remembered that the valve or tube may have a stipulated heater-to-cathode potential rating of something like 150 volts or less! For this reason a megger should never be used to check heater-to-cathode insulation.

While we are on the subject of checking inter-electrode insulation, it will be worthwhile to bear in mind that an insulation defect may not occur while the heater is cold, and for this reason it is often a good idea to check the insulation first while the heater is cold, and then check it again while the heater warms up and during the time it takes to become really hot.

This applies mainly to a suspected heater-to-cathode short, which, if it tends to be elusive, can usually be made to show itself during the temperature test by gently tapping the valve or the neck of the picture-tube.

It may be found possible to continue energising the heater from the set itself while the test is performed, although in certain cases it is desirable to use a separate heater transformer, and connect the ohmmeter as shown in Fig. 19.

Check Instrument Polarity (15)

When checking electrolytic capacitors for insulation (leakage resistance) due attention should be given to the polarity of the applied voltage. If we

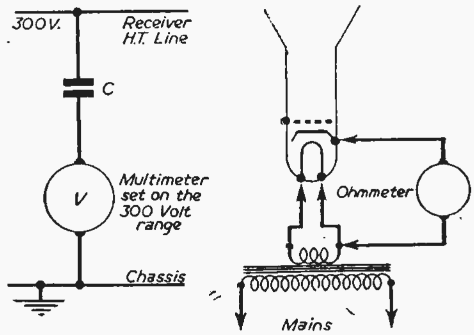

Fig. 18.—(Left) A multimeter set on a "volts" range to correspond to the receiver H.T. line voltage can be used to detect slight insulation leakages. Fig. 19.—(Right) An ohmmeter should be used to check inter-electrode insulation in a valve or picture-tube—it is often desirable to check for heater to cathode leakage while the heater is energised.

apply such a capacitor across an ohmmeter the needle will give a definite "kick" indicating, at least, that the capacitor possesses capacitance which is charging from the battery in the ohmmeter.

The needle will be observed gradually to return toward the high-resistance end of the "ohms" scale, and its final resting position will indicate the capacitor's leakage resistance in ohms.

The important factor here, though, is that if the capacitor is incorrectly polarised from the ohmmeter battery an excessive leakage resistance will be registered, which is liable to give the false impression that the capacitor is defective.

In most multimeters the positive lead is connected to the negative terminal of the internal battery. This means, then, that when measuring the leakage resistance of any electrolytic capacitor, the negative lead from the meter should be connected to the positive terminal of the capacitor, and the highest resistance range employed.

Similar consideration should be given when testing crystal diodes, rectifiers, and any other component whose resistance is liable to vary according to the direction of the current through it.

In conclusion, it must be stated that resistance tests should never be performed on components which are already carrying current.

Using the Multimeter as a Sound Output Indicator (16)

Tuned circuit adjustments on a broadcast receiver

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or on the sound section of a television receiver are best made in conjunction with a modulated signal generator and an audio-output meter. The experimenter often injects the modulated R.F. into the section of the receiver under adjustment in the proper way, and then tunes the associated circuits for maximum sound from the loudspeaker.

Although this aural method of adjustment can prove effective in a number of cases, it is not a 100 per cent. accurate method, as the ear does not readily distinguish between sounds of slightly different volume levels. By far the best procedure is to make use of an audio-output meter to indicate visually the loudness of the modulated note. A universal multimeter switched to an A.C. volts range can be made to serve this purpose with a high degree of success.

There are three ways in which the meter can be connected to the receiver to indicate A.F. output, and these are illustrated in Fig. 20.

Meter-connecting positions (a) and (b) are more or less the same, for in both cases the meter is arranged to measure the actual A.F. voltage appearing across the primary winding of the output transformer. In position (a) the meter is connected directly across the transformer primary, while in position (b) the meter is isolated from the H.T. supply by capacitor C1.

Capacitor C1, as with capacitor C2, which represents a large value electrolytic smoothing capacitor, yields little impedance to the A.F. current, which permits the meter connection to be returned directly to the receiver chassis.

In position (c) the A.C. meter simply measures the A.F. voltage appearing across the speech-coil of the loudspeaker, but since the impedance here is consider-

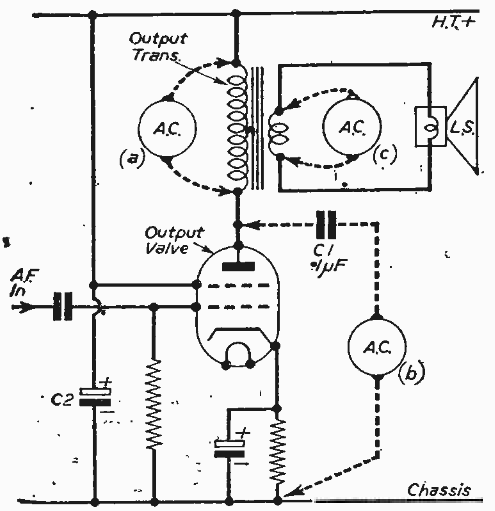

Fig. 20.—Illustrating three methods of connecting an A.C. voltmeter to indicate A.F. output.

ably lower than that across the primary of the transformer, a correspondingly lower voltage reading will be given.

Measuring A.F. Power (17)

Provided the inherent resistance of our universal multimeter on a selected A.C. volts range is reasonably high compared with the load resistance of the output valve (as seen across the primary of the output transformer), and provided we know the working impedance of the output valve, we can achieve a fairly accurate indication of the A.F. power delivered by the valve.

Let us suppose that the output valve loading is equivalent to 2,500 ohms, and that the meter records 50 volts due to a constant A.F. input voltage when connected as in position (a). Now, by applying the well-known formula for determining power, i.e., Watts equal Volts^2 divided by Resistance, we readily discover the A.F. output to be in the region of 1 watt (50^2 over 2,500).

(To be continued)

American Test Equipment

SIR,—Our attention has been drawn to your editorial in the March, 1955, issue of PRACTICAL WIRELESS, the last paragraph of which deals with American test equipment.

It would appear that a number of your readers have been given the impression that American kits of test equipment will shortly be "flooding" the market and will be available at prices below that of complete equipment currently sold in this country.

The position, to the best of our knowledge, is that the Import Licence Authority will now grant individual licences for the importation of certain American equipment—the reason for wishing to import the particular item required must be given. Kits of test gear are not being imported in quantity as your phrase "American invasion" would suggest.

You further state that "—— but only complete expensive apparatus has been available"—the inference being that the imported kits will be cheaper than complete British equipment. This is not true. For instance, the price of the Heathkit Condenser Checker is £13 12s. 6d. plus £2 19s. 6d. for a step-down transformer. Messrs. Taylor Instrument sell a similar complete and tested article for £14 and the price of our own CR50 Bridge is only £6 19s. 6d. If you care to examine the prices of any of these kits you will find that in no instance are they cheaper than their complete and tested British counterpart.

The position in America is that wages are relatively higher than in this country, consequently a large saving can be made by purchasing a kit of parts rather than an assembled and tested instrument. This same saving does not hold in this country. It is surely much better to pay a matter of 10s. or so extra to obtain test equipment for which the manufacturer claims a stated accuracy rather than a kit of parts producing an instrument of unknown accuracy when assembled. If you study the advertisements of any American kit manufacturer you will note that they are extremely "cagey" with regard to claims of accuracy.—GRAYSHAW INSTRUMENTS (Harpenden).

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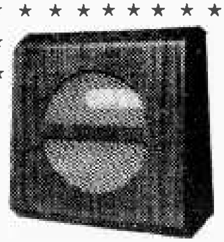

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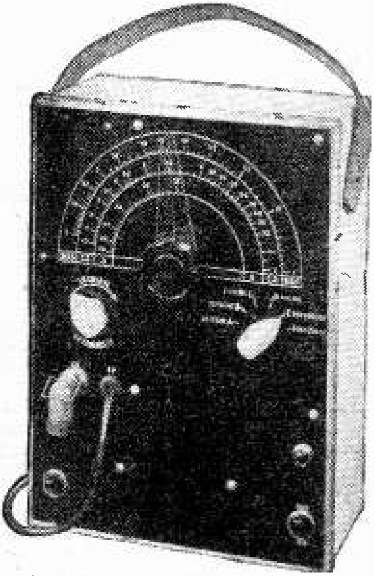

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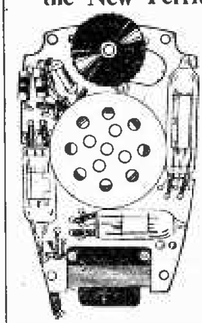

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Receiving F.M. Transmissions

HINTS ON THE TYPE OF APPARATUS REQUIRED, AND DETAILS OF CURRENT TRANSMISSIONS

By W. J. Delaney

SINCE the publication last year of details of Frequency Modulation principles, many queries have been received from readers concerning the type of apparatus required for receiving the programmes and details of the available transmissions. At the beginning of this year there was only the experimental radiation from Wrotham on 91.4 Mc/s and 93.8 Mc/s devoted to a relay of the Light and Home programmes. This transmitter closed down from March 7th until the beginning of April during which period Alexandra Palace radiated test transmissions on 93.8 Mc/s. It is planned to cover the whole country with a V.H.F. network using this system of modulation, and most listeners should be in a position to pick up their local transmitter as it comes on the air. The BBC cannot however, at the time of going to press, give any dates or other details except so far as concerns the London transmitter. This, the first of the new chain, will be brought into service on or about May 2nd.

Frequencies

The new station will transmit the three BBC programmes, the Light Programme on a frequency of 89.1 Mc/s, the Third Programme on 91.3 Mc/s, and the Home Service on 93.5 Mc/s. The effective radiated power will be 120 kW in each case, and the transmissions will be horizontally polarised. The station will serve the London area and South-East England within a range of about 50 miles.

The new transmitter at Wrotham, which will carry the Home Service, differs from the two already installed in that it is built as two separate units for operation in parallel, with each unit capable of maintaining the service at reduced power in the event of a fault on the other. For the first few weeks of the V.H.F. service from Wrotham, only one of these transmitter units will be in operation, and the Home Service transmissions will not be at full power; the effect of this is not likely to be noticeable except at extreme range.

Aerials

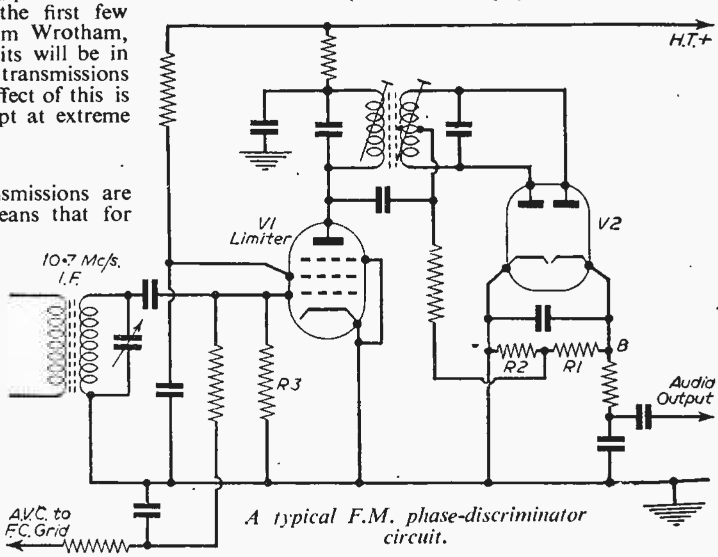
As already stated, the transmissions are horizontally polarised which means that for maximum performance the receiving aerial must be erected in a horizontal position. Whilst a proper aerial may be obtained, and will undoubtedly be needed in fringe areas, within quite a wide range of the transmitter quite an inexpensive aerial will suffice. A simple form of indoor aerial can be made from twin flex by untwisting the end to a distance of 2ft. 6in. to make a straight horizontal portion 5ft. long with the down lead at the centre. The other end of the flex should be connected to the input terminals of the receiver. For best results the direction of the horizontal portion should normally be at right angles with a line drawn to the transmitter. Since the signal strength at the receiver increases with the height of the aerial above ground, the latter should be mounted as high as possible, for preference in the loft of the house or above the roof.

For those who wish to make a more ambitious aerial, or who are situated at a distance, reflectors and/or directors may be added, following a similar technique to that used in present-day television equipment. The figure of 5ft. already given will come roughly in the centre of the V.H.F. band, and if a reflector is used it should be roughly 5ft. 3in. long, and the director 4ft. 9in., in other words 3in. or so longer or shorter according to the position of the additional element. The spacing between the aerial and the reflector should be about 30in., and between aerial and director roughly half of this. Reflectors are placed behind the aerial and directors in front (relative to the direction of the transmitter) and both reflectors and directors are insulated from the supporting crossbar and aerial itself, and are not connected to the aerial.

Tuners

Standard 70 ohm television coaxial feeder may be used, although the type of feeder will depend upon the input arrangements in the tuner or receiver used with the aerial. If the aerial is folded in order to reduce overall dimensions, the impedance will be raised to about 300 ohms and call for a different type of feeder or special matching arrangements.

(*Concluded on page 294*)



A typical F.M. phase-discriminator circuit.

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A Combined 465 kc/s Modulated Oscillator and Audio Oscillator

An All-dry One-valve Test Unit

By A. A. Tucker

THE following is a description of a compact piece of apparatus which is easily and quickly built with few components. The author has found it most useful for rapid checking and fault-finding on superhet receivers.

The Circuit

The valve is a pentagrid (1R5, CV782) working in a tuned-grid-tuned-anode circuit which utilises the inner grid to produce oscillation at a frequency of 465 kc/s. Modulation is achieved by A.F. feedback between the screen and control grids, by means of a small phone output transformer, the grid side of which is tuned to 1,000 c.p.s. The inter-electrode capacity existing between the anode and injection grid is insufficient to cause oscillation and it is therefore supplemented by a 5 pF capacitor (Fig. 1).

Output controls may be added to the circuit shown, but the A.F. outputs have a convenient amplitude and proximity of the R.F. probe to the test point gives sufficient control over I.F. input.

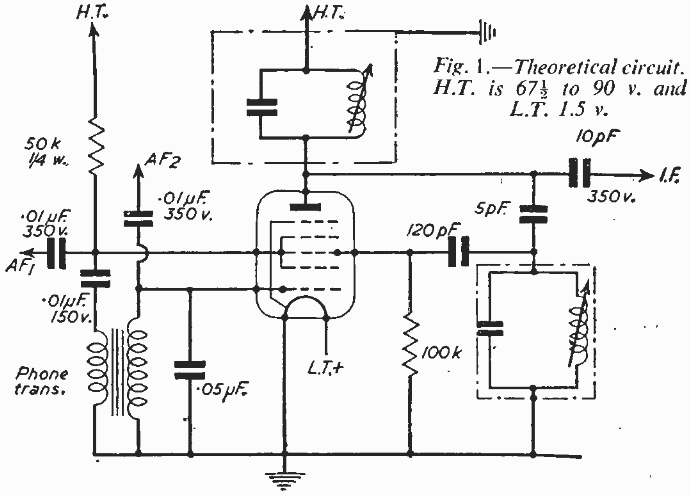
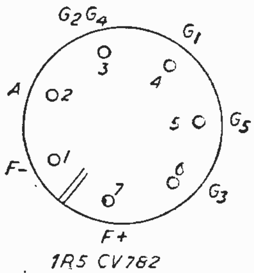
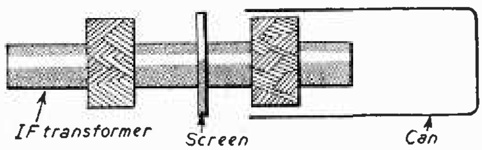


Fig. 1.—Theoretical circuit. H.T. is 67½ to 90 v. and L.T. 1.5 v.





Figs. 2 and 3.—Details of coil and valve base connections.

Open circuit output amplitudes are approximately:
3 volts at I.F.
3 volts at A.F.1.
1.5 volts at A.F.2.

Depth of modulation at 1,000 c.p.s., 50 per cent.

All outputs are sine waves.

The tuned anode and grid circuits are provided by the two sides of an I.F. transformer, and because oscillation is maintained by the Miller effect, magnetic coupling between the two windings must be destroyed by means of a copper screen at earth potential (Fig. 2).

Construction presents no problem. The positioning of components does not need special care other than making R.F. leads short and rigid. The writer's model has overall dimensions of 4in. by 4in. by 4in.

The frequency of R.F. oscillation is determined by the grid tuned circuit, whilst the anode tuned circuit should be resonant at a slightly higher frequency.

If other equipment is not available, the adjustments may be executed with the aid of a correctly aligned receiver. First, with the anode tuning core in minimum position, inject into the first I.F. stage and search for oscillations by tuning the grid coil. If not successful screw in the anode core to some other position and repeat the search. When oscillation is heard adjust the grid for maximum output, and then screw in the anode tuning core until oscillation ceases. A slightly higher frequency setting of the anode coil is the correct operational point.

Use

The I.F. output is sufficiently strong to force through the R.F. section of a superhet receiver, and so a set may be tested overall except for the local oscillator.

If a fault exists the 3 v. A.F. output connected across the primary of the output transformer (power disconnected) will test the speaker, transformer, and whether the transformer is connected the right way round. From there move back, testing at the grid of each stage, using A.F. or I.F. outputs where appropriate, until the faulty section is found, and then search in the same manner for the defective component.

I.F. alignment may be carried out by applying the I.F. output to the signal grid of the mixer valve with the L.O. out of circuit.

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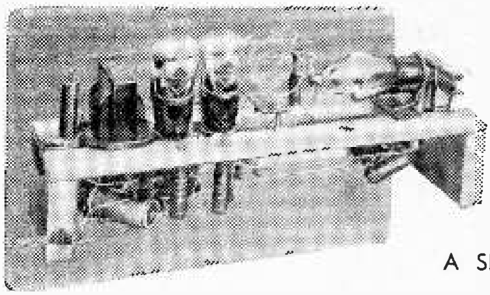

Making a Radio Telescope

A SIMPLE HOME-MADE BUT EFFICIENT INSTRUMENT FOR THE EXPERIMENTER

PART 1.—THE RECEIVER

By W. Schroeder

THE signals reaching us from outer space are weak, and detecting them and precisely measuring their strength calls for a very high degree of sensitivity of both the radio and the recording equipment.

As the average radio constructor is hardly interested in absolutely precise equipment—the results obtained with that could be appreciated only by an astrophysicist—the apparatus to be described here was designed with a view to simplicity in construction and operation without sacrificing an appreciable degree of sensitivity.

The intensity of the radiations reaching us from extra-terrestrial sources in the wavebands from 15 metres down to 1 centimetre is in the same region as the thermal noise generated by the aerial. The receiving apparatus, therefore, must have a very high amplification. It is also desirable to have a wide bandwidth in order to make a maximum of power available for detection. The signal-to-noise ratio should be as low as possible, and the equipment is preferably operated from a stabilised power supply, or from reliable batteries, to keep the gain at a constant level, and to make it possible to detect even small changes in the intensity of the received radiations.

Considering these requirements, the successful construction of a radiotelescope seems to be beyond the capabilities of an amateur. A T.R.F. receiver with sufficient gain has—of necessity—insufficient bandwidth, and the input of a superhet seems to be too noisy to be of any practical use.

A super-regenerative receiver can, however, easily be made to fulfil these requirements satisfactorily. It has sufficient bandwidth, extremely high gain, and its signal-to-noise ratio can be kept low enough to be employed usefully to detect the faint signals from the sun or the Milky Way.

The usual form of the super-regenerative receiver provides an output which is proportional to the logarithm of the signal strength, and the power indicated in the output circuit would be practically the same with, as without, a signal being present, as, in the latter case, the aerial noise will be amplified up to the same level as would the signal.

Many war-time radar receivers employed a super-regenerative circuit which is working in a linear mode, and it is this circuit which is the only practical solution for the amateur radio astronomer who constructs his own apparatus.

The Circuit

In Fig. 1 the circuit of a linear receiver is shown consisting of a super-regenerative oscillator, a quench oscillator, and the detector. The grid of the first oscillator is biased to a point where self-oscillation does not take place. The quench-oscillator produces

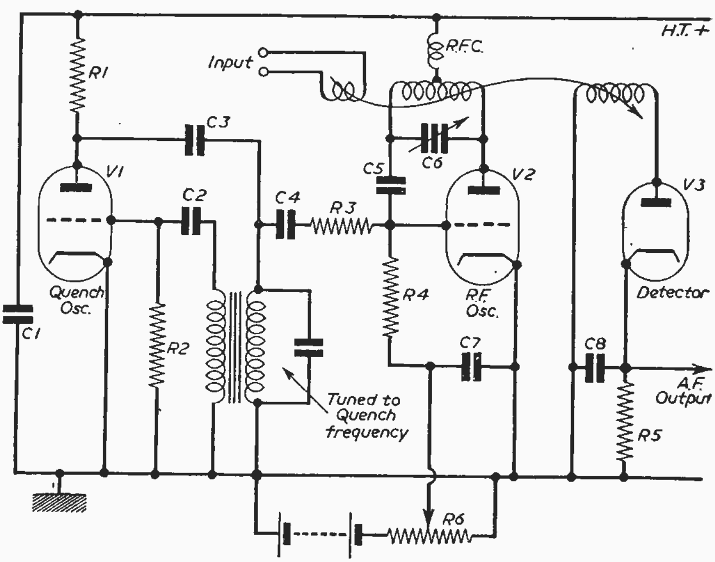

Fig. 1.—Basic circuit of super-regenerative receiver working in linear mode. V1—Quench oscillator, V2—Super-regenerative oscillator, V3—Detector.

List of Values

R1 = 50 KΩ
R2 = 10 KΩ
R3 = 100 KΩ
R4 = 100 KΩ
R5 = 25 KΩ
R6 = 100 KΩ (Variable)
C1 = 0.01 μF
C2 = 100 pF
C3 = 0.001 μF
C4 = 100 pF
C5 = 50 pF
C6 = 25 pF (split stator)
C7 = 0.001 μF
C8 = 0.001 μF

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an alternating voltage which is superimposed on the steady grid-bias voltage.

During the positive parts of the quench-cycles, the super-regenerative valve becomes conductive, and oscillations begin to build up.

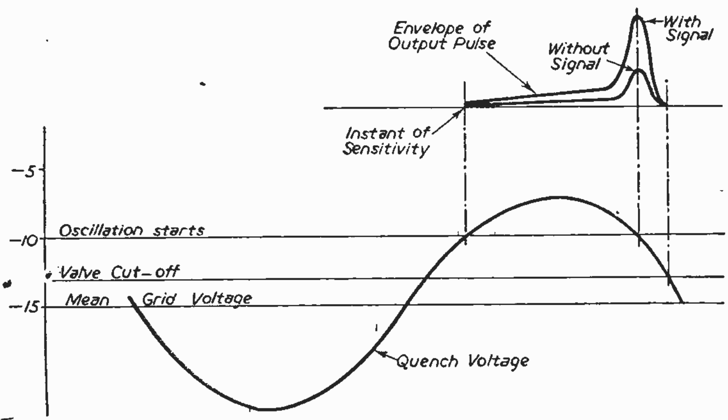


Fig. 2.—Shape of the output pulse envelope in relation to the voltage (bias plus quench) at the grid of the oscillator.

The exact moment when these two voltages cancel one another to the extent of making the valve conductive is the only part of the whole quench-cycle during which the receiver is sensitive either to signal or to noise. The signal (or noise) voltage then present determines the initial amplitude of the oscillations which afterwards build up to about one million times that value. Fig. 2 shows the envelope of the super-regenerative oscillations during one quench-cycle without and with a signal at the receiver input in relation to the grid-voltage at the oscillator.

During the n gative parts of the quench cycles, the valve must be biased beyond the cut-off point to make sure that the oscillations cease; otherwise the next burst of oscillations builds up from the remainder of the oscillations from the previous cycle, instead of from the signal, with consequent loss of sensitivity.

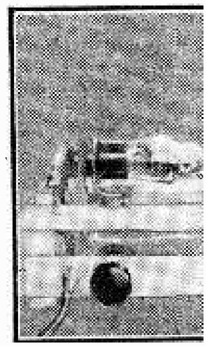
As the current required by the valve to start oscillation is only a fraction of the current passed by the same valve when used as an amplifier, the shot noise is considerably smaller, and the noise factor is decreased. This can be further improved by making the coupling very tight, thus further reducing the current required to start the valve oscillating.

The mean anode current of the oscillator increases during each burst of oscillation and, as the mean of the oscillation amplitudes alters with the signal strength, the anode current has a component at carrier modulation frequency which, in radio astronomy, is a random noise.

As the gain of a super regenerative receiver of this kind is proportional to the period of the quench cycle, this should be made as long as possible.

Five hundred cycles per second is by no means too low a frequency, and as the actual noise received is of no importance, it does not matter if the output is modulated by an audible frequency.

Gain is also increased by adjusting the grid-voltage of the super regenerative oscillator to a point where the peak amplitude of the oscillations in each burst comes as near saturation point as possible, but without actually reaching it. If it does, the set no longer works in the linear, but in the usual logarithmic mode. An oscilloscope connected to the output is the only means of



Radiotelescope as us
amplifier, R.F. oscill
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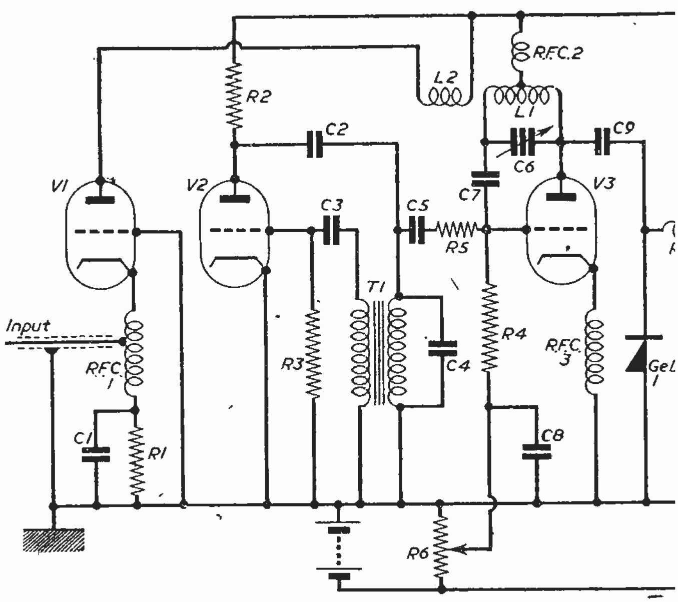

Fig. 4.—Circuit of the complete receiver consisting of grounded grid R
stage, L.F. crystal rectifier

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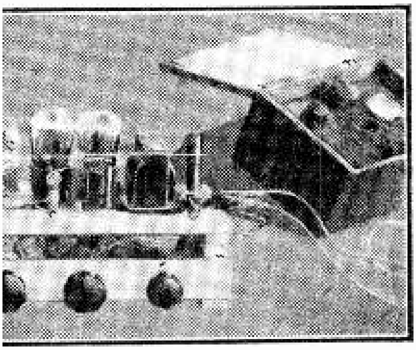
making sure of this, and the oscillation envelope should have a shape as indicated in Fig. 2. On no account must the top of the curve be flattened down.

Finally, the gain is inversely proportional to the capacity included in the tuning circuit, and this should consequently be kept as low as possible. At the short wavelengths concerned, a few picofarads are all that is needed, anyway.

Taking all this in account, the super-regenerative receiver should have a gain of about 90 to 100 decibels.

R.F. Stage

If this receiver is connected to an aerial, it is liable to radiate oscillations which will interfere with neighbouring receivers, and which may be reflected by nearby metal objects and thus give misleading indications of received signal power. It is, therefore, necessary to precede it by an R.F. amplifier, which has the advantage of giving some improvement in the signal-to-noise ratio.



he author. The unit on the left contains R.F. uench oscillator and detector. The other .F. amplifier and valve voltmeter.

Unfortunately, it also destroys what is possibly the greatest advantage of the super-regenerative receiver in its application as a radio telescope: this

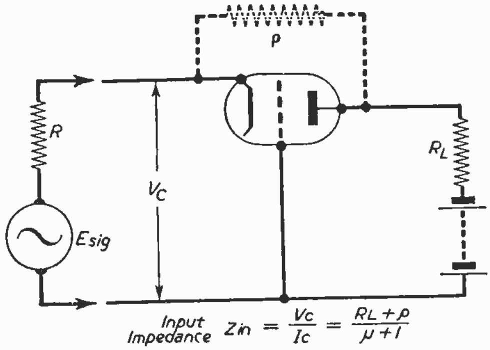
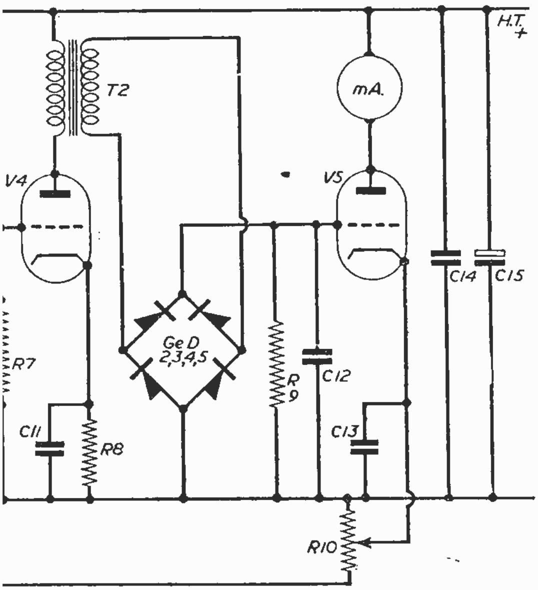


Fig. 3.—Basic diagram of grounded grid R.F. amplifier.

is the advantage of single circuit tuning with its consequent bandwidth. The application of a grounded grid R.F. amplifier triode, however, avoids this complication, see Fig. 3.

The output from the detector stage, which is either a silicon diode as used in radar receivers or a germanium diode capable of rectifying V.H.F.s, is amplified in a single-stage L.F. amplifier and then rectified by four germanium diodes in bridge circuit. These can be low-grade types, but must be reasonably well matched (Fig. 4). The output from the L.F. stage is, of course, a 500 c.p.s. frequency, the amplitude of which is determined by the strength of the received signal. The condenser C11 is, therefore, charged to a D.C. potential which is proportional to the signal.

The circuit associated with V5 acts like a valve-voltmeter, and the 0-1 mA meter in the anode lead gives an indication of the signal strength. Without an aerial connected to the set, the reading obtained will



re, quench oscillator, R.F. oscillator, crystal detector, L.F. ilve voltmeter.

LIST OF COMPONENTS
(Fig. 4)

R1—According to valve	C4—To tune secondary of T1 to 500 cps.
R2—50 kΩ	C5—0.001 μF
R3—10 kΩ	C6—25 pF (split stator tuning condenser)
R4—100 kΩ	C7—50 pF
R5—100 kΩ	C8—0.001 μF
R6—250 kΩ pot.	C9—10 pF
R7—100 kΩ	C10—0.001 μF
R8—According to valve	C11—25 μF electrolitic
R9—100 kΩ	C12—0.1 μF
R10—250 kΩ pot.	C13—25 μF. electrolytic
C1—0.001 μF	C14—0.001 μF
C2—0.05 μF	C15—8 μF electrolytic
C3—0.001 μF	

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correspond to the noise generated in the set itself, and although this consists of random voltages, the meter gives a comparatively steady reading, because it is damped by the circuit constants. The bias of V5 can be adjusted to give a reading of 0.01 mA (this is easier to adjust correctly than zero). After connecting the aerial the new reading obtained corresponds to signal voltage received plus noise generated by the aerial itself. By directing the aerial towards a part of the sky which is known to be practically free from radiations, the meter can again be adjusted to give a reading of 0.01 mA, and then any reading different from this is due to actually received radiations.

Because of the high amplification none of the readings will be completely steady; the needle will always fluctuate somewhat, but quite small signals still give a reading which it is possible to distinguish from these fluctuations.

Layout of the Receiver

While Fig. 4 shows the final circuit of the complete receiver, Fig. 5 is a diagram of a suggested layout. The whole receiver is mounted on two strips of wood, 1in. by ¼in. by 18in. long, which are screwed to the top of two blocks of wood 2in. by 3½in. by ½in. thick. A third strip of wood is screwed to the front and this carries all the adjustable controls. The whole chassis is given two coats of aluminium paint and is then ready for mounting the components.

The sensitivity of a receiver built along these lines is very great indeed. If a noise factor of 2 or 3 is obtained on the meter waveband—which is quite possible with modern U.H.F. valves—an input of only 10-14 watts gives a clear indication. With a receiver bandwidth of 1 Mc/s and an aerial gain of only 10, the greatest part of the Milky Way gives a clear indication of radiations. From some parts these are, under the conditions mentioned, about 10 to 20 times greater than the minimum detectable.

Individual "radio stars," or the sun under normal conditions, do not radiate enough power to give a reading on this receiver. Not even when extreme care has been taken to stabilise the gain of the receiver. But a method was discovered some years ago which increases the sensitivity several hundred or thousand times, and this has the added advantage of eliminating any instability in the gain of the instrument.

Increasing Sensitivity

Fig. 6 shows the modifications necessary to obtain this enormous sensitivity. V6 is a noise generator coupled to the receiver input by L3. The noise power generated can be adjusted by altering the filament voltage, but always working the valve at saturation point, that is, with the full high-tension on the anode.

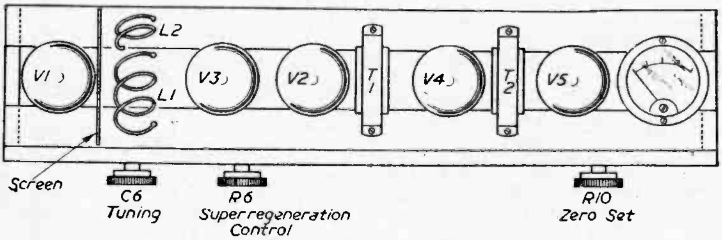

Fig. 5.—Suggested layout of receiver.

Two semi-circular aluminium plates rotate on a common shaft at a speed of about 25 rps, alternatingly coupling the aerial and the noise generator to the input. Any difference between the intensities of the received signal and the comparison noise appears as a 25 cps square-wave modulation in the output of V4 of the receiver.

This is mixed in a Cowan modulator (the four germanium diodes must be well matched to avoid cross-modulation) with another 25 cps square wave produced by the battery and the two brushes connecting a metal foil on the driving shaft of the plates, which make contact throughout the time the aerial is coupled to the receiver, and breaking it while the generator is coupled to it.

The receiver output is either in phase or 180 deg. out of phase with this square wave, and thus producing either an increase or a decrease of the D.C. voltage at the output of the mixer. This D.C. potential is measured by a valve voltmeter as in Fig. 4.

This arrangement eliminates any instability in the receiver, as now only the difference between two noise levels is measured, and it greatly increases the sensitivity.

(*To be concluded*)

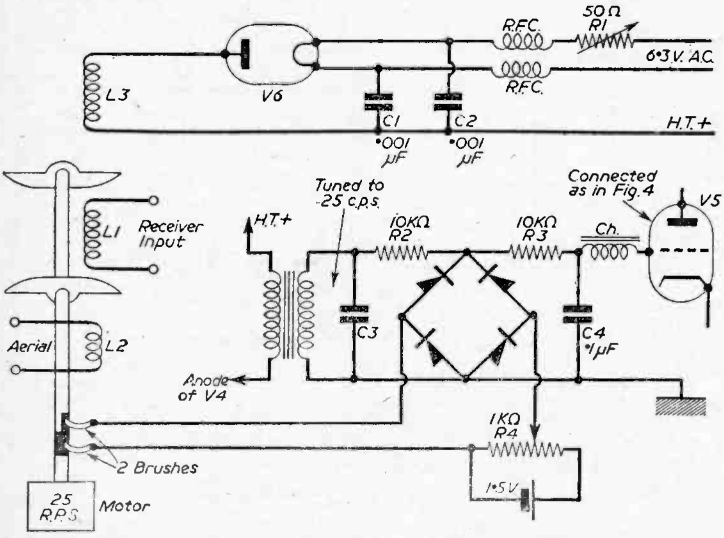

Fig. 6.—Additional circuitry for increased sensitivity. **V6**—*Noise generator.*

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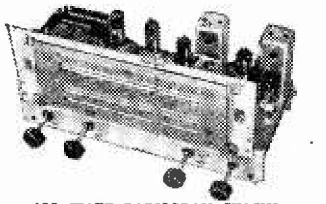

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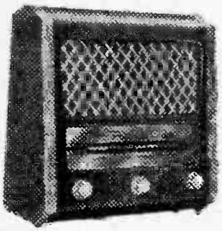

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MAKING TRANSISTORS

HOW TO USE SURPLUS DIODES IN THE CONSTRUCTION OF MODERN TRANSISTORS

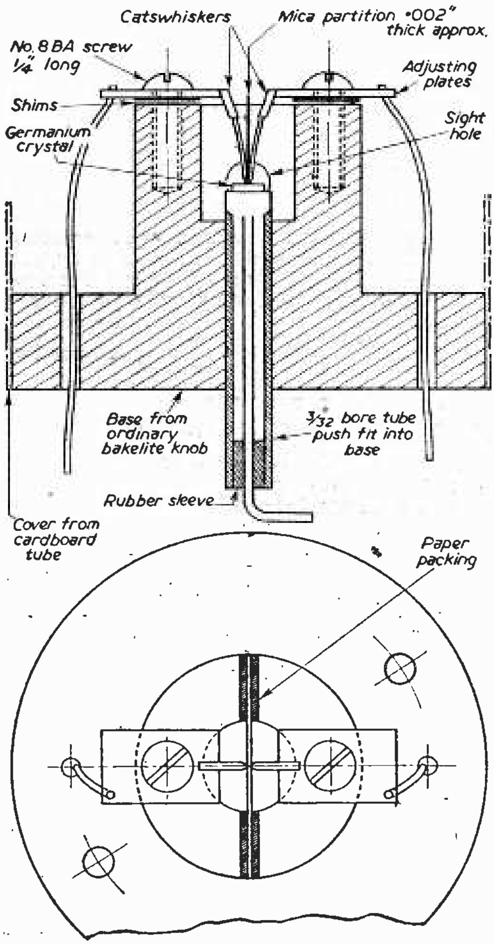
By H. T. Noar

THE small .161 dia. germanium diodes with wire ends can be made into a transistor as shown on the attached sketches. This assembly calls for two diodes, a body made from a type of knob usually found in the spares box, adjusting plates of strip brass from a spent battery, and a small piece of tube approximately 3/16in. outside diameter. The diodes are broken apart and both catswhiskers used, while one crystal is used and the other kept as a spare.

To construct, first modify the knob as shown, cutting off to length and file the end true. Next, drill all holes, using a No. 49 drill for 8 BA tapping. The central hole should be drilled to a push fit for whatever piece of tube is available. Next, saw cut, keeping directly across the centre, then file out the 5/16in. wide slot. The ends of the whiskers should be trimmed on an oilstone before cutting off the heavy wire to length. This is attached to the brass adjusting plates by soldering at a slight angle as shown. The 9/32in. dimension should be as nearly equal as possible in both plates, although any slight difference is taken up by varying the shims on assembly. A piece of mica, about .002in. thick, ¼in. by ⅜in. approximately, is placed in the slot and held in position with paper packing on each side. The ends of the whiskers should project 1/16in. beyond the bottom edge of the mica sheet.

The glass end of the germanium crystal should be left on, and is cemented to the end of the tube, which should be countersunk slightly. The wire end is brought out of the end of the tube through a piece of rubber sleeving.

Solder flexible wire to the adjusting plates to connect underneath through holes in the base. The



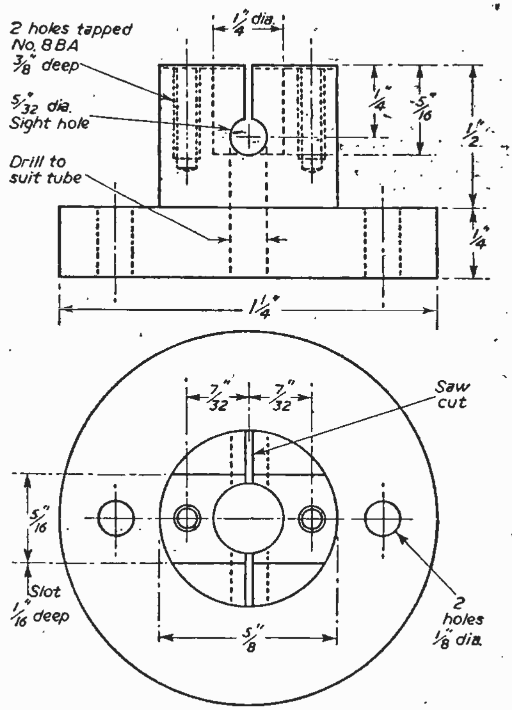


Fig. 1 (left).—Elevation and plan of the finished component, and Fig. 2 (right)—Details of modifications to control knob.

shims are made of thick paper or .010in. copper sheet, cut to the same size as the adjusting plates. This is for height adjustment, so that when assembled, each whisker touches the crystal with exactly the same pressure. When assembling use a magnifying glass to examine the position of points through the sighting hole.

The tube must be a fairly tight fit in the central

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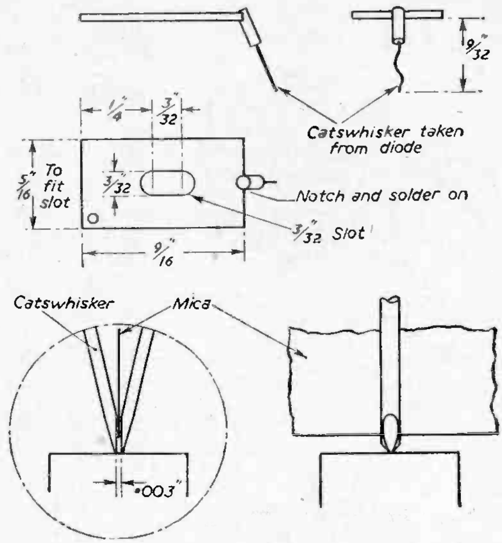
hole so as to stay in position once the correct position has been found. The crystal is pushed up against the catswhiskers until the resistance to either reads about 700 ohms in one direction, and about .5 megohms in the other direction. The tube should then be cemented lightly in position and a cardboard cap made to fit over the whole assembly and keep out dust, etc.

Forming

To form the collector it is necessary to pass a pulse current of about 250 volts through one of the whiskers, which should be painted red or marked C. This can be accomplished by discharging a .1μF condenser between the collector and the crystal at regular intervals until the back resistance drops to about 8,000 ohms. Commence using a small value condenser and low voltage, and working up to .1μF at up to 300 volts. Should the crystal become damaged due to overload, it can be turned round, readjusted and the collector re-formed.



Figs. 3 and 4.—Details of the adjusting plates, and an enlarged view through sight hole showing spacing of catswhisker.

TRANSMITTING TOPICS

(*Concluded from page 278*)

neutralise the crystal capacity, as shown in the circuit of Fig. 5. The small 3/30 pF trimmer is arranged as a neutralising capacity. To neutralise the circuit, the tank circuit is adjusted so that the circuit self-oscillates at a frequency near the required crystal overtone, *but* not close enough to cause the crystal to pick up. By listening in a receiver, the rough self-excited note can be picked up. The 3/30 pF trimmer is then adjusted so that oscillation ceases. This point is that at which the capacitative regenerative transfer through the crystal is balanced out. If the tuned circuit is now tuned to the required overtone frequency, the crystal will pick up and crystal controlled overtone operation will be obtained. F3GG was able to obtain easily the seventh overtone from an old 3,500 Kc crystal or as he puts it " d'un quartz 3,500 kc/s, ancien modèle." It should be noted that many 7 Mc/s quartz crystals, if induced to take off on their fifth harmonics, will provide useful TX frequencies in the 144 Mc/s band.

Colpit's Version of Hartley

A further adaption of the circuit of Fig. 4 is also now becoming popular. In fact, following upon its appearance in QST for September 1953, references to this circuit have appeared all over the world. Curiously enough, however, no British magazine has yet published it. The circuit is, in fact, the " Colpitts " version of the " Hartley " circuit of Fig. 4. Its merit is that it avoids tapped coils or feedback windings, and regeneration may be adjusted by a capacity adjustment. The 50 pF capacity which gives the effective capacity regeneration tap may be adjusted for optimum output when oscillating under crystal control at the third overtone. The circuit is, of course, not recommended for higher harmonics than the third unless special overtone crystals are used. For easy adjustment the circuit could be modified by replacing the 50 pF condenser by a variable, or a small fixed condenser shunted by a variable for adjusting regeneration. However, the 50/500 capacitor combination shown will provide excellent results when using either a 6J6 or a 12AT7 in the oscillator circuit. Fig. 6 shows the circuit, while an alternative slug-tuned version is shown in Fig. 7. For a 144 Mc/s transmitter, an 8 Mc/s crystal could be employed, with the first triode of a 12AT7 or 6J6 oscillating on the third overtone, i.e. 24 Mc/s. The second triode section of the 6J6 or 12AT7 can double or triple to give 48 or 72 Mc/s output which, passed to a doubler or tripler, provides direct 144 Mc/s drive for, say, an 832. Line-ups of this sort are, in fact, common for 2 metre working, and for third overtone operation the circuits shown are generally docile and stable when correctly adjusted.

RECEIVING F.M. TRANSMISSIONS

(*Concluded from page 285*)

For the reception of the transmission, a plug-in feeder will no doubt prove most useful, as the majority of listeners have a good radio, or amplifier used with a radio tuner or gramophone unit, and a tuner may be built with an output designed to be connected to the pick-up sockets of such an amplifier or receiver. There are several commercial tuners on the market and we shall be describing further designs in due course. There are several alternative arrangements available, but the critical part of any F.M. receiver is in the detector circuits, and although it is possible to make up the special transformers which are required they are available ready-made from at least one firm. The normal superhet circuit is best, and the tuning may be pre-set or manual, according to individual preference. An I.F. of round about 10 Mc/s is suitable and again I.F. transformers made for this frequency are commercially obtainable. At the high frequencies used for these transmissions stability is a most important factor, and care is necessary in the layout and wiring of any feeder or receiver, and also in the disposition of certain parts to avoid the effects of temperature changes.

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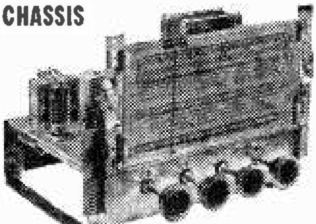

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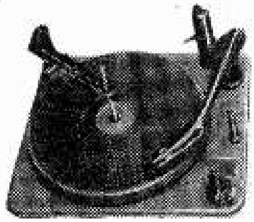

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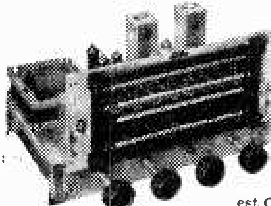

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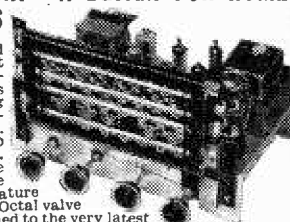

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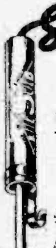

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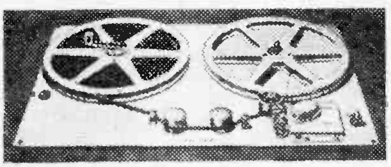

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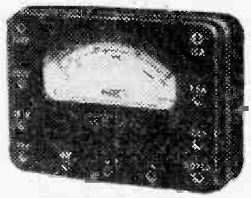

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A CIGAR BOX RECEIVER

A RECEIVER COUNTERPART TO THE SMALL ONE-WATT TRANSMITTER DESCRIBED IN THE MARCH ISSUE

By T. W. Dresser

IN a recent issue of PRACTICAL WIRELESS the writer described the "Cigar Box Transmitter," an extremely small 1 watt transmitter suitable for the amateur without mains electrical supplies or who is so restricted for space that anything in the nature of a normal sized shack and transmitter is entirely out of the question. In the present article it is proposed to describe the receiver counterpart to that transmitter, an equally small unit which, despite its small dimensions and simple circuit arrangement, will nevertheless put up quite a good show.

To begin with, those who think only in terms of double conversion, crystal filters, phasing controls and the other more elaborate gadgets of the high-priced commercial receivers, will not be interested in this receiver. None of those adornments can be built into a T.R.F., but even without them the performance of this receiver is not one to be despised. The circuit consists of an R.F. amplifier, leaky-grid detector, with reaction, and audio amplifier. All the valves are of the same type, 1T4's, just as are those in the transmitter. The excellent performance arises principally from good layout, adequate screening and the very smooth regeneration provided by potentiometer control on the screen grid of the detector. It has been called a cigar box receiver, and it can easily be built into such a box, as was the original, but there is no reason why it should not be assembled in a metal case or on a small metal chassis, and, in some cases, this may be an advantage in that it helps to keep down hand-capacity effects. These were not noticeable in the prototype, as the cigar box was completely lined with aluminium foil, which made a most effective screen.

Construction

The form of construction used at the R.F. end may be rather unusual, but it has many advantages, noticeably in keeping grid and anode leads down to a minimum length and in isolating the R.F. stage

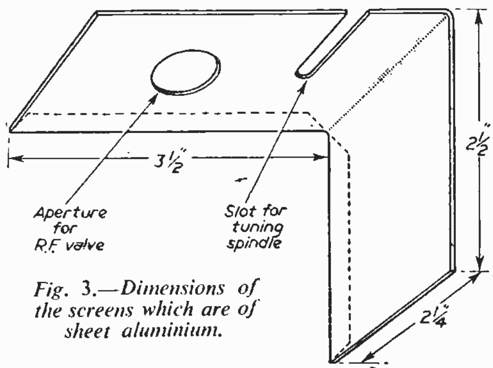

Fig. 3.—Dimensions of the screens which are of sheet aluminium.

from the detector as far as unwanted interaction was concerned. Nor is it difficult to build as the screen can be removed from the box, the R.F. valveholder and the detector grid coil holder fitted and wired to some extent before it is permanently fastened into position. This greatly facilitates construction.

As originally built, the receiver covered the five main amateur bands, 3.5, 7, 14, 20 and 30 Mc/s, using a ganged 15 pF tuning condenser. With some small changes it can be made to cover 3.5 to 30 Mc/s continuously, and the coil data and all necessary information is given for both coverages.

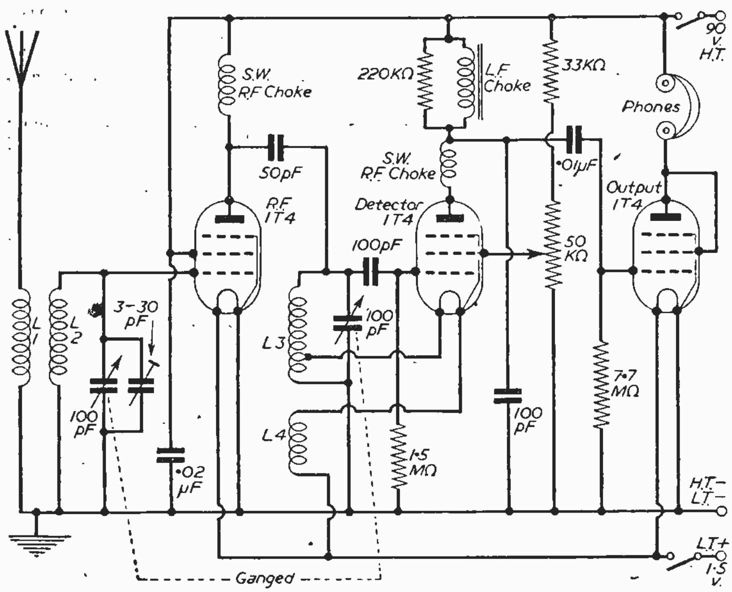

Fig. 1.—The theoretical circuit.

The theoretical diagram is given in Fig. 1, and it will be noted that the reaction is controlled by varying the screen-grid voltage, a method which has a lot in its favour in that it does not affect the tuning to any noticeable degree. The detector anode load is a high-inductance L.F. choke of some hundreds of Henries and that used by the writer was a pre-war component. It is questionable whether such a choke can be obtained to-day, but the primary winding of an ordinary inter-valve transformer will serve just as well. In that case, the secondary can be left disconnected or placed in series with the primary, but care must be taken to see that it is truly in series, and not connected in such a way that it reduces the inductance of the primary, which can happen. As with its companion transmitter, all components should be as

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small as possible consistent with good quality.

Lay-out

Fig. 2 shows the lay-out of the receiver. The cigar box is lined with thin, completely flat and unwrinkled, aluminium foil, pressed well down at all corners and fastened round the edge of the box with drawing pins or strips of aluminium screwed down. The screens are then cut and bent from sheet aluminium to the dimensions in Fig. 3. and the R.F. valveholder and detector grid coil-holder mounted, as shown. The screen can then be screwed inside the box with very small brass wood screws of no more than $\frac{3}{16}$in. or $\frac{1}{4}$in. in length. The remainder of the construction and the wiring are quite straightforward and if the diagrams are followed carefully, there is little likelihood of error.

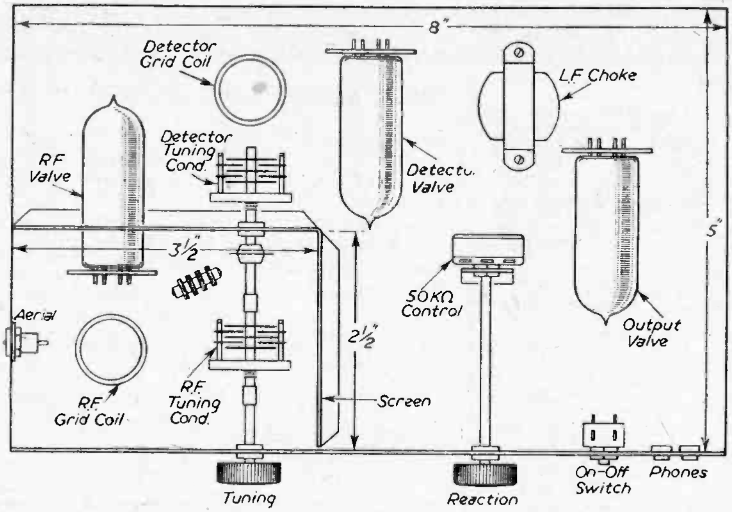

Fig. 2.—Lay-out of the receiver.

As with any other short-wave receiver all wiring should be as short as possible, and a common earthing point should be used for each stage. Coil formers should be of good quality material, such as polystyrene, and the tuning gang (or coupled condensers) should preferably have ceramic insulation.

The only differences between the amateur band version, and that for 3.5 to 30 Mc/s continuous coverage are in the size of the coil formers and the sockets for them, and in the capacity of the tuning condensers. In the first mentioned the coil formers are Maxi-Q dust cored 5-pin types, with holders to suit, and the tuning condenser is a 2-gang 15 pF variable or two separate 15 pF coupled together. In the continuous coverage version the tuning condenser is a two-gang 100 pF variable, and the coil formers are standard 1.25in. 5-pin types with sockets to match. The change in the mechanical layout is so small that it needs no detailed description.

As the interior of the cigar box is completely covered with aluminium foil, it is advisable to keep a close eye on connections and wiring generally in order that they may not earth to the foil. Where there is any danger of this a small piece of cardboard or fibre under valveholders and at strategic points will eliminate the danger. As with all T.R.F. receivers, a good aerial is half the battle. If the receiver is to be used with the cigar box transmitter, the same aerial will serve for both: a simple form of switching will change over the batteries and the aerial from transmitter to receiver simultaneously. If the receiver is to be used alone, an aerial as high and as long as possible should be erected.

In conclusion, the quiet background and signal getting qualities of this little set will prove a pleasant surprise to those accustomed to elaborate A.C. types, and, at the same time, its cheapness is such that even the beginner need not remain without a short-wave receiver if he has the pound or two necessary to build it.

Coil Data for 3.5 to 30 Mc/s Continuous Coverage

	L1	L2	L3	Tap L3	L4
1	6 turns 28 s.w.g. enamel	25 turns 28 s.w.g. enamel	25 turns 28 s.w.g. enamel	4	4 turns 28 s.w.g. enamel
2	5 turns 28 s.w.g. enamel	14 turns 18 s.w.g. enamel	14 turns 18 s.w.g. enamel	3 turns	3 turns 28 s.w.g. enamel
3	3 turns 28 s.w.g. enamel	6 turns 18 s.w.g, enamel	6 turns 18 s.w.g. enamel	2½ turns	2½ turns 28 s.w.g. enamel

Coil Data for Amateur Bands

Band	L1	L2	L3	Tap L3	L4
3.5 to 4 Mc/s	7 turns	60 turns closewound	60 turns closewound	10 turns	10 turns
6.9 to 7.4 Mc/s	5 turns	30 turns closewound	30 turns closewound	5 turns	5 turns
13.9 to 14.4 Mc/s	3 turns	20 turns spaced to ½in.	20 turns spaced to ½in.	3½ turns	3½ turns
20.5 to 22 Mc/s	3 turns	13 turns spaced to ½in.	13 turns spaced to ½in.	3 turns	3 turns
27 to 30 mc/s	2 turns	10 turns spaced to ⅜in.	10 turns spaced to ⅜in.	3 turns	3 turns

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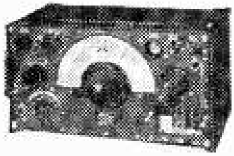

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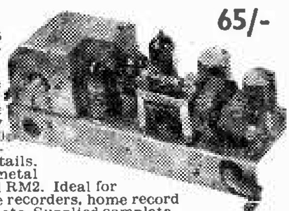

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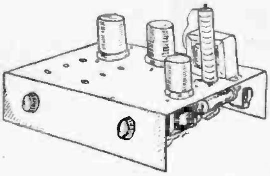

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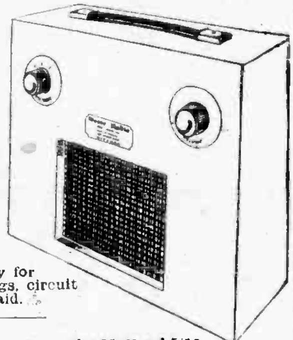

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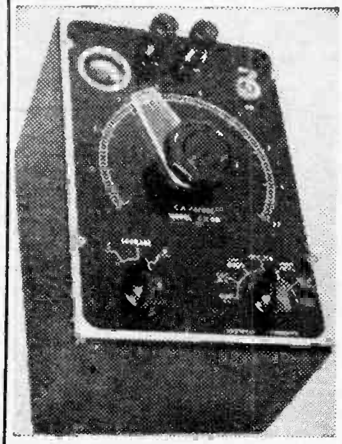

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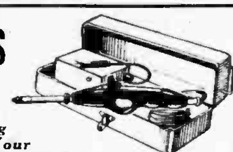

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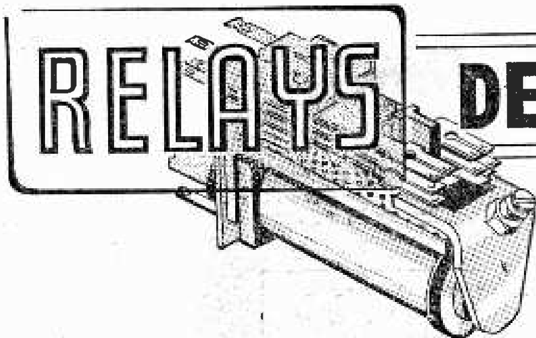

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THE THIRD ARTICLE IN A NEW SERIES DEALING WITH A MOST USEFUL TYPE OF RADIO ACCESSORY

By J. R. Davies

IN the first and second articles of this series we devoted our attention to the various types of relay which are likely to be encountered in radio work; and discussed also their operation when used by themselves or in various circuits designed to alter their speed of operation.

This month we shall pass on to relay circuits proper, illustrating how they may be used for remote control and for various automatic switching processes.

Remote Transmitters

Remote control is a matter of interest to many radio enthusiasts. Particularly is this true of the amateur who may wish to control his transmitter from a distant receiving point.

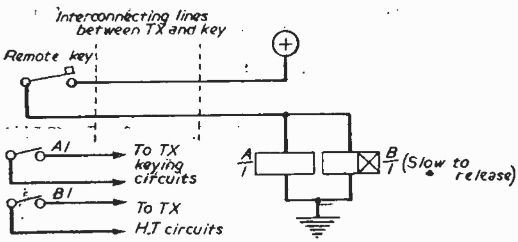


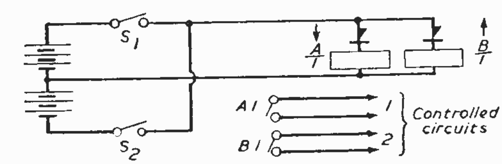
Fig. 14.—A simple remote control circuit for a transmitter.

An extremely simple two-line circuit capable of doing this is shown in Fig. 14. This circuit uses two relays, one slow to release, $\frac{B}{1}$, and one capable of operating at Morse speeds, $\frac{A}{1}$. It is assumed that the transmitter heaters are left switched on permanently (or, at least, during operating periods), the only remote control switching desired being that of H.T.

When the key at the receiver is used to send a message, relay $\frac{A}{1}$ follows it in the normal manner and keys the transmitter. Relay $\frac{B}{1}$ energises as well, but, since it is slow to release, it is not able to release during the short time existing between the Morse characters sent by the key; and it keeps the transmitter switched on all the time the message is being sent. In practice it would probably be necessary to commence by sending a short dash to energise initially relay $\frac{B}{1}$; after which it could be relied upon to remain closed until keying was completed.

One of the two interconnecting lines of Fig. 14 could possibly be dispensed with by using an earth return. However, earth returns do not always give reliable results.

Despite the fact that this circuit is simple and useful, it has several disadvantages. The first of these is the need to send the initial dash to switch on the H.T. It could happen that, after a short pause in sending, the H.T. relay may have released; whereupon, on resumption, the first few characters will be lost until the transmitter switches on again. However, once the operator has become used to working with the circuit, this effect should not be too troublesome. A possible second disadvantage lies in the fact that



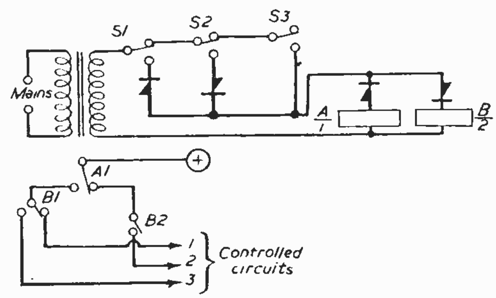


Fig. 15 (a) (left).—A circuit capable of controlling two operations over two interconnecting lines. Fig. 15 (b) (right).—The circuit of (a), expanded to control three operations. On closing S1, relay $\frac{A}{1}$ energises; on closing S2, relay $\frac{B}{2}$ energises; and, on closing S3, both relays energise. The switches are so wired that no damage can result if more than one switch is accidentally operated at the same time.

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transmitter H.T. appears whilst the key is depressed; with the result that it is always switched on on load.

An alternative scheme would consist of using separate circuits for keying and switching. It is possible to control several relays over two remote lines, but the necessary circuitry does not readily allow the use of a high-speed keying relay. An easy solution consists of using a three-line system, two lines of which are used for keying; whilst the remaining line, with one of the keying lines, is employed for all the switching that may be required. Alternatively, two lines with an earth return could possibly be used instead of the three.

Control Over Two Lines

We stated just now that several relays can be controlled over two lines. If a uni-selector arrangement is employed, the number of different circuits which may be brought into operation over two lines becomes very large indeed. However, we shall be dealing with uni-selectors next month; and so it would be better to concern ourselves here with some examples of what may be done with normal relays.

Fig. 15 (a) shows a simple circuit designed to control two relays over a single pair of lines. When S1 is closed, relay $\frac{A}{1}$ energises, current being passed to its coil by the rectifier in series with it. When S2 is closed, a voltage of the opposite polarity is connected across the lines and relay $\frac{B}{1}$ energises. (The "arrow" of the rectifiers in the diagram shows the direction of electron current flow.)

This circuit is not fool-proof, however, because damage to the batteries would result if S1 and S2 were both pressed down at the same time. The battery circuit could be protected by a fuse, but a better solution would consist of making S1 a double-pole switch, its additional contacts breaking the supply to S2 when it was closed.

If, instead of D.C., an alternating voltage were applied to the lines, both relays would operate. This is due to the fact that both rectifiers would conduct on alternate half-cycles and apply D.C. (unsmoothed) to their respective relays. Advantage could be taken of this effect to allow a third control to be used.

Since A.C. would then be required at the controlling point, it would be worth while to dispense with the energising batteries altogether and use rectified A.C. instead. A circuit showing how this may be done is given in Fig. 15 (b).

It will be noticed that, although two relays only are still being used, their contacts control three external circuits. If the contact circuits are traced out it may be seen that, when $\frac{A}{1}$ energises by itself, a circuit is made to terminal 1 via contacts A1 and B1. When $\frac{B}{2}$ energises by itself, external circuit No. 2 is made via A1 and B2. When both relays energise, external circuit No. 3 is made; this appearing via contacts A1 and B1. (It is assumed that the external circuits are actuated by the positive source of supply connected to the arm of contact A1.)

In practice it would be found that the application of unsmoothed half-wave-rectified A.C. to the relay

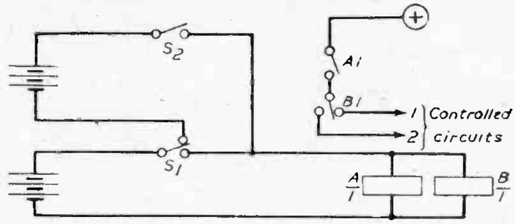

Fig. 16.—A simple circuit, explained in the text, by means of which two circuits may be controlled over two lines. S1 is connected in the manner shown to prevent any damage which might result if both switches were operated at the same time.

coils would cause them to "chatter" rather badly. A solution would consist in having them slugged so that they were slow to release. Relays which are slow to operate and release would cope just as well, provided that the user was prepared to wait a moment or two before they came into operation. (An ordinary relay could be fairly effectively slugged by wrapping, and soldering, several thicknesses of copper foil around the outside of the coil.)

Another method of controlling two relays over a single pair of lines is shown in Fig. 16. The operation of this circuit is extremely simple. The coil of relay $\frac{B}{1}$ has a higher resistance winding than has that of relay $\frac{A}{1}$; so that, assuming a similar construction, relay $\frac{B}{1}$ needs a higher voltage to energise it. Thus, when S1 of Fig. 16 is closed, relay $\frac{A}{1}$ alone comes into operation, selecting external circuit No. 1. If S2 is closed, the additional voltage is sufficient to energise relay $\frac{B}{1}$ as well, thus operating circuit 2. Such a system is practicable, although it may not always be

(*continued on page 305*)

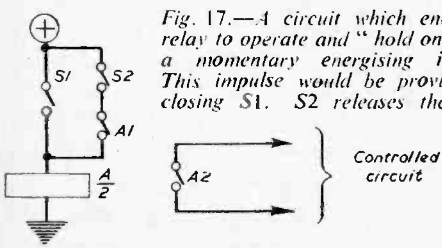

Fig. 17.—A circuit which enables a relay to operate and "hold on" after a momentary energising impulse. This impulse would be provided by closing S1. S2 releases the relay.

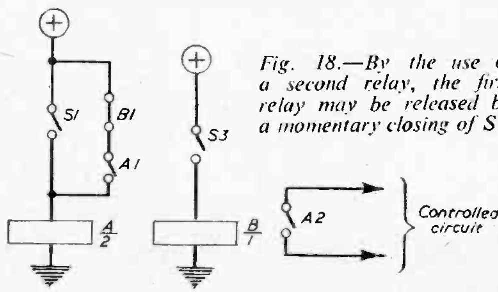

Fig. 18.—By the use of a second relay, the first relay may be released by a momentary closing of S3.

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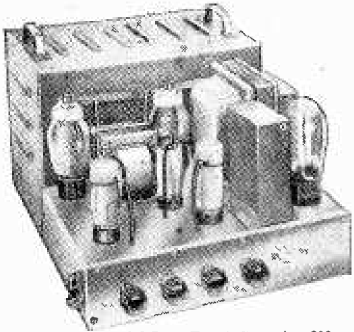

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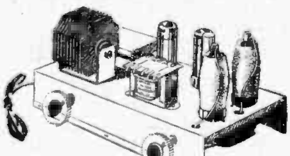

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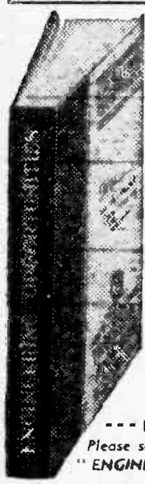

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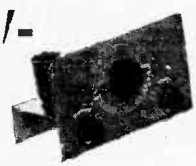

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The control of a relatively large number of operations over a small number of lines is not, of course, confined entirely to the examples cited above. As, however, most other systems are especially applicable to radio control as well, we shall defer their description to the time when we come to deal with this particular aspect of the subject.

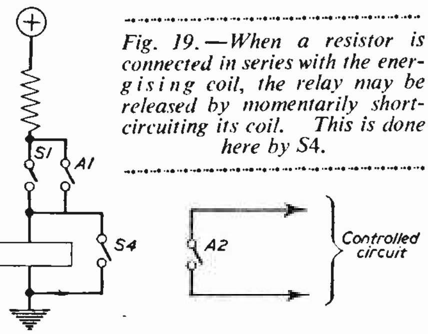

Fig. 19.—When a resistor is connected in series with the energising coil, the relay may be released by momentarily short-circuiting its coil. This is done here by S4.

Time Switching

The ability of a relay to "hold on" by one of its own contacts after it has been momentarily energised makes it very useful in certain applications where it is desired to "trip" a circuit by a single short impulse.

A typical example is shown in Fig. 17. When contacts S1 of this diagram are momentarily closed, relay $\frac{A}{2}$ energises. As soon as it energises, its make contact A1 causes the coil to be connected continually to the energising supply. The relay can then only be released by opening S2; whereupon it returns to its initial state and is ready for use once more.

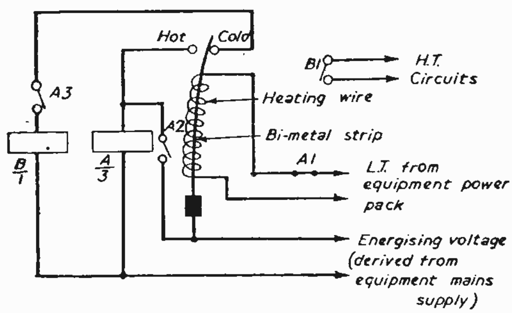

Fig. 20.—An H.T. time-delay circuit, using a bi-metal strip and two relays.

This circuit could be utilised very successfully for switching a piece of equipment on or off at certain times. If, for instance, contacts are fitted to a clock, they could take the place of S1 and cause the relay to switch on the equipment at a pre-set time. The equipment could then be switched off by opening S2.

Alternatively, by using a second relay in the manner shown in Fig. 18, the clock could switch off the equipment as well. Switching off would be accomplished by momentarily closing contacts S3, these also being operated by the clock. The process of fitting contacts to a clock need not be considered as being somewhat clumsy since, when properly carried out, such a fitting can be made both neat and efficient. It should be pointed out again that it is necessary for S1 and S3 (Fig. 18) to make a momentary contact only; and it is of no importance whatsoever if such a contact is somewhat intermittent or "crackly."

A further circuit which accomplishes the same thing is given in Fig. 19. This time the second relay is not required, relay $\frac{A}{2}$ being de-energised by momentarily short-circuiting its coil. To make this process possible it is necessary to feed the coil through a resistor (which should have approximately the same value as the resistance of the coil) and to use twice the energising voltage.

Delay Switching

Quite a different type of circuit is shown in Fig. 20, this being used to delay the application of H.T. to certain types of equipment. The circuit is intended to ensure that L.T. has been applied for a fixed period of time before H.T. is switched on. A device of this sort is particularly necessary when mercury-vapour H.T. rectifiers are being employed, as the heaters of these valves need to warm up for at least a minute or two before H.T. can be connected.

The delay circuit employs two relays and what is known as a bi-metal strip. This latter consists of two lengths of metal whose coefficients of linear expansion for heat differ fairly widely. The two metals are riveted or welded together along their lengths to form a single strip. When heat is applied to the strip one of the metals expands by a greater extent than does the other, causing the whole strip to bend. Fig. 21 illustrates the process.

In Fig. 20 the bi-metal strip is heated by a coil of resistance wire wrapped around it and insulated from it by a layer of mica. The resistance wire could conveniently be heated by the L.T. supply of the equipment in which it is used.

Referring to the diagram, let us assume that the equipment is switched off and that the bi-metal strip is cold. As soon as the equipment is switched on L.T. is applied to the heating coil and the strip begins to warm up. After some time it has become sufficiently hot, and has bent over sufficiently far to touch the "hot" contact. This causes relay $\frac{A}{3}$ to energise, thereby switching off the supply to the heating coil by means of the break contact A1. Relay $\frac{A}{3}$ remains energised via its own contact A2. The bi-metal strip starts to cool; when sufficiently cool it touches the "cold" contact, energising the other relay via the make contact A3. H.T. is then switched on by contact B1.

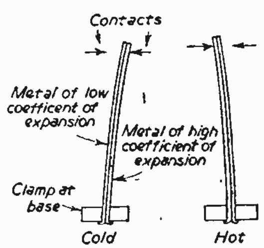

Fig. 21.—Illustrating how a bi-metal strip bends when it is heated.

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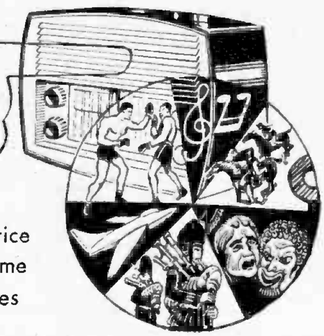
Programme Pointers



Our Critic, Maurice Reeve, Reviews Some Recent Programmes

Early Cricket Commentaries

I WONDER how many of my readers listened in to the test match commentaries from Australia last winter; or whether the hour deterred them? And, of those who did, what did they think of them? I thought them superior to ours, less donnish and slightly less repetitious, rather remarkable seeing that the rate of scoring was even slower than it is here. There was rather more camaraderie and interchange of views between the commentators than we are given, which seemed partly due to the presence of a "spectator" in Arthur Gilligan, whose presence helped to create a more sociable and less austere atmosphere than we provide. This practice could well be copied. I know we have experts at Test Matches such as Alf Gover and George Duckworth, but they don't quite function in the same way.

Anyhow, it will be four years before we cricket-fans will be called upon to tune in to the atmospheric cracklings which fill the air between here and Australia, and a deal can happen in the meantime.

"Personal Column"

I heard the last of Jenifer Wayne's present series of *Personal Column* of impressions, reflections and facts—"Tea-shops"—and it made me hope that another will soon follow. Miss Wayne has the ability to marshal the facts of our ordinary "lawful occasions" and to put our comings and goings—in the present instance our bath-bun and butter and our midday replenishment—into the right business-like perspective. Coupled with a fluent delivery and a pleasing personality, hers make very entertaining broadcasts.

Admirers of the work of Thomas Hardy, of whom I am one of the foremost, will have derived great pleasure from the programme of reminiscences and recollections "by his friends," which was excellently edited and narrated by Henry Reed. A large number of distinguished people, who in their younger days knew the great man, contributed. No mention was made of the visit to Max Gate of the Duke of Windsor when Prince of Wales.

I also liked the radio adaptation of the actual work of another favourite author of mine, Henry Fielding's "The Journal of a Voyage to Lisbon"; racy and pungent as befits the creator of Tom Jones and Jonathan Wild, and vividly portrayed by Patience Collyer and Richard George, edited by Eric Ewens, and narrated by David Peel.

Plays

The best play of the month was probably Galsworthy's "Old English," starring Sir Cedric Hardwicke as Sylvanus Heythorp, chairman of the Island Navigation Co., one of those typically English gentlemen, dour as granite and as straight as a cork-screw, pursuing his will to the cost of his life. Galsworthy knew how to draw this to perfection. Sir Cedric brought to the part all the rugged pig-headedness which the play's title symbolises. Heaven save us from meeting such men in real life!

"One Fine Day" was a rather weak story of film-making and what purported to be "back-screen" life in the studios. It was done as Marjorie Westbury's choice in the series *Stars in Their Choices.* If it really was, I didn't think much of it.

"The Devil's General" was a powerful story—and good radio—of Nazi Germany. Trevor Howard was excellent as the Luftwaffe general who, whilst despising Hitler and the Party, rides on the band-wagon and enjoys a pretty good time. Written by a German, Carl Zuckmayer, and seen at the Savoy Theatre in 1953, it should be a fairly authentic picture of war-time Germany. It was good entertainment and Mr. Howard was admirably supported by a very lengthy cast impossible to enumerate here.

R. F. Delderfield's "The Orchard Walls" was also the type of play that appeals to me: a play of high purpose and powerfully argumentative, whether we agree with it or not. This time it is the headmistress of a girls' school whose more than usually broad-minded views bring her up against the governors and the usual cliques, especially her handling of the tricky case of the girl who has a passionate love-affair which obviously recalls memories. Angela Baddeley and Janet Burnell were powerfully contrasted as the headmistress and her assistant, each with opposing views on most subjects until the play is resolved by the retirement of one in favour of the other. Again, no fault could be found with the supporting cast.

"The Violent Friends" was Winston Clewes's well-known play about Jonathan Swift, Stella and Vanessa, a story so improbable that we would discount it were it not that history tells us it was actually lived out. How two such charming girls, apparently as beautiful as they were gifted, can fall devotedly in love with such a boor and a curmudgeon as the author of *Gulliver*, is past comprehension. But it makes a very good radio play. Donald Wolfit, Rosalind Iden and Mary Wimbush saw to it that the essential characters of the three chief protagonists were drawn to perfection.

"Payment Deferred," by Geoffrey Bell, was Richard Williams'—a recent award winner—"star's choice." Perpetrator of as gruesome a murder as one could reasonably wish for, Mr. Williams was called upon to cover a wide range of emotion, wider than I have heard him play before. He was very successful, as was Betty Hardy as his wife.

As Important as Wars?

"Scrapbook for 1924," as usual, made out dance-tunes and musical comedy airs to be at least as important as wars, revolutions and unemployment.

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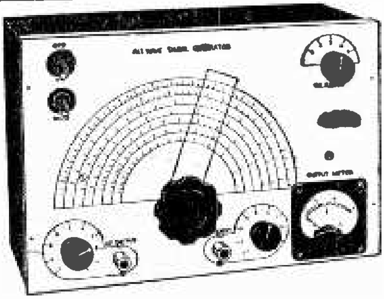

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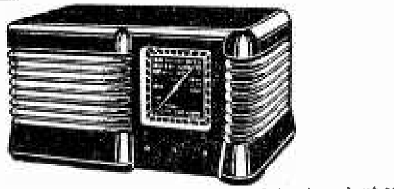

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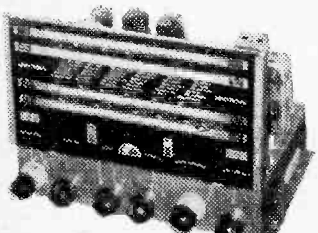

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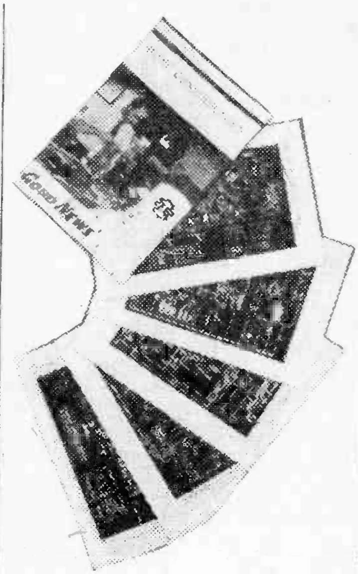

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15 volts	A.C. 2½in. Flush circ.. mov. iron	8/6

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Locating Obscure Faults

ADVICE TO SERVICE ENGINEERS AND OTHERS ON THE TRACING OF DIFFICULT AND UNUSUAL FAULTS

By F. E. Apps

DURING the many years that I have been connected with radio and television servicing, I have on many occasions met other engineers who have been "stuck" on a job for a considerable time, and, in fact, did not seem to be able to locate the fault at all. Yet eventually when it has been found, the fault has generally been quite a simple one. The main reason for this has been the fact that the engineer in question has been working on a laid-down routine of checking, which he has followed meticulously and has been doing the same checks over and over again. In other words, he has been "going round in circles," all the while missing the fault.

Now, it is quite in order for the reader to ask why the laid-down routine checks for a faulty receiver do not find all the faults. The answer to that question is that faults, unfortunately, do not always follow the usual lines as laid down in the many books on radio and television servicing, and in consequence are missed when checking.

How are these unusual faults to be located? The answer is that when the ordinary check methods fail, the intelligence and imagination of the engineer must be used. He must say to himself, what is there in the faulty circuit that I have not checked? I have checked valves, resistors, condensers, coils, etc. Is there any other component left, however unimportant, that I have missed? That is the way these difficult faults are found and an immense amount of time and worry saved.

I now propose to give a few instances of unusual faults and how they were found and eliminated.

Fault No. 1

This was a case of a 5-valve superhet with a valve line-up of 6K8, 6K7, 6Q7, 6V6, 5Z4. The set had been running for a couple of years, and then suddenly developed a terrific hum. The engineer on the job, at the owner's house, employed the usual checks, and located the hum as between the 6Q7 and 6V6 stage. Electrolytic replacements did not effect a cure, and he tried a new 6Q7, but the hum persisted. Thinking that perhaps the spare valve he tried was also faulty, he left the job and returned with another tested 6Q7. The hum was still there. He decided to take the set in for a thorough check. This he did, but the fault still eluded him. I happened to call in on him that day and he told me about it. I pointed out that he had checked everything except the valve-holder. On removing this, a paxolin type, we found that a small sliver of solder had wedged itself in between the top and bottom leaves of the holder, apparently in manufacture, and had eventually shifted, until it was making a dead short between pins 7 and 8 when the valve was inserted.

Fault No. 2

This was a case of a small type receiver using A.C./D.C. type B7G valves. The fault was that the volume control became very noisy after an hour of being switched on. This component was removed, cleaned, replaced, and components attached thereto checked. The fault again occurred. A new volume control was fitted, and although the period was now longer the fault still occurred. The trouble was eventually located by touching the spindle of the volume control, which was found to be quite warm. This was being caused by a resistor carrying the total H.T. for the set, having been replaced previously by one of the correct resistance value but of insufficient wattage. This resistor lay close up to the volume control and heated it up sufficiently to cause imperfect contact between slider and track, and thus noise.

Fault No. 3

Here was a case that ordinary checks could not find. The receiver was a six-waveband set with bandspread on four bands. The trouble occurred on band I, the highest frequency band, where a blank spot appeared in the centre of the band at a point where the owner of the set was wont to receive a certain station. R.F. and frequency changer valves were replaced, but there was no improvement. Sensitivity everywhere else was up to scratch and it was noticed that by altering the aerial trimmer of band II the blind spot was eliminated. Now this could mean that absorption was occurring between bands I and II at that spot. A faulty earth connection on the aerial section of the wavechange switch caused this trouble and on being re-made the fault was cured.

Fault No. 4

A fault that perhaps should not be classed as difficult is one where for some reason or other the tuning on a receiver alters quite an appreciable amount at intervals, and in some cases renders stations on some parts of the tuning range unreceivable. This fault is hard to find where the engineer has had insufficient experience. It is nearly always a poor earth connection on the ganged condenser. This may be the actual soldered connection, but may also be the spade connectors to each section of the rotor of the gang. Dirty contact here can cause this at various settings of the gang.

Fault No. 5

Another case where standard tests did not apply was where a set developed microphony on bandspread bands, especially those at the higher frequency. The trouble had only appeared since the set was previously serviced for another reason. Valve replacement did not cure the trouble, and the fault was located in the oscillator section. Here the wiring had been disturbed and long leads were tightened, running parallel to screening and setting up microphony on the higher frequencies. A very small movement and repositioning of these leads cured the trouble.

Fault No. 6

R.F. in the audio stages of a set are generally only

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traceable and eliminated by trial and error methods. In the case of a portable receiver for battery and A.C./D.C. mains, the trouble was caused by the leads to the output transformer on the speaker being shifted so that R.F. was picked up by them. Moving these leads eliminated this trouble.

Fault No. 7

Attention should always be paid to component positioning in sets, especially when the components are closely spaced. A case occurred where a set gave very noisy reception after being switched on for about half an hour. The trouble was caused by a .02 μF coupling condenser heating up through its proximity to a resistor. The replacement condenser was differently situated and the trouble vanished.

Fault No. 8

Intermittent performance at long intervals is one of the worst faults that the service engineer has to contend with. No real hard and fast rules can be laid down and the only method to adopt is to take one circuit at a time, if the circuit where the intermittency is unknown, and with meters at the vital points wait for it to occur. I have known sets to have periods of six or eight hours, so that this is definitely a workshop job, for it means "soak" testing.

News from the Clubs

BARNSLEY AMATEUR RADIO CLUB

Hon. Sec.: Mr. P. Carbutt, G2AFV, 33, Woodstock Road, Barnsley.

THE programme for March includes:
March 11th—Lecturettes.
March 25th—"Transistor Transmitting," by J. Ward.

THE EAST KENT RADIO SOCIETY

Hon. Sec.: Mr. D. Williams, Llandogo, Bridge, Canterbury.

THE Society meets every Tuesday fortnight, at 8 p.m., at "The Two Brothers," Northgate Street, Canterbury.

Competitions, contests, sales and lectures have been arranged for this year. A cup is presented every year for the best constructed piece of apparatus. New members are cordially invited.

BRIGHTON AND DISTRICT RADIO CLUB

Hon. Sec.: T. J. Huggett, 15, Waverley Crescent, Brighton.

THE Brighton and District Radio Club meet every Tuesday, at "The Eagle Inn," Gloucester Road, Brighton, at 7.30 p.m. At the Annual General Meeting the following officers were elected.

Chairman, Mr. R. Langridge; vice-chairman, Mr. C. T. Fairchild; hon. secretary, Mr. T. J. Huggett; treasurer, Mr. R. Sowerby; fifth member, Mr. D. Hemsley.

It was agreed that the A.G.M. in future should be held in September, thus avoiding a change of committee in the middle of the winter season. A comprehensive programme has been arranged for the present season.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: F. C. Ward (G2CVV), 5, Uplands Avenue, Littleover, Derby.

AT the Annual General Meeting on February 4th the following were re-elected to serve on the 1955 Committee:

Chairman, C. M. Swift (G3IUK); hon. sec., F. C. Ward (G2CVV); hon. treasurer, W. R. Chaffe (G2DLJ); hon. contest sec., T. Darn (G3FGY); committee, Messrs. A. McCabe (G4CO), B. J. C. Brown (G3JFD), C. Rodger (G3IIJ) and F. Cox (G3GRM).

It was reported that the Society's assets stood at £85, net profit for the year amounted to some £6 and that the fully paid membership stood at 74. Meetings would continue to be held weekly for the present on a Wednesday, commencing at 7.30 p.m., but in order that juniors might obtain more benefit from membership, it was under consideration that the club rooms should be opened on a Friday evening for their benefit.

RAVENSBOURNE (DOWNHAM) AMATEUR RADIO CLUB

Hon. Sec.: J. Wilshaw, 4, Station Rd., Bromley, Kent.

THE Society holds its meetings every Wednesday evening from 8 to 10 p.m. in the Science Room, Durham Hill School, Downham Estate, Bromley, Kent (124 Bus), when RAE lectures, morse instruction, radio repairs and operating of the club transmitter (G3HEV) takes place. Club membership fee is 1s. 6d. annually and instruction is given by G2DHV (Chairman) alternately with G3FTI on the transmitter. New members are welcomed.

CLIFTON AMATEUR RADIO SOCIETY

Hon Sec.: C. H. Bullivant, G3DIC, 25, St. Fillans Rd., Catford, S.E.6.

THE month of February was quite full for the Clifton A.R.S. and, in addition to hearing two very interesting talks and taking part in a quiz, members were afforded the opportunity of visiting Electra House (P.O. Cable and Wireless Services).

The first of the two talks was given by G. Stone, G3FZL, and his subject was "V.H.F." This was in the nature of an introduction to the very high frequencies and it is hoped that a number of members will be encouraged to experiment in those regions.

The "New Zealand Z.C.I Mk. II" transmitter/receiver was covered by J. Lambert, G3FNZ, in the second talk and in addition to giving details of the circuit and desirable modifications for amateur mobile use, the simplicity of tuning was demonstrated.

Proposed programme for April:
April 8th—No meeting.
April 15th—"Direction Finding" by C. Hatfull, G3HZI.
April 22nd—Junk Sale.
April 29th—Constructional Evening and Ragchew.

Meetings are held at the clubrooms, 225, New Cross Road, London, S.E.14, at 7.30 p.m.

SOUTHEND AND DISTRICT RADIO SOCIETY

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

MR. H. WILKINSON, holder of the Pocock Cup for "Best workmanship in home-constructed radio gear," continued his lecture on "Frequency Modulation" to members of the Southend Radio Society. He prefaced his lecture by comparing frequency with amplitude modulation, explaining that modulation is a change of the carrier or continuous wave emitted by a transmitter. This modulation or change reproduces electronically the sounds it is intended to convey.

Amplitude modulation has, for technical and financial reasons, been almost exclusively used on medium frequencies. These frequencies have now become so congested that conditions which even now are chaotic will soon become impossible.

The BBC and radio engineers and manufacturers in all countries have already turned their attention to "very high frequency" transmissions using frequency modulation, with marked success for regional purposes.

Mr. Wilkinson traced out, with blackboard diagrams, the evolution of the F.M. Receiver. A German model has eventually found favour. In this receiver, modulation is effected by a device known as a radio detector: it uses only two I.F. valves whereas former models required three.

TORBAY AMATEUR RADIO SOCIETY

Hon Sec.: L. H. Webber, G3GDW, 43, Lime Tree Walk, Newton Abbot.

A MEETING was held at the Y.M.C.A. Torquay, on Saturday, 19th February, under G2GK, the Chairman. As a result of the recent successful social and dinner, it was resolved to hold a similar function this year before Christmas, instead of in the new year.

A hearty welcome was extended to a new member—George Western, BRS. No. 20605—who is unfortunately blind. He is being coached in technical subjects by Bern Symons, BRS. 19991: they are also both working up their speeds in Morse. On a proposal by a member, George Western has been voted an Honorary Member of the Torbay Society.

Another new member, and a new call, is R. Coleman, G3KDV, of 16a, Castor Close, Brixham, S. Devon, who was also welcomed. The meeting closed, after an interesting talk by John Hawke, G3FUT, on "Audio Amplifiers."

At the April meeting, on 16th April, the Annual General Meeting of the Society will be held.

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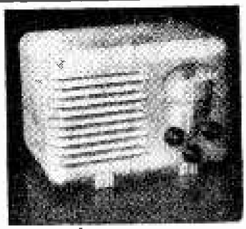

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Good reception on both medium and long waves. All parts including three valves, resistors, tuning condensers, in fact, everything except loudspeaker, cabinet and chassis (available if you haven't something suitable) costs only 19/6: data available separately, price 1/6.

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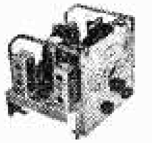

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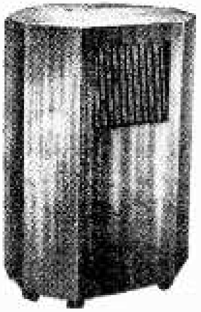

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Band 5	3.7	to	7.5 mc/s	
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The Sensitivity is 4 micro valves for full output. It uses 8 valves and operates from batteries (12 or 24 volt) or from the mains through a power pack. It has built in output stage with a jack socket for Controls, all of which are brought to the front panel, include aerial switch comparative condenser, main tuning condenser, band selector, C.W. switch, power on/off switch, and volume control.

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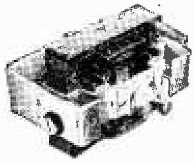

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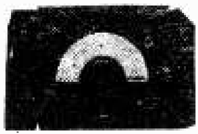

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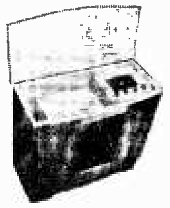

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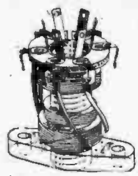
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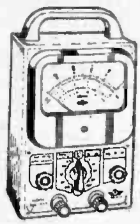

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1A7GT	11/6	6LD20	9/6	35L6GT	8/6	EL91	6/6
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1D5	11/-	6P28	20/-	35Z5GT	8/6	EZ40	8/6
1H5GT	11/6	6Q7GT	9/-	50L6GT	8/6	EZ41	9/-
1N5GT	11/6	6SN7GT	8/6	80	8/6	FC2	9/6
1R5	7/3	6U4GT	17/-	B36	18/6	KT63	7/6
1S5	7/3	6V6G	7/6	CL33	12/6	MU14	8/6
1T4	7/3	6V6GT	7/6	D77	6/9	N78	14/6
3Q5GT	11/6	6X4	7/6	DAC32	11/6	Pen45	15/-
3S4	7/3	6X5GT	6/9	DF33	11/6	PCF80	10/6
3V4	8/6	7B7	7/6	DH77	8/6	PCC84	11/6
5U4G	8/6	7C5	8/6	DK32	11/6	PL81	11/6
5Y3GT	7/9	7C6	8/6	DK92	7/6	PL82	9/6
5Z4G	9/-	7H7	7/6	DL33	11/6	PL83	12/6
6AL5	6/9	7S7	7/6	DL35	11/6	PY80	9/6
6AM5	6/6	7Y4	8/6	EA50	1/9	PY81	10/-
6AM6	7/6	10C1	12/6	EB91	6/9	PY82	7/9
6AT6	8/6	10F1	10/-	EBC33	7/6	PZ30	17/-
6BA6	7/6	10LD11	10/-	EBC41	10/-	T41	13/-
6BE6	6/6	10P13	10/-	EBF80	10/6	U14	8/6
6BH6	6/6	10P14	13/6	EC91	7/6	U22	7/6
6BJ6	6/6	12AT7	9/-	ECC81	9/-	U24	17/6
6BW6	7/6	12AU6	7/6	ECH35	11/9	U25	12/-
6BW7	9/6	12AU7	10/6	ECH42	10/-	U50	7/9
6C4	7/6	12J7GT	10/6	ECL80	9/6	U78	8/6
6C9	8/6	12K7GT	9/-	EF37A	14/6	U404	9/-
6F1	19/6	12K8GT	10/6	EF39	6/6	U801	14/6
6F6G	7/6	12Q7GT	9/6	EF41	9/-	UBC41	9/-
6F12	7/6	12SK7	6/-	EF50 (Sylvania)	8/6	UBF80	10/6
6F13	13/6	20F2	11/6	EF80	10/-	UCH42	9/9
6F14	13/6	20P1	15/-	EF91	7/6	UF41	8/6
6J7GT	7/6	25Z4G	9/-	EF92	5/6	UF42	13/6
6K7G	6/-	25Z5	8/6	EL41	11/6	UL41	9/9
6K7GT	6/-	25Z6G	8/6			UU8	17/-
6K8G	8/6					UY41	9/-
6K8GT	9/-					W77	5/6
6K25	11/9					Y63	7/6
						Z77	7/6

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Open to Discussion

The "Coronet"

SIR,—I wish to thank you for the circuit of the battery version of the "Coronet." I have built one myself, and it is second to none of the professional sets of the kind available in the local market. I had no previous knowledge of radio, other than building a one-valve set, with regeneration. I had to use parts available here, i.e., coil pack, Weyrad 6BA; three-waveband, 2 short and 1 medium; loudspeaker, R. and A. 8in.; I.F. transformers, Wearite.

All the connections were done without soldering.—H. DHARMASENA (Ceylon).

Using Test Instruments

SIR,—Reference Fig. 8 of the article, "Using Test Instruments," in February's issue of PRACTICAL WIRELESS.

Surely the simplest method with the circuit shown would be to adjust the voltage of the auxiliary H.T. supply until the current measured on the m/a meter is zero. Then the voltage registered on V is equal to Va. The original H.T. supply remaining connected. The resistance of the auxiliary source need not be considered.—M. R. HOLLAND (Singapore).

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

Modifying the R1132A

SIR,—I would appreciate it very much if you could publish this letter in answer to the article written by Mr. L. H. Cox re the R1132A receiver, as interfering with the coils on this R.X. is a very tricky job. I know several people who have tried to do it and have failed dismally. I got over the difficulty by changing the *tops* of the Philips trimmers with some from an old RF24 unit, with the exception of the aerial trimmer. Alignment was carried out as per Mr. Cox's article. The aerial trimmer is experimented with by changing the trimmer completely for one from an RF24 unit. I have received good results here at Bedford on (a) 66ft. (b) 12ft. vertical whip (c) 28in. dipole aerials. These different aerials tuned well and except in the case of the dipole single wire was used. Wrotham is received with the indicator at about 160 deg. and 135 deg. on the scale. One thing with this system is that should it not work one can easily put the set back to normal; with the coils interfered with it is a different matter.

I would appreciate it if any reader has modified a set for 144 Mc/s and could send me some details.—DAVID W. BUTTON (Bedford).

Time and Frequency Checks

SIR,—May I endorse and amplify on Mr. G. Prentis's letter in March PRACTICAL WIRELESS on time signals and fixed frequency transmitters. Working for Trinity House, often on radio beacons, I have recourse to use BBC time signals for setting up the control clocks. The lack of time signals at certain periods of the day, especially at the week-ends, causes considerable inconvenience.

After working on an equipment and having made some adjustment which means the clocks have to be reset, a delay of two or three hours is sometimes encountered and as these clocks must be accurately set, causes delay.

If the BBC could keep the time signals at the same time each day it would help, but I can't see why they are not transmitted hourly. The time signal could be superimposed on the programme going out and would hardly be noticed except by those awaiting it.

I have long hoped for a British station broadcasting fixed frequencies particularly in the audio-frequency having spent many hours experimenting with electronic musical instruments.—J. F. B. ELDER (Smalley.)

N.P.L. Transmissions

SIR,—I feel that the letter from Mr. G. Prentis, published in the March issue of PRACTICAL WIRELESS, should not be allowed to pass without comment.

His reference to time and frequency checking services in the United States obviously refers to the transmissions from station WWV, but Mr. Prentis is apparently unaware of the similar services radiated from Rugby under the auspices of the National Physical Laboratory. The details in my possession refer to experimental transmissions which started in 1950, but I believe that these services have now been extended.

I believe that there are also some other, restricted, services by the Royal Greenwich Observatory through a station at Abinger on 2 Mc/s and by GB1RS (the H.Q. station of the Radio Society of Great Britain).

May I suggest that you devote some space in an early issue to details of these various transmissions for the information of your readers in general, as the WWV transmissions are not always satisfactorily received in this country.—E. S. SMITH (Eltham).

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News from the Trade

"Rai-Tel-Ade"

WHEN using the conventional hearing aid, the listener receives the output of a radio set, TV set or radiogram at second-hand, because the aid picks up the set's speaker output and reproduces it again. The user receives much distorted sounds for two reasons. First, the conventional hearing aid is designed to aid conversation between two or more persons conversing in comparatively close proximity, therefore, at normal distance from a radio set and at comfortable viewing distance from a TV set, the aid must be at full volume, which seriously distorts its output. Secondly, even at maximum volume, the aid does not pick up satisfactorily unless the sound output of the radio, TV or radiogram is uncomfortably high for those with normal hearing, thus increasing the distortion of the original sound output and also greatly amplifying the normal environmental noises thereby further adding to the distortion babel.

The obvious answer to this problem is an instrument which does not depend on reproducing sound second-hand. Instead, it should plug into the output circuit of the radio, TV set or radiogram and itself receive the signals, which actuate the loudspeaker. The instrument turns these signals into sound, which the user receives directly from his ear-piece.

The "Rai-Tel-Ade" utilises the same type of miniature insert ear-piece as is used in the conventional hearing aid. This is connected to the small "Rai-Tel-Ade" by a thin, plastic-covered flex.

The "Rai-Tel-Ade" being only 3 inches by 3 inches by $4\frac{1}{2}$ inches, sits comfortably on a side table or the arm of an easy chair. It is connected by a long lead to the radio, TV set or radiogram to which connection is easily made without harming the most expensive or delicate set. Thus the user may sit in any part of the room and as far away from the sound source as is desired.

Extraneous noises are entirely eliminated and the user has a personal volume and tone control for speech or music on the instrument itself. Their use does not affect the loudspeaker output. Indeed, it gives the person who is hard of hearing greater independence than the unafflicted, because he, or she, can listen in and view with the loudspeaker switched off. This property makes the instrument useful for those with normal hearing, since parents may listen in without disturbing their children doing homework, for example.

The retail price, complete with plug and socket, connecting lead, miniature insert type receiver, which accepts the personal ear mould, is £4 15s. Electric Aids, Orchard House, Sunbury-on-Thames, Middlesex.

"His Master's Voice" 3-Speed Radiogram at 32 gns.

TO meet the ever-growing demand—additionally stimulated by the steadily increasing sales of records of all kinds—for a compact, high-quality and inexpensive radiogram, "His Master's Voice" have made their Models 1507 and 1508 portable 3-speed radiograms available at the attractive price of 32 gns. (including purchase tax). The Gramophone Co., Ltd., Hayes, Middlesex.

"Denco" Fish-Band Coils

IN response to a considerable number of requests, Messrs. Denco have increased the new range of CP3 coil packs to include the 50/160 metre Fish Band.

There appears to be quite a demand for this type of pack in coastal areas, and the reference number is CP/F 4 waveband coil pack.

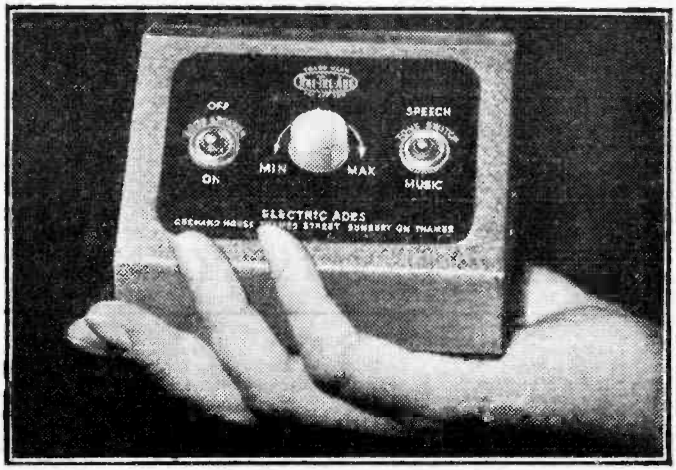
Denco (Clacton) Limited, 357/9, Old Road, Clacton-on-Sea.

A New Magnetic Recording Tape

A NEW magnetic recording tape with an exceptional performance has been introduced by Salford Electrical Instruments Limited, at an unusually low price. Sold under the trade name of "Puretone" for 20s. a spool, it is a paper-based material with an output and frequency response which compares favourably with those of plastic tapes costing almost twice as much.

The new tape is sold in lengths of 1,200 ft. wound on specially designed plastic spools slotted to facilitate rapid threading, and other lengths of tape will shortly be available. The 1,200 ft. reels give 32 minutes playing time at $7\frac{1}{2}$ inches/second, or 64 minutes at $3\frac{3}{4}$ inches/second. Twin track recording is also possible and this doubles the playing time; the tape can be used on all types of recorders. The highest grade oxide with a particle size range from 0.5—1.5 microns, is used in the magnetic coating. The base, which is superior to that of many other paper tapes, consists of a high quality super calendered Kraft paper.

"Puretone" has the high tensile strength of about 6 lb./sq. in. breaking strain with a coercive force and remanence of 220 oersteds and 700 gauss respectively. "Static," the principle disadvantage of plastics-based tapes, is eliminated with the use of "Puretone."



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2,000 VR65A VALVES.—2/- each, post 6d.
2,000 BRAND NEW VR137 VALVES.—1/3 each, post 6d.
500 BRAND NEW 524 VALVES.—8/- each, post 6d.

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CONDENSERS: Micas: 30, 50, 75, 200 pf., .001, .002, .005 mfd., 2/6 doz. Electrolytics: 32 mfd. 450 v. (large) 1/3; 2,000 mfd. 15 v. 3/9. metal block: .5 + .5, or .1 + .1 (400 v.) 4d.

RESISTORS (carbon): ½ w. 30 Ω, 5.1 k., 6 for 9d.; 1 w. 30 k, 75 k, 180 k, 6 for 1/-; 5 w. 500, 700, 3 k, 4 k, 5.6 k, 12 k, 20 k, 30 k, 200 k, 6 for 3/-.

POTENTIOMETERS (carbon): 500 k, ⅞in. dia. 1in. spindle; 5 k, 100 k, 1⅛in. dia. ½in. spindle; boxed 500 k, 1¼in. dia. ⅜in. spindle, all 1/6 (6 for 7/6).

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28	1/10	3/2	2/2	3/10
29	1/11	3/4	2/3	4/-
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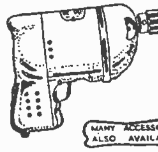

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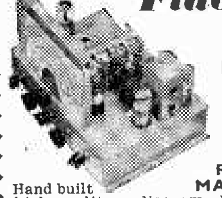

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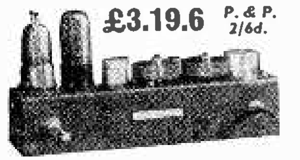

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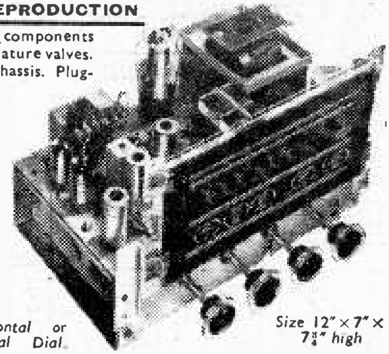

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