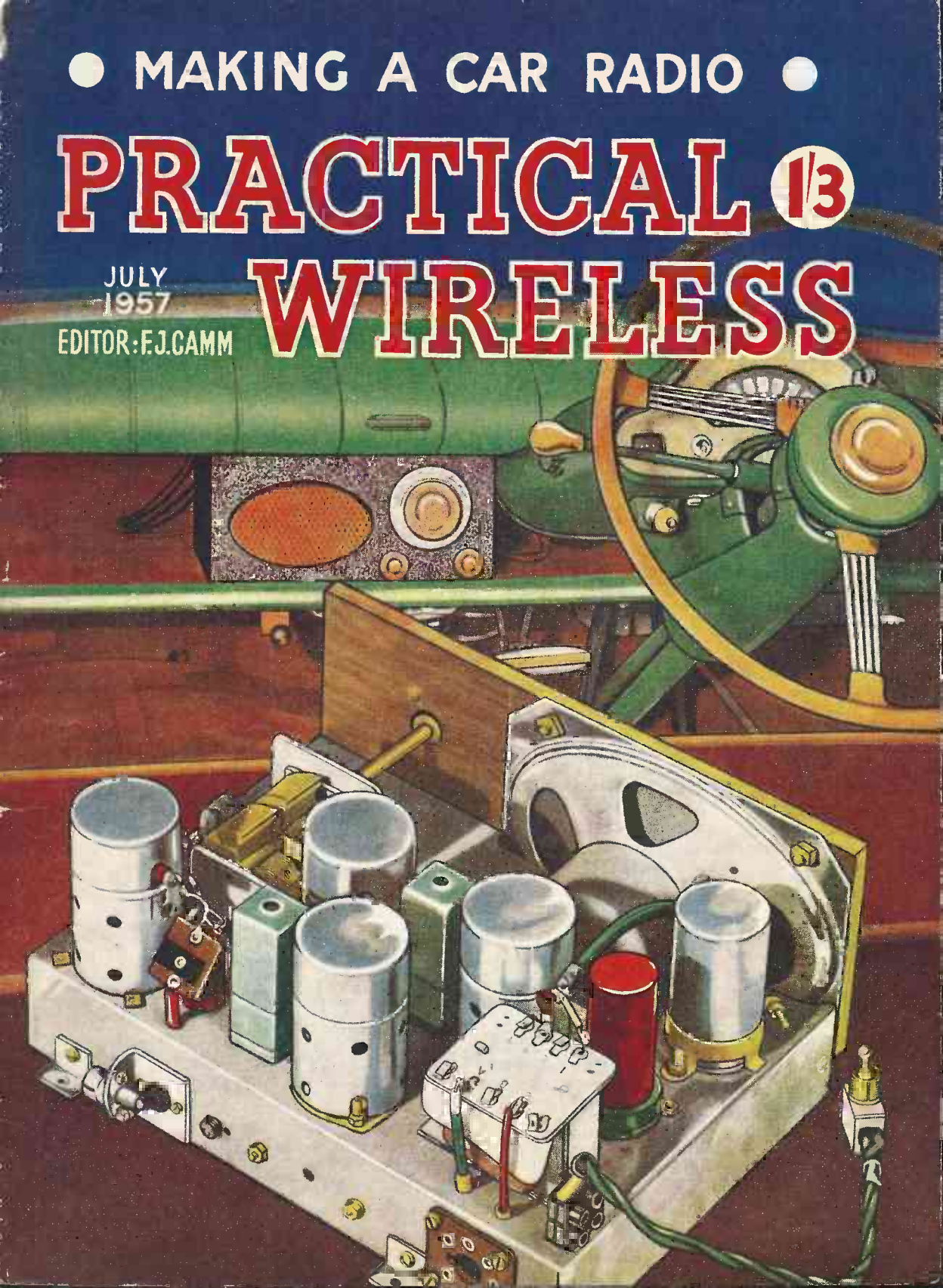
● MAKING A CAR RADIO ●

PRACTICAL WIRELESS

1/3

JULY 1957

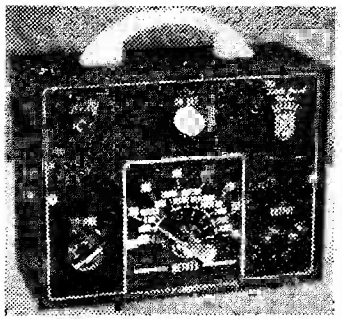
EDITOR: F.J.CAMM



EASY AS "A.B.C"—CHEAP TO MAKE!

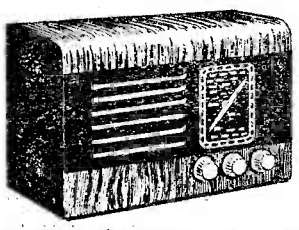
LOOK! BUILD THIS POCKET RADIO FOR ONLY 37/6

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



47/6

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



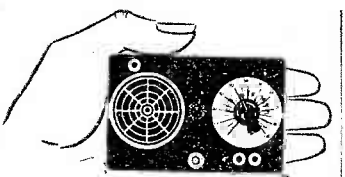
107/6

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

Build This TRANSISTOR POCKET SET For Only 49/6!

FEW ONLY AT 92/6!

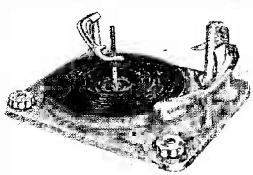
NEW in maker's sealed cartons!—limited quantity of the famous 3-speed record player units, exceptionally easy to fit, with lightweight pick-up, incorporating "Acos" crystal turnover head and separate sapphire stylli for Standard and Long-Playing. With full instructions and fixing plans. **Unbeatable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



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

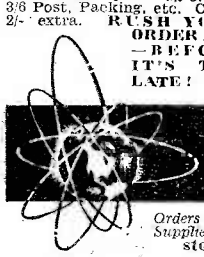
BUILD THIS TRANSISTOR SET FOR ONLY 35/-

VERY SPECIAL OFFER WHILE STOCK OF PARTS LASTS!—The "Sky-Scout" Pocket (two-stage transistor set, size only 4in. x 3¼in. x 1¼in. Covers all medium-waves and works entirely off tiny "pen-light" battery which costs 6d. and fits inside case. All parts tested before despatch. Can be built for 35/-, plus 2/- post and packing, including Case, Transistor, **STEP-BY-STEP PLANS FOR ABSOLUTE BEGINNERS,** nuts, bolts, etc. (C.O.D. 1/6 extra.) Parts sold separately, priced parts list, etc., 1/6. **VERY SIMPLE TO BUILD.**



ONLY £8-12-6

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



CONCORD ELECTRONICS

69, PRESTON STREET, BRIGHTON Dept. PWK

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

R.S.C. BATTERY CHARGING EQUIPMENT

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

ASSEMBLED CHARGERS

6 v. 1 amp. ... 19/9
6 v. or 12 v. 1 amp. ... 25/9
6 v. 2 amps. ... 29/9
6 v. or 12 v. 2 amps. ... 38/9
6 v. or 12 v. 4 amps. ... 59/9
Above ready for use. Carr. 3/6. With mains and output leads.

SELENIUM RECTIFIERS

6/12 v. 1 a. 4/11
6/12 v. 2 a. 8/9
6/12 v. 3 a. 11/9
6/12 v. 4 a. 14/9
6/12 v. 6 a. 19/9
6/12 v. 10 a. 25/9
6/12 v. 15 a. 35/9

L.T. Types H.W.
6-12 v. 1 a. H.W. 2/9

H.T. Types H.W.
150 v. 40 mA. 3/9
250 v. 50 mA. 5/9
250 v. 80 mA. 7/9
250 v. 150 mA. 9/9
250 v. 250 mA. 11/9

BATTERY CHARGER KITS

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

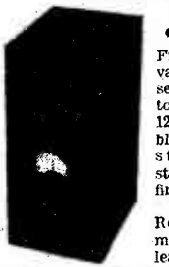
6 v. or 12 v. 1 amp. ... 22/9
6 v. 2 amps. ... 25/9
6 v. or 12 v. 2 amps. ... 31/6
6 v. or 12 v. 4 amps. ... 53/9

BATTERY CHARGER KIT

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

ASSEMBLED CHARGER

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



Assembled 6 v. or 12 v. 4 amps.

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

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

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

Interleaved and Impregnated. Primaries 200-230-250 v. 50 c/cs Screened. TOP SHROUDED DROP THROUGH

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

FULLY SHROUDED UPRIGHT

250-0-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a, Midget type 2½-3-3in. 17/6
350-0-350 v. 70 mA, 6.3 v. 2 a, 5 v. 2 a 18/9
250-0-250 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a ... 26/9
250-0-250 v. 100 mA, 6.3 v. 6 a, 5 v. 3 a, for R1355 conversion 31/-
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a 23/9
300-0-300 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a 26/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a 23/9
350-0-350 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a 27/9
300-0-300 v. 120 mA, 6.3 v. 4 a, 6.3 v. 1 a, for Mullard 510 Amplifier 35/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a 33/9
350-0-350 v. 150 mA, 6.3 v. 2 a, 6.3 v. 2 a, 5 v. 3 a 35/9
425-0-425 v. 200 mA, 6.3 v. 4 a, C.T. 6.3 v. 4 a, C.T., 5 v. 3 a. Suitable Williamson Amplifier, etc. 49/9
450-0-450 v. 250 mA, 6.3 v. 6 a, 6.3 v. 6 a, 5 v. 3 a 69/9

FILAMENT TRANSFORMERS

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

SMALL POTTED MAINS TRANSF. Removed from New Ex-Govt. units. Primary 0-200-230-250 v. Secs. 250-0-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a. Size 3¼ x 4¼ x 3in. **11/9**

ELIMINATOR TRANSFORMERS

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

CHARGER TRANSFORMERS

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

SMOOTHING CHOKES

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

OUTPUT TRANSFORMERS

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

MANUFACTURERS' SURPLUS MAINS TRANSFORMERS. Primaries 250-250 v. 50 c/cs. Drop Through Chassis type. 250-0-250 v. 70 mA, 6.3 v. 2.5 a, 11/9.

SPECIAL OFFERS : Electrolytics. 32-32-32 mfd. 250 v. Dubilier small can, 2/9 ea. 150 mfd. 450 v., 3/9. Small .0005 mfd. 2-gang, 4/9 ea. Westinghouse Rectifiers 250 v. 250 mA., 7/9. **CO-AXIAL CABLE.** 75 ohm. 1in. 8d. yd. Twin Screened Feeder 11d. yd.

EX-GOVT. TRANSF., 230/250 v. 50 c/cs. HEAVY DUTY OIL FILLED suitable for electric welding or soil heating. Output 12 v. 80/100 amps., £6/19/6. Carr. 7/6.

EX-GOVT. SMOOTHING CHOKES

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

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

EX-GOVT. METAL BLOCK (PAPER) CONDENSERS

4 mfd. 500 v., 2/9 ; 4 mfd. 1,000 v., 4/9 ; 8 mfd. 500 v., 4/9 ; 10 mfd. 500 v., 3/9 ; 4 mfd. 400 v. plus 2 mfd. 250 v., 1/11.

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

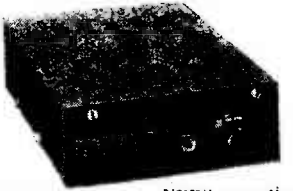
EX-GOVT. DOUBLE WOUND STEP UP/STEP DOWN TRANSFORMERS. 10-0-100-200-220-240 v. to 5-0-75-115-135 v. or REVERSE. 80-100 watts. Only 11/9, plus 2/9 post. 10-0-100-200-220-240 v. to 9-0-110-122-136-148 v. or REVERSE. 200 watts, 35/9, plus 7/6 carr.

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

EX-GOVT. VALVES (NEW)

1T4	7/9	EF39	5/9	EF80	7/9
1S5	7/9	6V6G	7/9	EB91	8/9
3S4	8/9	6X4	8/9	EF36	4/9
5Y3G	8/9	6X5GT	7/9	EL32	3/9
5U4G	8/9	6L6G	11/9	EL91	5/9
5Z4G	8/9	807	7/9	KT41	8/9
6K7G	5/9	12A6	7/9	EZ90	3/9
6SJ7GT	6/9	15D2	4/9	EZ80	3/9
6SLGT	8/9	35Z4GT	9/9	EL84	10/6
6SN7GT	8/9	MH4	4/9	SP61	2/9
6AT6	7/9	ECC83	9/9	35Z4	8/9

R.S.C. BATTERY TO MAINS CONVERSION UNITS



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

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

Type BM2. Size 8 x 5½ x 2¼in. Supplies 120 v., 90 v. and 60 v., 40 mA, and 2 v. 0.4 a to 1 amp. fully smoothed. **Thereby completely replacing both H.T. batteries and L.T. 2 v. accumulators.** When connected to A.C. mains supply 200-250 v. 50 c/cs. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulator. Complete kit of parts with diagrams and instructions **49/9**, or ready for use **59/6**.

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

T.V. CABINETS. Leading manufacturers' surplus. Attractive designs. Walnut veneered, with doors for 15, 16 or 17in. Tube. **23-19-6**. Carr. 7/6.

MINIATURE MOTORS. 24/28 v. D.C. or A.C. made by Hoover Ltd., Canada. Size only 2¼ x 1¼in. Spindle 1¼in. long, ¼in. diam. Brand New, **9/9**.

EXTENSION SPEAKERS

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

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

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

ELECTROLYTICS (current production) NOT EX-GOVT.

Tubular Types		Can Types	
8μF 450 v. ...	1/9	16 mfd. 350 v.	1/11
8 mfd. 500 v.	2/6	16 mfd. 500 v.	2/9
16μF 350 v. ...	2/3	16μF 450 v. ...	2/9
16μF 450 v. ...	2/9	32μF 350 v. ...	2/11
16μF 500 v. ...	3/9	32 mfd. 450 v.	4/9
32μF 350 v. ...	3/9	100 mfd. 150 v.	4/9
25μF 25 v. ...	1/3	8-8μF 450 v. ...	2/9
50μF 12 v. ...	1/3	8-16μF 450 v.	3/11
50 mfd. 25 v. ...	1/6	16-16μF 450 v.	3/11
50μF 50 v. ...	1/9	32-32μF 350 v.	4/9
100 mfd. 12 v.	1/9	32-32μF 450 v.	5/9
100 mfd. 25 v.	2/3	100-100mfd. 350v.	4/9
3,000 mfd. 6 v.	3/9	64-120mfd. 350v.	7/9
6,000 mfd. 6 v.	3/9	100-200 mfd. 275 v. ...	6/9

Many others in stock.

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

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

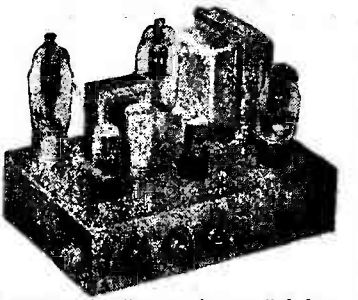
High-Fidelity Push Pull Amplifier with "Built-in" Tone Control, Pre-amp stages, High sensitivity. Includes 5 valves (807 outputs). High Quality sectionally wound output transformer, specially designed for Ultra linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS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

£7-15-0

If required louvred metal cover with 2 carrying handles can be supplied for 17/6. Additional input socket with associate Vol. control so that two different inputs such as Gram and 'Mike' or Tape and Radio can be mixed, can be provided for 13/- extra. Guaranteed 12 months.

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

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



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

A highly sensitive Push-Pull, high output unit with self-contained Pre-amp. Tone Control Stages. Certified performance figures compare equally with most expensive amplifiers available. Hum level 70 db. down. Frequency response ± 3 db. 30,30,000 c/cs. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All components are chosen for reliability. Six valves are used, EF86, EF86, ECC83, 807, 807, GZ33. Separate Bass and Treble Controls are provided. Minimum input required for full output is only 12 millivolts so that ANY KIND OF MICROPHONE OR PICK-UP IS SUITABLE. The unit is designed for CLUBS, SCHOOLS, THEATRES, DANCE HALLS or OUTDOOR FUNCTIONS, etc. For use with Electronic ORGAN, GUITAR, STRING BASS, etc. For standard or long-playing records. OUTPUT SOCKET PROVIDES L.T. and H.T. for a RADIO FEEDER UNIT. An extra input with associated vol. control is provided so that two separate inputs such as Gram and 'Mike' can be mixed. Amplifier operates on 200-250 v. 50 c/cs. A.C. Mains and has outputs for 3 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. If required cover as for A8 can be supplied for 17/6. The Carr. 10/- amplifier can be supplied, factory built with 12 months' guarantee, for £12/19/6. TERMS: DEPOSIT 28/11 and 9 monthly payments of 28/11.

ONLY **10 GNS.**

COLLARO RC/54 3-SPEED AUTO-CHANGERS with Studio Pick-up. Brand New. For 110 v. 50 c.p.s. A.C. mains. Price with 110 v. to 200-250 v. Auto Trans. only £7/15/-. Carr. 7/6.

COLLARO RC/456 4-SPEED AUTO-CHANGERS with high fidelity Studio Pick-up. Latest model. Brand new. Cartoned. For 200-250 v. 50 c.p.s. A.C. mains. Normally over £14. Our price £8/17/6. carr. 5/6.

SUPERHET FEEDER UNIT Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). Delayed A.V.C. Very high Percentage modulation of the Transmitter can be handled without distortion. The W.Ch. Sw. incorporates Gram position. Controls are Tuning, W. Ch. and Vol. Only 250 v. 15 mA. H.T., and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Simple alignment procedure. Point-to-point wiring diagrams, instruction and priced parts list with illustration, 2/6. Total building cost £4 15/-. For descriptive leaflet send S.A.E.

LINEAR L45 MINIATURE 4-5 WATT QUALITY AMPLIFIER. Suitable for use with Garrard, B.S.R. or any other record-playing unit, and most microphones. Total negative feed-back 12 db. Separate Bass and Treble Controls. For A.C. mains input of 200-250 v. 50 c/cs. Output for 2-3 ohm. speaker. Three miniature Mullard valves used. Size of unit only 6-5-5½in. high. Chassis is fully isolated from mains. Output for 2-3 ohm speaker. Guaranteed for 12 months. Only £5/19/6; or Deposit 22/- and five monthly payments of 22/-. Illustrated leaflet 3d.

LINEAR 'DIATONIC' 10 WATT HIGH FIDELITY PUSH-PULL ULTRA LINEAR AMPLIFIER. For 200-230-250 v. 50 c/cs. A.C. Mains. Valve line-up ECC83, ECC83, EL84, EL84, EZ81 miniature Mullard. The unit has self-contained Pre-amplifier/Tone Control stages and separate Bass and Treble Controls. Independent 'Mike' and Gram input sockets are provided. Total harmonic distortion only 0.25% at 6 watts. Due to use of latest miniature components of proved reliability size is only 10-6-6ins. Output Matchings for 3 and 15 ohm. speakers. Finished in attractive stoved Blue-Grey hammer. Only 12 GNS.; or Deposit 26/9 plus 10/- carr. and 9 monthly payments of 26/9. Leaflet 3d.

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

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads, in addition to all other types of pick-ups and practically all 'mikes'. Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71 db. down. 15 db. of negative feedback is used. H.T. of 300 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape Deck pre-amplifier. For A.C. mains input of 200-230-250 v. 50 c/cs. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with Blue hammer finish and point-to-point wiring diagrams and instructions. Exceptional value at only £4/15/-, or assembled ready for use 25/- extra, plus 3/6 carr.; or Deposit 22/6 and 5 monthly payments of 22/6 for assembled unit.

LT45 HIGH QUALITY TAPE DECK AMPLIFIER. For A.L.J. Tape Decks with High Impedance, Playback and Erase Heads, such as Lane, Truvox. Ready for etc. Or for Collaro, Broneil, etc. Type of Deck should be stated when ordering. Output is 4-5 watts. For 2-3 ohm speaker. For A.C. Mains 230-250 v. 50 c/cs. Positive compensated identification for recording level by Magic Eye. Recording facilities for 15, 7½ or 3¾in. per sec. Automatic equalisation at the turn of a knob. Linear frequency response of ± 3 db., 50-11,000 c/cs. Negative feed-back equalisation. Minimum hum. High output with completely effective erasure and distortionless reproduction. Sensitivity is 15 millivolts. Any kind of crystal microphone is suitable. Only 2 millivolts minimum output required from Recording head. Provision is made for feeding a P.A. amplifier. Unit can also be used as a gram-amplifier requiring input of 0.75 v. Illustrated leaflet 8d. Special price quoted for above with Deck.

Use, ONLY **12 GNS.** Carr. 7/6

R.C.A. 20 WATT RE-ENTRANT SPEAKERS. 15 ohms or 600 ohms matching. For Outdoor work. Only **8 GNS.**

P.M. SPEAKERS. All 2-3 ohms, 5in. Goodmans, 17/9. 6½in. Goodmans wafer type, 16/9. 8in. Rola, 19/9. 10in. Elac, 26/9. 12in. Plessey, 29/11. 10in. W.B. "Stentorian" 3 or 15 ohms type HF1012 10 watts, hi-fidelity type. Recommended for use with our A8 amplifier. £4/10/9. 12in. Plessey 15 ohms 10 watts, 59/6.

PLESSEY DUAL CONCENTRIC 12in. 15 ohm HIGH FIDELITY SPEAKER with built-in tweeter (completely separate elliptical speaker with choke, condensers, etc.) providing extraordinarily realistic reproduction when used with our A8 or similar amplifier. Rated 10 watts. Price complete, only £5/17/6.

M.E. SPEAKERS 2-3 ohms, 8in. R.A. Field, 600 ohms, 11/9.

P.M. SPEAKERS, 2-3 ohms. Suitable for use with L45, A5 or A7 amplifiers. Elac 7 x 4in. elliptical, 19/9. Celestion 6½in. with high flux density magnet, 19/9. 12in. Plessey, 29/11. 12in. Plessey with high flux density magnet, 47/9. The latter is especially recommended.

R.S.C. 3-4 WATT A7 HIGH-GAIN AMPLIFIER

For 230-250 v. 50 c/cs. Mains input. Appearance and Specification, with exception of output wattage, as A5. Complete Kit with diagrams, £3/15/-. Assembled 22/6 extra. Carr. 3/6.

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

Terms: C.W.O. or C.O.D. NO C.O.D. under £1. Post 1/9 extra under £2; 2/9 extra under £5.
Open 9 to 5.30; Sats. until 1 p.m. Catalogue 6d., Trade List 5d. S.A.E. with all enquiries.
Personal Shoppers (Not Postal) can also be supplied by Messrs. Viners (Middlesbro'), Linthorpe Rd., Middlesbrough.

RADIO SUPPLY CO. (LEEDS) LTD.

32, THE CALLS, LEEDS, 2

COMPLETE KITS of PARTS for the "HI-FI" ENTHUSIAST

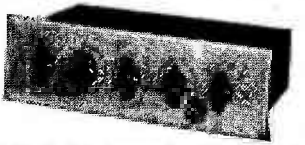
The MULLARD "5-10" MAIN AMPLIFIER

This is the very latest design and needs no recommendation from us. Our Kit is complete to Mullard's specification, including the latest GILSON ULTRA LINEAR OUTPUT TRANSFORMER and the entire MULLARD Valve line up. ALL SPECIFIED COMPONENTS are supplied. **PRICE OF COMPLETE KIT OF PARTS £11.11.0.** (Plus 5/- carr. & ins.)

THE full SPECIFICATION and PRACTICAL BUILDING INSTRUCTIONS for these Units are available for 1/6 each. SPECIAL PRICE REDUCTION. We supply the two complete Kits—Mullard 5-10 and "fidelity" Preamplifier—for **£16.16.0.** We also supply both fully assembled and ready for use for **£19.19.0.**

STERN'S "fidelity" PREAMPLIFIER-TONE CONTROL UNIT

"A design for the music lover"



Briefly it has inputs for all types of MICROPHONES, HIGH and LOW GAIN PICK UPS and a RADIO TUNING UNIT. It incorporates (a) GRAM EQUALISING CONTROL. (b) STEEPCUT FILTER. (c) Continuously variable BASS and TREBLE CONTROLS and a variable OUTPUT CONTROL which enables its use with any type of Amplifier.

PRICE OF COMPLETE KIT OF PARTS (Plus 5/- carr. and ins.). **£6.6.0.** WE ALSO OFFER IT ASSEMBLED, READY FOR USE, **£8.0.0.**

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

Has power supply for Radio Tuning Unit.

PRICE OF COMPLETE KIT OF PARTS (Plus 5/- carr. & ins.) **£7.10.0.**

SUPPLIED ASSEMBLED and READY FOR USE **£9.10.0.**

Proved one of the most popular models yet offered to the HOME CONSTRUCTOR. Provides excellent reproduction up to 8 watts, employing 6V6's in push-pull, incorporating negative feedback. Provides for use of both 3 and 15 ohm speakers.

WE HAVE THE FULL RANGE OF DULCI CHASSIS IN STOCK

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

The following two **RADIOGRAM CHASSIS** are very well designed and reproduce most excellent quality on both Radio and Gram.

MODEL H.3. A 3 Waveband AM/FM CHASSIS **£20.17.0.**

MODEL H.4. A 4 Waveband AM/FM CHASSIS **£24.6.6.**

TUNER UNIT CHASSIS

THE FM/VHF TUNER CHASSIS with self-contained Power Supply ... ... **£17.10.3.**

MODEL H4/T. A 4 Waveband AM/FM TUNER with self-contained POWER SUPPLY **£20.17.0.**

MODEL H.11. A combined 4 Waveband AM/FM Tuner incorporating a "HI-FI" Control Unit—Audio Preamplifier, which has switching and connections for Tape Replay, Gram equalising, Bass and Treble Controls, etc. **£29.3.10.**

"HI-FI" AUDIO AMPLIFIERS

MODEL G.A.4. A self-contained 4 watt Amplifier with adjustable Tone Control Box ... ... **£9.9.0.**

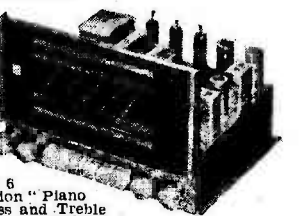
MODEL D.P.A.10. A 10 watt Amplifier with separate Tone-Preamplifier Unit incorporating Bass and Treble Controls and Gram equalising ... ... **£19.19.0.**

MODERNIZE YOUR OLD RADIOGRAM

★ **THE LATEST A.M./F.M. RADIOGRAM CHASSIS.**

★ **A NEW 4-SPEED AUTOCHANGER.**

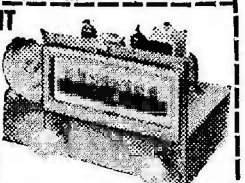
The NEW ARMSTRONG PB. 409 A.M./F.M. Radiogram Chassis



"A chassis for those who want the highest quality." ● A 9 valve line up employing the latest MULLARD preferred-type valves. ● Provides complete coverage of the V.H.F./F.M. Transmissions plus the Short, Medium and Long Wavebands. ● Has Push-Pull Output with Negative Feedback for 6 watts peak Output. ● Quick Action "Piano Key" Selectors and separate Bass and Treble Controls. ● Has "Magic Eye" Tuning Indicator. ● Dimensions 13in. x 9½in. x 8in. high. Dial size 11¾in. x 6¾in. PRICE **£29.8.0.** TERMS: Credit £7.7.0 and 9 monthly payments of £2.14.0. (Plus 6/- carr. & ins.). H.P. £14.14.0 and 12 monthly payments of £1.7.6.

SEND S.A.E. FOR ILLUSTRATED LEAFLET.

STERN'S "F.M." TUNING UNIT



A 5-valve Tuner incorporating the latest Mullard Permeability Tuning Heart and a "Magic Eye" Tuning Indicator.

PRICE ASSEMBLED READY FOR USE: £14.10.0. (Plus 7/6 carriage and insurance) TERMS: (a) Hire Purchase: Deposit £7.5.0 and 9 monthly payments of 18/4. (b) Credit: Deposit £3.12.6 and 9 monthly payments of £1.6.7.

THE COMBINED AM/FM/TUNER is precisely similar in appearance to the above and incorporates 7 valves. It provides complete coverage of F.M. Transmissions and MEDIUM WAVEBAND giving a good selection of foreign stations.

PRICE (Plus 7/6 carr. & ins.) **£18.18.0.** TERMS: (a) Hire Purchase: Deposit £9.9.0 and 10 monthly payments of £1.1.0. (b) Credit: Deposit £4.15.0 and 9 monthly payments of £1.14.7.

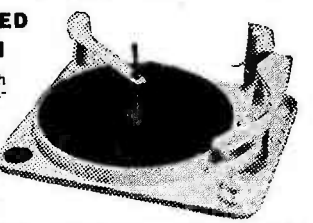
RECORD PLAYERS AT GREATLY REDUCED PRICES

THE VERY LATEST MODELS OFFERED

Send S.A.E. for ILLUSTRATED LEAFLET.

AN EXCEPTIONAL "CASH ONLY" OFFER £7.19.6.

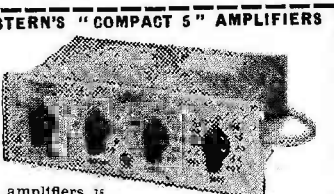
THE NEW 4-SPEED B.S.R. MONARCH



● Complete with High Fidelity Crystal "Turnover" Head which incorporates separate stylus for L.P. and 78 r.p.m. records. ● A "MIXER" Unit that will autochange on 7in., 10in. and 12in. records of same speed. ● Incorporates the Manual Control position.

Expressly developed for very high quality reproduction of Gram. Records and particularly suitable for high quality reproductions of the F.M. transmissions. Two models are available:

STERN'S "COMPACT 5" AMPLIFIERS



(a) The "COMPACT 5-2" A Two-stage high sensitivity Amplifier having SEPARATE BASS AND TREBLE CONTROLS and designed to give up to approx. 5 watts with very pleasing quality. PRICE £6.6.0. (Plus 5/- carr. & ins.)

(b) The "COMPACT 5-3" A Three-stage version of the "5-2" model but in this case having an additional stage and incorporating Negative Feedback. PRICE £6.16.0. (Plus 5 - carr. & ins.).

A separate **POWER SUPPLY UNIT** to operate with these amplifiers is available for **£2.10.0.** Has additional supply available for Radio Tuner, etc.

CALLERS ONLY

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

STERN RADIO LTD. 109 & 115 FLEET STREET, LONDON, E.C.4. *Telephone: FLEet 5812/3/4*

PRACTICAL WIRELESS

EVERY MONTH
VOL. XXXIII, No. 607, JULY, 1957

EDITOR : F. J. CAMM

25th YEAR OF ISSUE

COMMENTS OF THE MONTH

BY THE EDITOR

Editorial and Advertisement Offices :
PRACTICAL WIRELESS
George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.
Phone : Temple Bar 4363.
Telegrams : Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

SUBSCRIPTION RATES
including postage for one year
Inland - - - 18s. per annum.
Abroad - - 16s. 6d. per annum.
Canada - - - 16s. per annum.

CONTENTS :

SUN SPOTS

AN official of the Radio Corporation of America concerning the weather forecasts recently made the surprising statement that sun spots improve rather than hinder radio communications. He said that records prove that transmitting conditions on international radio circuits actually get better as the number of sun spots increases. The spots to which he refers are the dark areas on the surface of the sun. They are centres of gigantic storms of glowing gas and they emit streams of rays towards the earth. These rays contain ultra-violet light and according to this spokesman they strengthen the ionosphere which is 200 miles above the earth's surface, and contain electrified particles. He says that to shoot a beam of radio waves across an ocean or continent it is necessary to bounce them off the ionosphere and therefore the stronger the ionosphere, the better the bounce it gives to radio waves and the less power is needed to reach long distances.

THE RADIO SHOW

THE Radio Show at Earls Court which this year takes place from August 28th to September 7th will undoubtedly reveal the advances which have been made in the sphere of electronics, and the formation of new companies over here to manufacture transistors is a straw in the wind. From every point of view, it would be wise if the electronic industry, which, after all, is only a part of the industry, amalgamated with the radio industry and ran a combined exhibition at Earls Court. We are opposed to this tendency for small pieces of an industry to fly off at a tangent and to regard themselves as self-contained industries. There are far too many exhibitions as it is, and indeed far too many trade associations. These break-away movements weaken the parent industry as far as the Radio Show is concerned. These criticisms apply equally to the Audio Fair, the Radio Components Show and other small exhibitions, such as the Amateur Radio Show. The public is not impressed with exhibitions run on a small scale from hotels and similar small buildings, small that is when compared with exhibition buildings such as Earls Court. They would gain strength by amalgamating or joining forces with the R.M.A. It is unwise to make several appeals during the year to the purses of the public which has a common interest in all of these exhibitions.

TRACKING THE EARTH SATELLITE

ELSEWHERE in this issue we publish an article issued under the authority of the U.S. Navy Department showing how radio amateurs can help in tracking the Earth Satellite which the Americans propose to launch during the Geophysical Year. It extends from July 1st, 1957, to December 31st, 1958. Readers should study this article. Any help they can render with tracking the Earth Satellite when it is launched will be of extreme value to the sponsoring authorities.—F. J. C.

Our next issue, dated August, will be published on July 5th.

Round the World of Wireless

By "QUESTOR"

Atlantic Islands Linked by Radio-telephone

CABLE AND WIRELESS LTD. announce that a radio-telephone service has been opened between Ascension Island in mid-South Atlantic and its nearest neighbour, St. Helena, 800 miles away.

The service is available for one hour each weekday on demand, and the cost of a three-minute call is 10s. 6d.

In due course it is hoped to extend this link into the international network and provide a service between St. Helena and Europe.

The International Geophysical Year

AN exhibition to illustrate the scope and aims of the International Geophysical Year will be on view at the Science Museum opened on May 10th and will continue till October 31st.

The International Geophysical Year extends from the beginning of July, 1957, to the end of December, 1958. During this period many scientists representing more than 40 nations will make simultaneous observations throughout the world of physical phenomena associated with the earth, the sea and the air. The results of this great enterprise are expected to yield the most complete picture ever obtained of man's physical environment.

Radio System for New Comet IVs

ONE of the most comprehensive radio systems ever undertaken for an airline operator will be installed by Marconi's in the new De Havilland Comet IVs now on order for B.O.A.C. for its Australian, Far East and South African services. This new installation has been planned by Marconi engineers working in close collaboration with engineers of De Havillands and B.O.A.C.

All major radio requirements of a modern passenger aircraft will be met by the Marconi equipment, which will include dual installations of the new Type AD712 Automatic Direction Finder, Type AD307 multi-channel transmitter/receiver for H.F. communication, and Type AD305 transmitter with Type AD704 Receiver for V.H.F. communication.

A special feature of the Comet radio installation will be the aircraft selective calling system, which permits ground radio operators to send a call signal which will be received only by the aircraft with which communication is desired. This system relieves the pilot of the tedious necessity of continual listening to incoming messages of which only a small fraction may be relevant to his aircraft. The Comets will have the Marconi "Selcal" Decoder Unit, the only British-made aircraft selective calling system.

Electronic Computer Exhibition and Symposium Next Year

AN Electronic Computer Exhibition, to include data handling equipment of all kinds, is to be held at Olympia, London, from November 28th to December 4th, 1958.

The Exhibition will be the first of its kind to be held in Great Britain. It is being sponsored, at the suggestion of the National Research Development Corporation, by a joint committee of the Radio Communication and Electronic Engineering Association and the Office Appliance and Business Equipment Trades Association under the chairmanship of Mr. J. A. Cumming, chairman of the Exhibition Committee of O.A.B.E.T.A.

Concurrently with the Exhibition there will be a symposium at which papers dealing with the applications of computers to problems in business, industry and science will be read and discussed.

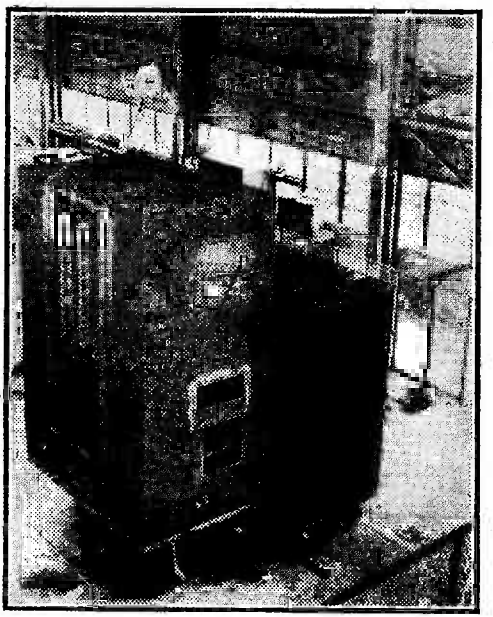
H.M. The Queen Radio Show Patron

H.M. THE QUEEN has consented to be patron of the National Radio and Television Exhibition to be held at Earls Court, London, from August 28th to September 7th.

Her Majesty has been patron of each National Radio Show since 1954, after the death of Queen Mary, who was patron from 1947 onwards.

Apprentice/Technician Brian Young (17), of Bournemouth, repairing an intricate piece of equipment at the R.E.M.E. Apprentices School, Arborfield, where he is training as a tele-communications engineer.

The Queen, as Princess Elizabeth, was also joint patron with Queen Mary in 1951.



The prefabricated sound enclosure is shown being lowered over a 5,000 kVA, 34.5 kV tank transformer at the General Electric Medium Transformer Department, Rome, Ga. The tube bank is mounted separately outside the enclosure and connected to the transformer by four resilient oil pipes.

A Prefabricated Sound Enclosure

AT Schenectady, N.Y., the Niagara Mohawk Power Corporation has installed what is believed to be the world's first transformer with a prefabricated sound enclosure. Tailor-made, the sound enclosure has resulted in a 19.6-decibel sound reduction for this 5,000 kVA, 34.5 kV General Electric transformer.

The oil-filled, load-tap-changing transformer was specifically engineered by the company's Medium Transformer Department, Rome, Ga. It is the first integrated transformer and sound enclosure capable of being fully assembled and pre-tested at the factory.

First V.H.F. Radiotelephone Link for Needles Lighthouse

FOR nearly a hundred years keepers on the Needles lighthouse, which guards the important shipping lanes around the Isle of Wight, have relied upon lamp signalling to maintain communication with the shore. In bad weather poor visibility often made the passing of operational and emergency messages to the mainland extremely difficult if not impossible.

Now this problem has been overcome by the installation of a V.H.F. (Very High Frequency) radiotelephone link—the first of its kind to be employed by Trinity House for communication between one of its rock lighthouses and the shore.

Using the new equipment, which provides a normal telephone service without the use of landlines or cable, the Needles' crew will in future be able to contact the shore station at St. Catherine's Point—fourteen miles to the east—within seconds of an emergency arising.

French Honour for British Inventor of Printed Circuits

DR. PAUL EISLER of London has been made an officer of the French "Order of Merit for Research and Invention" for his invention and pioneering work of printed circuits. The investiture took place in Paris recently.

R.A.C. Radio Link

THE Royal Automobile Club has inaugurated a new Radio Road Service for the benefit of motorists under which all the R.A.C.'s mobile offices and patrol vehicles have been equipped with two-way radio. The new service operated for the first time at the British Industries Fair in Birmingham on May 6th.

Radio communication will be used primarily to bring assistance to any member whose car, van or motor-cycle has broken down, but will also be used to report traffic blocks and other information for the use of police and Show authorities.

The new radio-equipped vehicles can be easily identified as they carry a sign, "Radio Road Service."

Sweden to Establish F.M. Radio Network

WITH the ever-increasing congestion in the low- and medium-frequency broadcasting bands, more and more countries are turning to V.H.F. (Very High Frequency) transmission as a solution to the problem.

In Sweden the Royal Board of Telecommunications has placed orders with Marconi's for the supply of 12 5kW. frequency modulated V.H.F. transmitters (Type BD.321B), together with three Combining Units. One transmitter has already been supplied against a pilot order, and is in operation at Ostersund.

The value of the orders is approximately £50,000. Delivery of the equipment is expected to be completed by November next.

It may be recalled that last year Norway placed a similar order for 11 transmitters; the Norwegian Telegraph Administration is currently proceeding with the installation of these.

New Ekco Executive Director

E. K. COLE, LTD., announce that Mr. S. A. Clodd, works manager, radio and television, has been appointed an executive director of the company.

Joining the Ekco war-time factory, at Aylesbury, Bucks, in 1941, as material controller, Mr. Clodd transferred to the company's main organisations at Southend in 1945 as production controller. He was appointed works manager in 1950.

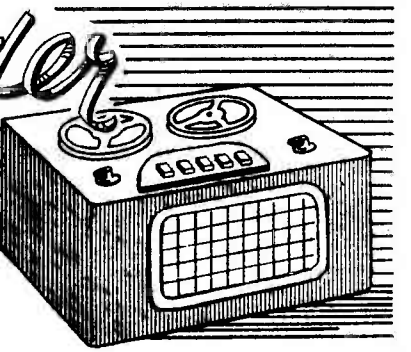
New Radiotelephone Circuits

TWO new radiotelephone circuits have been opened between Mauritius and Reunion Island and Mauritius and Madagascar, announce Cable and Wireless, Ltd. The charges for a three-minute call are 15s. and £1 2s. 6d., respectively.

Later it is planned to extend the service to Nairobi and eventually to London and other European capitals.

A radiotelephone service has also been opened between Aden and Djibouti (French Somaliland). A three-minute call costs £1 2s. 6d.

Tape Recorder MAINTENANCE



By J. Brown

THE maintenance and repair of tape recorders is a job that cannot be taken too seriously. Many of the faults can be remedied, if not cured, by the use of simple gear and patience and time. This article is written in the hope that some reader might find it a helping hand, and it caters for the tape recorder owner who is both mechanically and electrically minded and who has a normal selection of tools. Should any reader lack any of these qualities, he is well advised to seek advice from another man who possibly has had more experience. Some typical faults are given, as well as some remedies. The faults will be dealt with in sections, and therefore we can devote certain separate space to each.

Motors

The first section is the mechanism that is commonly known as the deck or desk. This covers the motors, capstan, tape guides, braking systems and heads. The motors used in the majority of tape recorders are known as *shaded pole type motors*. They are brushless motors of 4-pole construction, can run for very long periods without becoming overheated, with little or no lubrication, and run at a constant speed even when on load. We will not go into their construction as this would make an article of its own. The only troubles these motors can give are :

1. Fields being burnt out.
2. Bearings becoming worn after a long time.
3. Motors becoming noisy.

No. 1.—This is not a frequent occurrence, but if it has happened there will be no reading when an ohmmeter is applied to the two leads from the motor. Should the fields burn out the only remedy is to return the motor to the manufacturer for rewind or send to a specialist firm for rewind. The resistance of the average tape motor is between 100 and 400 ohms.

No. 2.—This is very unlikely, but the writer has experienced end play in the shaft of a motor, as well as a chatter in the motor. The remedy for the first is to tighten the thrust screw fitted on some motors at the bottom of the shaft (this will be explained later). The chatter was due to loose laminations, and was cured by loosening the ends of the motor and then tightening the screws that held the motor together. In passing, there are lots of motors on the market suitable for recording. The rotation is given

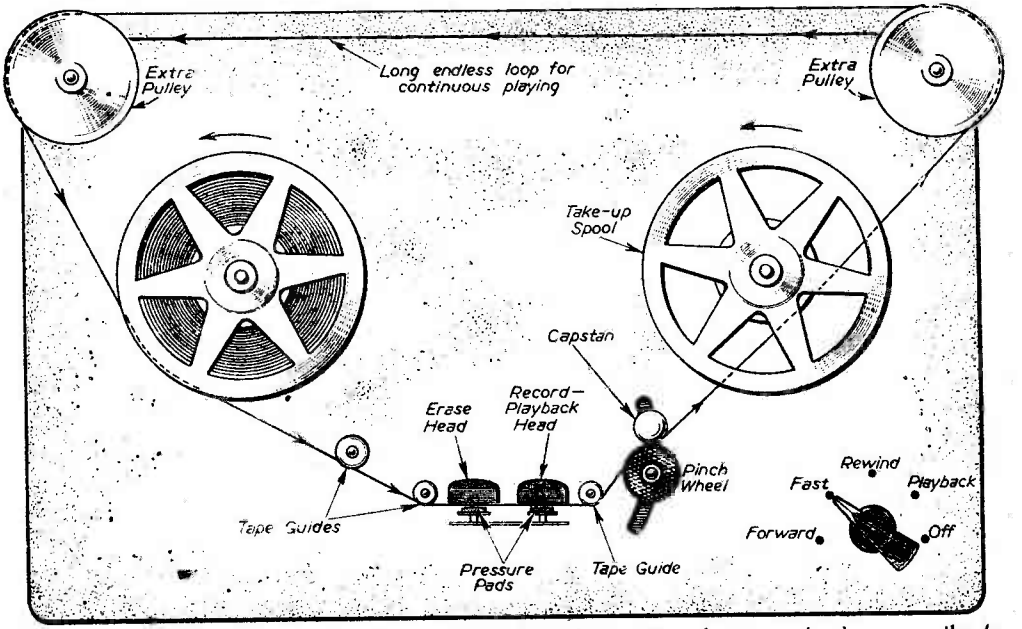


Fig. 6.—Typical tape deck. When a tape is in playback position the erase head can easily be identified as the head nearest the unplayed or full spool.

as clockwise or anti-clockwise. A shaded-pole motor may be easily reversed by changing around the stator (see Fig. 1).

The capstan is the heavy flywheel that transmits the drive from the motor to the tape. This is normally

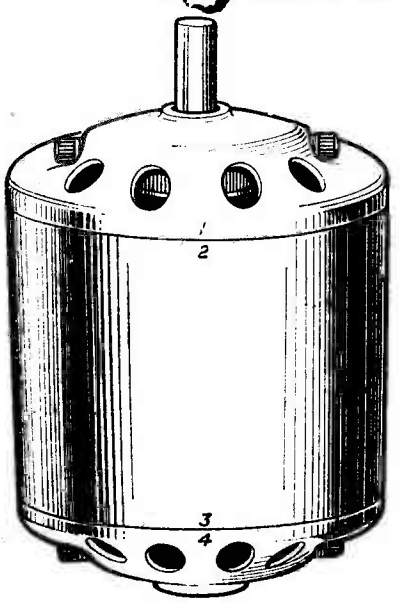


Fig. 1.—The standard shaded-pole motor. If the motor travels anticlock *when in the position above* (1 *over* 2, *and* 3 *over* 4), *then if we* transpose *the* body *of the* motor *and get* 1 *over* 3 *and* 2 *over* 4, *we find that the motor travels* clockwise.

a heavy machined wheel of different diameters for speeds, and the only troubles that may be experienced are possible wear, failure to drive or noise.

If wear is experienced the recorder becomes more susceptible to "wow". This is described later (Fig. 2). Failure to drive is nearly always too much oil being used for lubrication; this gets on the capstan and makes the drive either impossible or intermittent. Noisy capstan is again due to either wear or friction against some object on the deck. We now come to tape guides. The purpose of these is to keep the tape taut during its travel from one spool to the other, and to stop it from fouling on the deck itself. These again need be sparsely lubricated, usually with a lubricant made from some non-magnetic material. Braking systems of all types are found on present-day machines, from mechanically operated, servo types, electro-magnetic to the common or garden friction brake. These usually can cause only two troubles either they do not operate or they operate and cause friction. Again a mechanical fault, this can be clearly seen except in the case of the electro-magnetic type of brake or clutch, when the adjustments must be carried out as per the maker's instructions.

Heads

We now come to the heads. There are various types of heads available—combined record/playback, erase, monitor, and even the combined record/play-

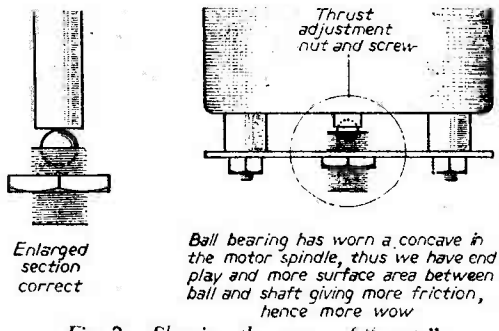


Fig. 2.—Showing the cause of "wow."

back/erase head, all in one case. They are made in two distinct types, *low impedance* and *high impedance*. The main trouble with these is that the heads wear, due to the pressure pads which keep the tape up to the head. This wears the laminations of the heads. In this case the cure is to replace the heads, but if kept clean and free from dust, or the particles of tape are kept from clogging up the laminations, they will give years of trouble-free service. The best cleaning method to date is thoroughly to brush the heads with a small brush, e.g., a toothbrush, which has been soaked in carbon tetrachloride. This removes the dust and cleans the laminations at the same time. Heads *must* never be tested with an ohmmeter as the D.C. would magnetise them. The writer had developed a simple instrument to test both high and low impedance heads, and this has been found to be O.K. Should the heads become magnetised, they should be returned to the makers for demagnetisation. Low impedance heads are easily recognised as they are wound with heavier gauge wire than the high impedance type, and also they have to have a transformer or headlift transformer to match the output of the heads to the high impedance of the amplifier. This transformer is usually mounted near the first audio valve in the amplifier.

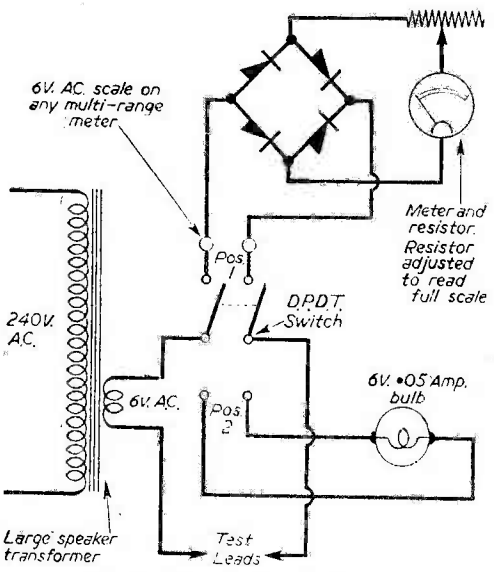


Fig. 3.—Circuit of a head tester.

In Fig. 3 we have the head tester. In position 1

we have a 6-volt supply with a pair of test leads in series with a meter to read 6 volts A.C. This can be accomplished by using a meter rectifier and wire-wound potentiometer, so that the meter reads full scale on the 6-volt reading when the leads are shorted. Any reading when the leads are applied to the heads, which are disconnected from the rest of the circuit, should, if the head is intact, give a reading on the meter, dependent on the actual resistance of the head winding. This then caters for the high impedance heads. In position 2 we have the leads for testing in series with the A.C. supply of 6 volts and a 6-volt bulb. When these test leads are placed across the heads, as previously explained, if the winding of the head is O.K. we get a light in the bulb. This is the same as a continuity test with an ohmmeter except that we are not damaging the heads by passing A.C. through them. The heads can be easily demagnetised (Fig. 5) by using an old field coil of 2,000 ohms from an energised speaker. Connect the ends of the field coil to the mains and draw the heads through the centre hole, which had previously been occupied by the pole piece of the speaker. These are about the only things that can be said for heads, but in any case of query the makers will be only too pleased to advise or test.

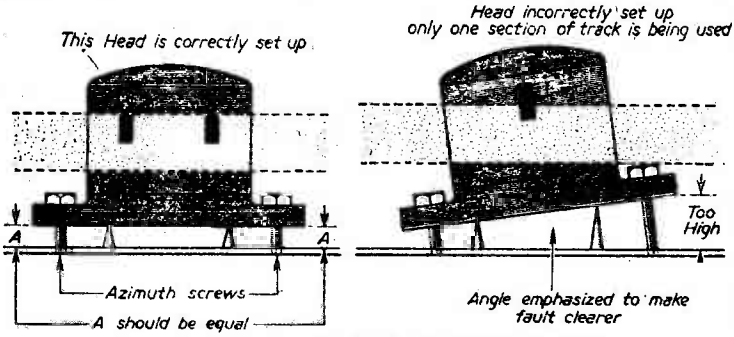


Fig. 4.—Adjusting the heads for correct tracking.

Amplifier

We now come to the main amplifier and some of the faults which may be experienced. In a case of poor record, yet good playback, with a tape that has been previously recorded, the trouble is usually due to :

1. Worn bias heads.
2. Faulty bias circuit.
3. Faulty bias voltage.
4. Incorrect setting of the bias core in coil.
5. Head adjustment.

No. 1 we can only see if there is a slight flat worn by the tape on the head. This we cannot correct, and this means a new head.

No. 2 is quite simple to find, and may be in the coil or associated circuit, the valve in the oscillator circuit, or voltages. In one case that comes to mind the failure was due to the core of the oscillator coil coming away from the adjusting screw and was found in the case floating around. In another case, the screen resistor had gone high and the voltage was low on the screen of the EL41 oscillator valve. Check the insulation of the screen decoupling condenser for insulation and leakage.

No. 3. The approximate voltage for the bias is about one-third the value of the erase voltage, e.g., if erase voltage is 180 volts the bias should be round about 60 volts. This can be measured with a 20,000-ohms/volt meter or by connecting a flash lamp bulb, 6 volt .3 amp, to the erase head and test for light, and across the bias for light, and adjust for the difference in the illumination. The bias and recorded circuits are very tricky, and the reader is well advised to obtain service data before attempting to rectify any fault. These examples are given as typical of those that may be met.

No. 4. Incorrect setting of the erase oscillator coil slug. This is again slightly difficult as the normal frequency is between 40 and 60 Kc/s, and can only be really adjusted for the best performance.

No. 5. Head adjustment. The reader will appreciate that for efficient performance the tape must be correctly run on or across the head. The modern tape heads have what is known as *azimuth adjusting screws* (see Fig. 4). These screws control the path of tape in respect to the heads, as per sketches. This, wrongly adjusted, can give poor record and playback, as will be seen. The way the author recommends to adjust these is to get a recording of the 1,000-cycle note the BBC use to open up the morning's test transmissions on the television. Record this on a known to be O.K. recorder that travels the same way as the recorder to be set up. Play this tape, connect an A.C. voltmeter to the speaker wires of the recorder, turn the gain of the amplifier up enough to get a reading on the meter, and adjust the screws for the maximum reading on the meter. This operation must be taken very seriously, as the adjustment is very critical for maximum performance of the recorder.

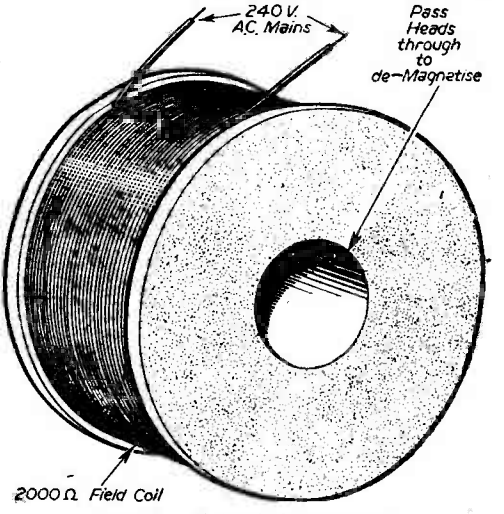
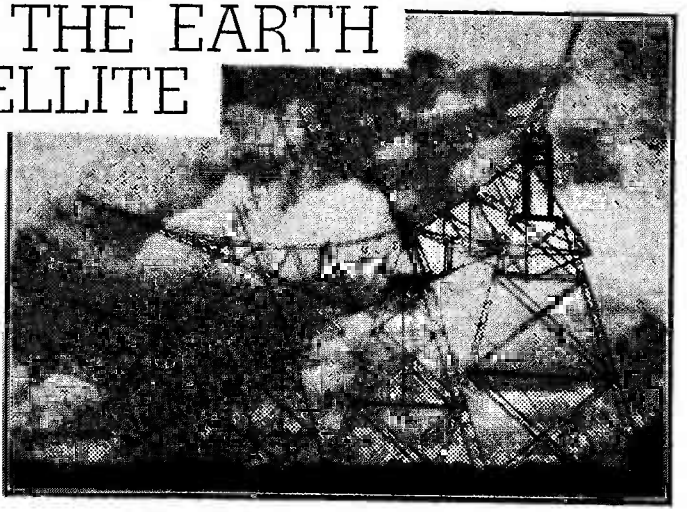


Fig. 5.—A head demagnetiser.

(*Continued on page* 340)

TRACKING THE EARTH SATELLITE

AN ARTICLE OF GREAT INTEREST TO CLUBS AND SIMILAR ORGANISATIONS



A Radio Telescope Assembly at Cambridge.

ON July 29th, 1955, the White House announced that the United States planned to launch small, unmanned, earth-circling satellites as part of the United States' participation in the International Geophysical Year, from July 1st, 1957, to December 31st, 1958.

"Project Vanguard" is the name assigned to the Department of Defence part of this programme. The project was undertaken by the Department of Defence at the request of the U.S. National Committee for the International Geophysical Year, established by the National Academy of Sciences, and of the National Science Foundation, which are sponsoring U.S. participation in the I.G.Y.

Department of Defence participation is on the three-service basis, with the Navy management under the Chief of Naval Research. Project Vanguard is established at the Naval Research Laboratory, which has the responsibility for implementing the technical programme, including the production of the three-stage rocket vehicle and the launching and the radio tracking of the satellite. Astronomers will search for the satellite with optical instruments, but visibility conditions will make acquisition a difficult task. Of interest to radio amateurs is the fact that the satellite will carry a 108 Mc/s transmitter system.

THIS article describes a simplified tracking system that has been worked out for amateur use. It is not a complete technical exposition but rather a broad outline of principles, including a brief description of equipment required for a tracking installation. It gives enough of an idea of the magnitude of the undertaking to enable a group such as a radio club to decide whether it has the needed technical and other resources.

Interested groups are invited to make their intentions known to ARRL Headquarters, at 38, La Salle Road, West Hartford, Conn. As the satellite programme progresses, it is expected that more detailed information will become available. Amateurs have the opportunity not only to aid tracking but also to make some real contributions in the development of suitable equipment.

This article, reproduced from the American magazine QST, describes a simple interferometer system which can be used to detect the satellite's presence and, with some refinement, to measure its angular position. Interested amateurs around the world can perform a real service to the satellite programme by building and manning satellite-tracking stations. Such a station would be a large undertaking and would be more suitable for a club project than for individual effort. In addition, the backing of a university or an industrial firm would be desirable as a possible source of some of the more expensive components needed for a tracking system.

Satellite Path

The northernmost latitude over which the satellite will pass will not be known exactly until the first satellite is launched. Since it will be launched from Cape Canaveral, Florida, it will reach a latitude of at least 28.5 degrees even if fired due east. If fired away from due east the maximum latitude can only increase, the most likely value being 36 degrees. The altitude of the satellite may vary from about 200 miles to about 800 miles, so that it will be detectable from latitudes much greater than 36 degrees, especially when at its greatest altitude (apogee).

The path traced by the satellite in space will be a slowly rotating ellipse, while the path traced by the sub-satellite point on the earth's surface will be approximately a sine wave. At the maximum latitudes reached by the orbit, the times of passage will be roughly 90 minutes apart, becoming earlier by about 30 minutes per day. Each station at the maximum latitude will be able to receive from as many as four consecutive passes and will then have to wait until about the same time (minus 30 minutes) on the following day.

Radio Transmitter

The transmitter will emit a 108 Mc/s signal with a power output of at least 10 milliwatts for a minimum period of two weeks. This signal will be used for proving the presence of the satellite, for determining its orbit, and for directing optical equipment. Ultimately, the orbital measurements may be used to measure the shape and size of the earth, and inter-continental and inter-island distances.

The satellite aerial system will probably consist of four radiators spaced equally around a great circle on a sphere so as to produce circular polarisation in the plane of the radiators. When the satellite is launched the direction of polarisation will be normal to the direction of travel. When the satellite has travelled 90 degrees around the earth, the radiators will be parallel to the earth's surface, if disturbing torques are negligible, and a station below would receive a circularly polarised signal. The portion of

the earth's surface receiving circular polarisation will be most suitable to receive the satellite transmissions because of the rotation of the plane of polarisation through the ionosphere by the Faraday effect. This favourable situation can exist initially at two locations on the earth's surface, at approximately South Africa and Hawaii. These optimum locations will shift because of the earth's rotation and also because of the rotation of the elliptical satellite orbit resulting from the earth's equatorial bulge.

In the areas where the polarisation of the signal from the satellite is linear, a linearly polarised ground aerial will receive a signal that will vary as a function of the degree of polarisation. As the satellite passes through the aerial pattern, the received signal strength will vary approximately sinusoidally because the Faraday rotation is dependent on the angle between the radio path and the ionosphere. The frequency of the variation can be used to measure the total ionisation content in the radio path, and the latter information can be used to correct the measured satellite position for ionospheric refraction.

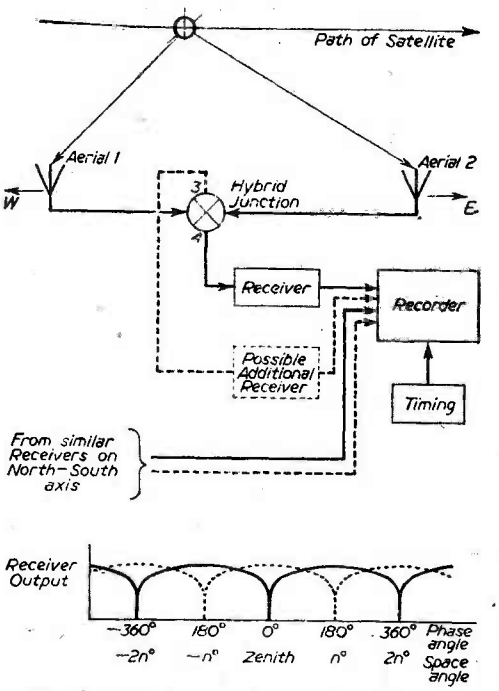


Fig. 1.—The Mark II Minitrack system.

Radio Tracking Systems

Several versions of tracking systems have been considered for this project. The primary system, called "Minitrack," will be used at a number of stations in the Western hemisphere to obtain basic orbital data. The Minitrack system is non-ambiguous and will provide satellite ephemerides (an astronomical term meaning a table of location of a celestial body at regular intervals of time), so that after the first few satellite orbits the future path of the satellite over the earth's surface can be predicted.

Since the Minitrack system requires a large installation, a simpler tracking system called the "Mark II Minitrack" has been devised. While the simplified system will give ambiguous data, the ambiguities can be resolved by the use of data from the Minitrack stations. By using the two systems together, it will be possible to determine the position of the satellite over any ground point as accurately with the Mark II Minitrack system as with the complete system.

The Mark II Minitrack, like the Minitrack system, is based on the interferometer principle. This principle is well known to radio astronomers and to students of optics, but it may not be too well understood by some readers, so it will be described in detail.

The interferometer principle as applied to the simplified Minitrack system is shown in Fig. 1. Here two aerial arrays are separated by many wavelengths and are connected together by transmission lines. The midpoint of the transmission lines is connected to a hybrid tee and to a receiver (or receivers) which actuates a meter or recorder.

The geometry of the situation is shown in Fig. 2. We assume the satellite S is at a distance which is great compared with the separation between aerials. If we make the distance SP=SA1, then A1P will be approximately perpendicular to SA2, since the angle A1SP is small. The phase difference that will be read will be proportional to the distance PA2, and cos will equal PA2, A1A2.

Now let us assume that the distance PA2 is an integral number of wavelengths. Then the voltages from the two aerials arriving at the hybrid in Fig. 1 will be in phase and the reader will record a maximum output. If the distance PA2 is an odd number of half-waves, the voltages from the two aerials will be out of phase and will cancel at the hybrid, in which case the output will be at a minimum.

As the satellite travels across the aerial pattern, the distance PA2 will vary so that the receiver output will vary from a maximum to a minimum sinusoidally. The number of maxima and minima can be increased by increasing the base-line distance A1A2. For a 50-wavelength baseline a minimum will occur for approximately each angular degree travelled. For example, if the satellite is at 200 miles and is travelling at 25,000 feet per second, this will occur about once per second. The minimum may be made sharp and thus useful for the satellite position measurements by distortion of the output.

System Requirements

Details of the hybrid tee used in Fig. 1 are shown in Fig. 3. The hybrid allows each aerial to look into a matched load and also gives two outputs. As is shown in Fig. 1, when output 3 is a maximum, output 4 is a minimum. The use of two receivers is advantageous, for if a minimum is present on both simultaneously we can infer that such a minimum is not a true phase minimum, but it is due to a loss of signal.

For a tracking installation a large, level field will be needed. The two aerials, 500 to 1,000ft. apart on an east-west line, should be level to $\frac{1}{2}$in. and the aerial pattern area should be free of tall obstacles. To preclude excessive noise in the system, the installation should be moved from population centres, industrial installations, busy highways and other noise sources. The aerial and receiver system needed will depend on the signal strength received from the satellite, on the signal-to-noise ratio required for the system, and on the noise in the system.

Assuming a transmitted power (Pt) of 10 milliwatts, a transmitter aerial gain (Gt) of 0.5 (referred to

isotropic), a receiver aerial gain (Gr) of unity, a wavelength (λ) of 9ft., and a range (R) of 1,000 miles (5×10^6 ft.), we can compute a theoretical signal strength from the following well-known formula :

$$Pr = \frac{Pt\ Gr\ Gt\lambda^2}{(4\pi R)^2} = \frac{(0.01)\ (1)\ (0.5)\ (81)}{16\pi^2\ (20)\ 10^{12}} = 10^{-6} \text{ watts}$$

The noise power in a perfect receiver is about 4×10^{-21} watts/cycle or 204 db. W/cycle (decibels below one watt per cycle of bandwidth). A noise figure of 4 db and a pre-detection bandwidth of 10 Kc/s gives the noise as 160 dbW or 10^{-16} watts.

Since a pre-detection signal/noise ratio of at least 10 db. is required, either the bandwidth must be reduced, the receiving aerial gain increased, or the distance reduced. The pre-detection bandwidth can be reduced to perhaps 5 Kc/s.

Since amateurs have been using considerably smaller bandwidths than this in V.H.F. scatter work, it seems as though a considerable improvement may be possible in this respect, assuming that other requirements of the Minitrack system do not preclude the use of high selectivity.

The transmitted power and the range may be considered as fixed, leaving only the receiving aerial gain as a variable. The Minitrack aerial will cover an area of about 2.5 λ^2 and will provide a gain of about 50 or 17 db. These changes give a theoretical received power of 5×10^{-15} watts or 0.5 μV. With a 5 Kc/s pre-detection a signal-to-noise ratio of 20 db. is obtained.

The Minitrack aerial array consists of 12 parallel half-wave dipoles to give a narrow pattern in the east-west direction and a wide pattern in the north-south direction. The wide north-south pattern is required to cover a large region in the sky because the stations are far apart. If a north-south line of closely spaced stations could be built, the north-south aerial pattern could be reduced. With an average satellite altitude of 300 miles and the stations spaced 50 miles apart, the beam width could be cut to about 10 deg. An aerial with an equal east-west beam width would give an aerial gain of about 300, or better than 24 db. Such an aerial would give a receiver input power of 30×10^{-15} watts or more than 1 μV across 50 ohms.

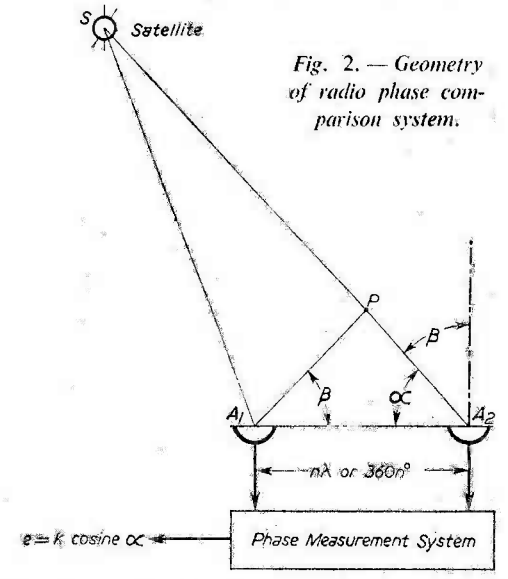


Fig. 2. — Geometry of radio phase comparison system.

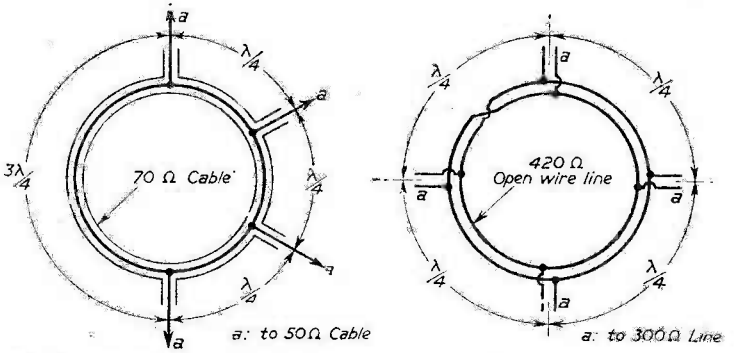


Fig. 3. — (Left) A co-axial hybrid junction, and Fig. 4 (Right) a balanced line hybrid junction.

In addition to permitting larger aerial gains, a line (or lines) of several stations has further advantages. It can back up the Minitrack system for acquisition of the satellite and it would always permit near-vertical observations of each satellite orbit at some station. The vertical observation will reduce the effect of ionospheric and atmospheric refraction and thereby will make conditions favourable for the most accurate satellite position measurements, as well as reduce the range from the satellite to the ground station.

Tracking Equipment

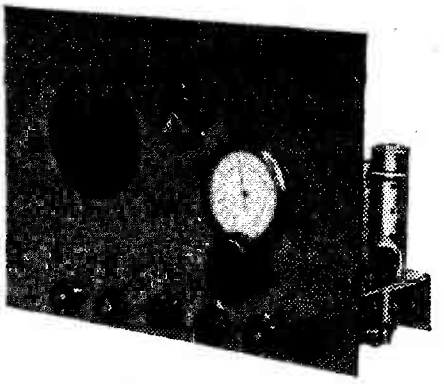
Some components for the simplified system are identical with components of the Minitrack and will be briefly described. Other components are different and are still being designed. The aerial for the Minitrack may consist of 12 parallel dipoles giving a 12 deg. east-west beam width and a 60-deg. north-south beam width with a power gain of about 40. Its dimensions will be about 7ft. by 55ft. Another promising aerial possibility for the simplified Minitrack would be the centre-fed, full-wave, four-dipole array. It should have nearly the same gain and could easily be made rugged to minimise phase shifts due to distortion of the elements.

The transmission line used for either system must have a low loss and be stable in phase. For the Minitrack system $\frac{7}{8}$in. air-dielectric cable will be used. This cable is suitable but the cost is high. Another type that will be tested is the similar type made with $\frac{3}{8}$in. tubing. This cable has a greater loss but is less expensive. The only inexpensive low-loss cable is the " railroad " or " ladder " type of balanced line. If it could be so placed as to be stable in phase it would be suitable.

The hybrid junction can be made in several ways. If the transmission line is coaxial, one of the most

(*Concluded on page 332*)

An Amateur Communications type Receiver



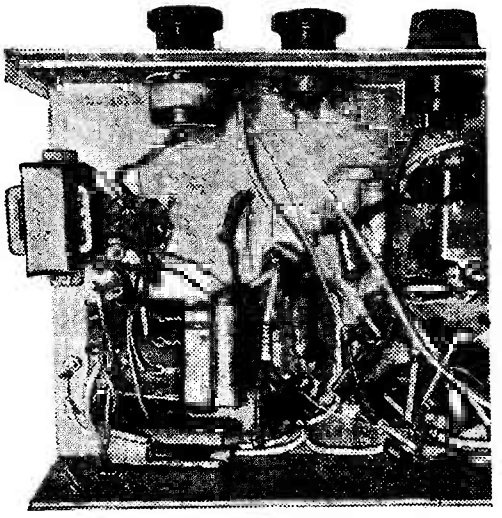
By F. G. Rayer

(*Continued from page* 254 *June issue*)

ONLY a few wiring points arise in relation to Fig. 2. The 30 pF oscillator trimmer is soldered directly to the front section of the gang condenser. Three holes are drilled under the positions to be occupied by the condenser fixed plates, so that leads can pass directly down to the band switch. The condenser frame wiper contacts are all joined, the lead being taken to chassis. Underneath, the oscillator coils are earthed directly to this same connecting point.

Three further pairs of leads pass through the chassis. One pair supplies the dial lamp from the heater circuit. Two leads pass from the tuning meter to H.T. and I.F.T. circuits. A final pair from 6V6 anode and S.G. (H.T. positive) go to the speaker transformer, of 5,000 ohms impedance and rated to carry 50 mA, this component being mounted on chassis or speaker.

The coils mentioned are of the type requiring a single hole each, into which they are a push fit,



The rectifier and output stages.

a clip keeping them in place. The slug adjusting screws are opposite the tagged end, so that sufficient space must be allowed for these to be reached with a long screwdriver with insulated blade. Other types of coils may need two fixing holes or may be adjustable from both ends.

High/Low Switch

It was found that the stray capacity between tags in an ordinary two-way switch wafer caused oscillation of the I.F. stages when all I.F.T.s were correctly peaked, so a four-way wafer was modified as shown in Fig. 4. Here, two tags have been removed (those near the M.C. connecting point), and when the switch is turned so that the circuit is taken from A to B, the stray capacity to C is very small indeed. This is the high-gain, high-selectivity position, where instability was otherwise troublesome. The 1-megohm resistor is necessary to avoid an open grid circuit.

Short connections and full screening in the I.F. circuits is necessary, because eventually all the transformers will be peaked to the same frequency, not staggered, as is usual in a 2-I.F. domestic receiver. Peaking at a common frequency gives greatest

LIST OF COMPONENTS

9 octal valveholders.
3 of 6K7, 6L7, 6H6, 6J5, 6V6, 6C5, 5Z4 valves.
3-gang .0005 μF tuning condenser.
2 of 30 pF pre-set condensers.
2 of 50 pF or 75 pF panel variable trimmers.
2 standard 465 kc/s IFT's.
2 midget 465 kc/s IFT's. (Astral Radio Products, 82, Centurion Rd., Brighton.)
6-pole 5-way rotary switch.
2-pole 2-way High Low switch (see text).
6.3 V. bulb and holder.
Mains transformer : 200/250 V. input, 250-0-250 V. 80 mA., 5 V. 2 A., 6.3 V. 3 A.
80 mA smoothing choke.
Electrolytics : 16 μF 350 V., 2 of 8 μF 350 V., 25 V. 25 μF, 50 V. 50 μF.
Tuning meter and shunt (see text).
Aerial, H.F. and Osc. coils for required wavebands (see text). (Astral Radio Products.)
Padders to suit (see text).
Chassis approx. 16in. x 8in. x 2½in. deep.
Tuning drive. (Eddystone or J.B.)
Extension control spindle. (Coventry Radio.)
Knobs, etc.
P.M. speaker with 5000 ohm, 50 mA transformer.
Resistors : 3 of 220 ohm, 270 ohm, 400 ohm, 2 K., 5 K., 30 K., 33 K., 47 K. 5 of 50 K. 4 of 100 K. .25 megohm. 2 of .5 megohm. 2 of 1 megohm. 2 of 50 K. potentiometers. 1 megohm volume control with switch.
Fixed condensers : 50 pF mica. 3 of 100 pF mica. 2 of .001 μF. .005 μF. 2 of .01 μF. 10 of .1 μF.

sensitivity and sharpest tuning, but also considerably increases any chance of instability.

Top-coupled Filter

This is wired up separately upon a small aluminium base, as shown below. The base only requires to

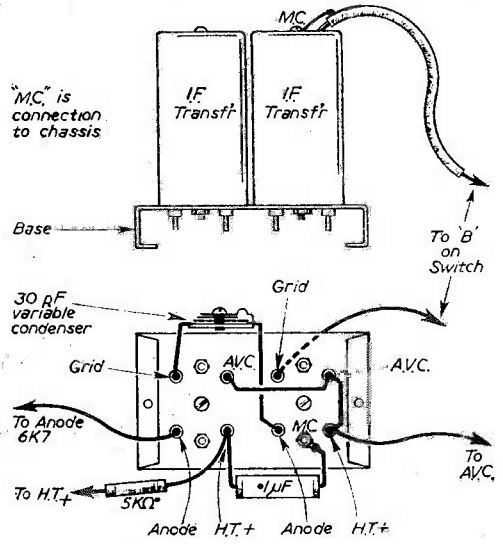


Fig. 3.—The I.F. filter.

be large enough to accommodate the two I.F. transformers used, lifting these about ½in. from the chassis. The individual tag connections are marked in Fig. 3. If transformers with tags in other positions are used, wiring must, of course, be modified to suit, and reference to the diagram will make this easy.

When the unit is complete there will be the same number of leads from it as from a single I.F. transformer. Three pass through the chassis to H.T., A.V.C. and anode circuits. The remaining lead, issuing from the top for grid connection, is screened and taken to the High/Low switch.

Miniature transformers of this kind have core-adjusting holes at top and bottom, centrally placed, and provision for reaching these must be made by drilling base and chassis. Transformers with side adjusting holes could be employed in the other

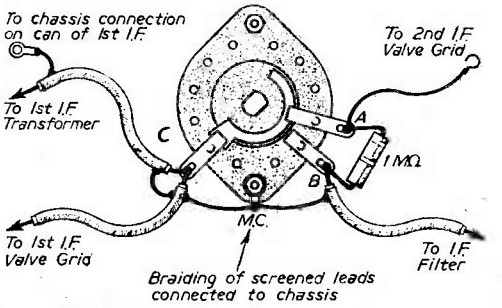


Fig. 4.—"High-low" selectivity switch.

positions and reached from the back, but this is not possible with the pair in the filter unit.

The small top-capacity coupling condenser is supported by short connections from the transformer tags, and is normally set near minimum capacity. As capacity is increased, sensitivity is slightly increased, but selectivity is reduced. Re-alignment of the I.F. transformers is necessary after adjusting the pre-set, but in actual practice this will not prove difficult, since it is only necessary to tune in a local station and turn the cores for maximum indication on the tuning meter. The 30 pF trimmer setting is in no way critical. It is suggested it be almost wholly

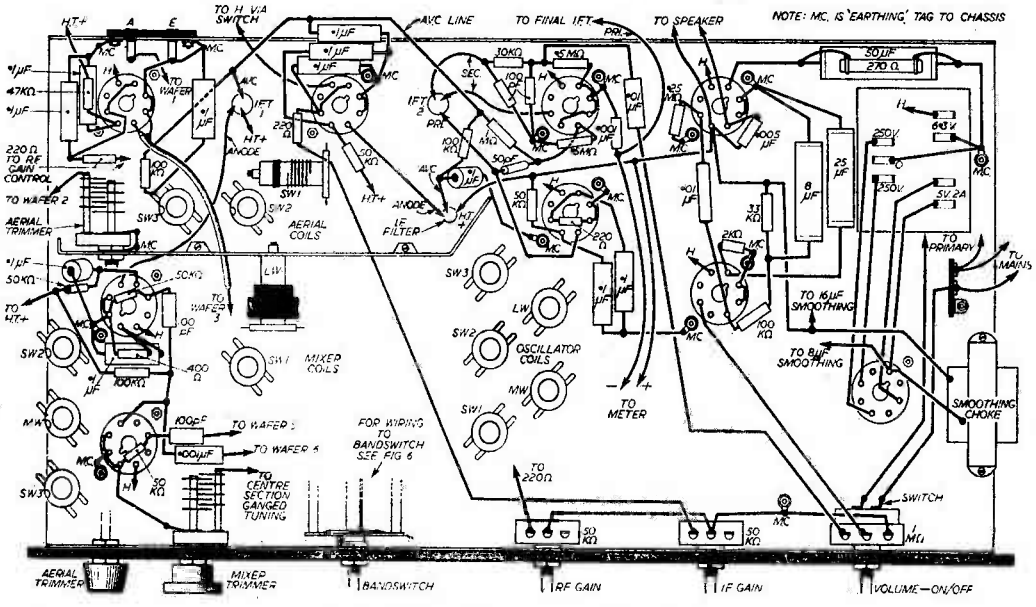


Fig. 5.—Principal layout and wiring details.

unscrewed when building the filter unit, and only modified later if this appears desirable.

Wiring Points

Fig. 5 shows connections, etc., under the chassis, except for those to the wavechange switch and coils, which can most conveniently be added later.

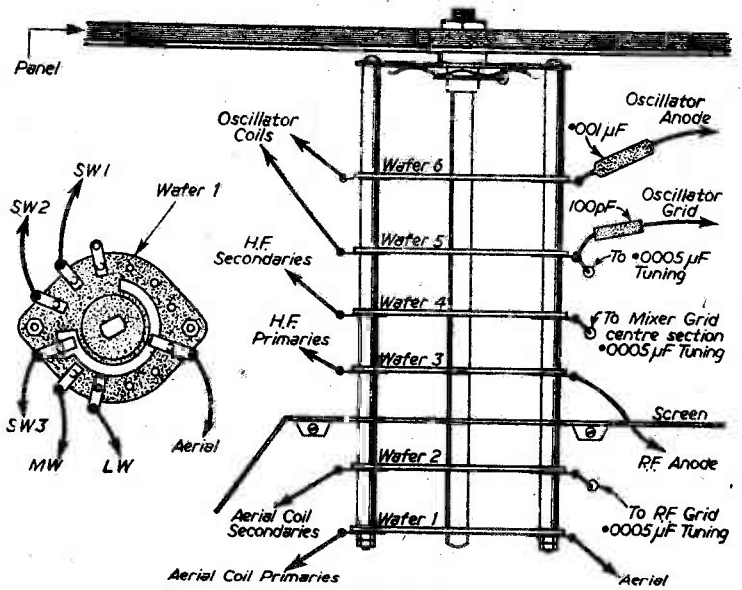


Fig. 6.—Wiring details of the main switch.

Beginning with the heaters, all points marked " H " are connected, leads being run close against the chassis. Various points are also taken to the chassis itself; these are marked M.C. and are soldered to 6 B.A. tags tightly bolted in position.

The small screen is 2¼in. by 8in. with ¼in. mounting flanges. The back nuts of the wavechange switch need to be removed, and two wafers, with spacers, are then removed. The last pair of spacers is sawn in half, and two halves placed on the switch bolts. The screen is then drilled to fit, requiring two 4 B.A. holes (for the long bolts) and a ⅛in. diameter hole to clear the spindle. The remaining half spacers and wafers are then replaced and the nuts tightened. When the screen is bolted in place, the switch is thus rigidly supported here, while the two aerial wafers are screened from those associated with subsequent circuits. The screen also supports the L.W. mixer coil and aerial trimmer.

Wiring can progress until all leads in Fig. 5 are finished, both R.F. and mixer anode connections being screened. Three leads pass up to the first I.F. transformer—6L7 anode and H.T. positive to primary and AVC line to secondary. The remaining secondary (grid) lead emerges from the can top. The other transformers are wired as shown, " P " indicating primary, and " S " secondary. By-pass condensers should be wired reasonably near the valve tags. Twin flex is used for speaker and mains connections, the latter being anchored on a two-way insulated tag strip fitted near the choke as shown.

Bandswitch Wiring

When wiring in Fig. 5 is completed, the switch and coils can easily be installed. Since fifteen coils are present for the five bands it is recommended one band only be wired in first and the receiver tested, as this will wholly avoid any trouble arising from confused coil connections. The set of M.W. coils will be most suitable for this purpose.

Switch connections will become clear from Fig. 6. Wafer 1 goes to the aerial socket. When the switch is in its first position the L.W. primary is connected; when in its second position the M.W. primary, and so on for subsequent positions, as in Fig. 6. The wiring to other wafers is virtually a copy of that for the first wafer.

(To be concluded)

Sound Is Their Business

IN a room in one of the BBC's buildings near Broadcasting House two ingenious men can be found poring over scripts to decide on sound effects produced from a thousand-and-one different gadgets in their " storeroom." For on-the-spot sound effects are the business of Charles Willis and Jack Holden. They are in great demand by producers of programmes ranging from schools broadcasts to that zany half-hour, " The Goon Show."

Both have been connected with the Sound Effects Department for a number of years. Charles Willis joined the BBC in 1929 and was " inventing " sound back in those Savoy Hill days. Jack Holden did not arrive until 1952 after having been a stage manager at a Manchester theatre, where he learned many tricks of the trade. His training for seven years as an apprentice engineer in his young days, his carpentry and electrical engineering experience have equipped him well for this work.

Willis explains: " Producers often like the various sounds involved in a play, feature or variety show to be made at the time it is being broadcast or recorded. This helps to create atmosphere, eliminates the use of recorded effects and saves a great deal of time."

Both agree that the most difficult programmes to cater for are schools broadcasts which demand the most exacting work and attention.

The most difficult sound ever produced? It was for the BBC series " The Lost World," when it was essential to give the effect of prehistoric animals roaming the land. The thud of their huge feet was at last achieved by striking a bass drum covered with sand with two coconut shells.

Housewives who use an ordinary mincer might like to know that Messrs. Willis and Holden have a rather rusty one in their collection. It is used, fixed to a table, for giving the impression of the opening of a heavy steel door or cave. The most treasured possession is an old musical box dating back to 1870 which plays haunting Strauss waltzes.

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2 v. 2 a.	8/3 each
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APEX TUNED FILTER UNIT. A crossover box for use with combined or separate Band I and Band III aerials. The unit is completely shrouded, 7/6 each.

Dance Music, Trumpets and All That

RECALLING my numerous attacks on jazz, crooners, dance music, rock and roll, skiffle, piffle, particularly the BBC variety, I could hardly believe my ears when listening the other evening to a BBC announcer interviewing a lady visitor to this country. She was asked what she thought of dance music, and it was obvious by her immediate reply that she had decided views on this subject. She said dance music, which she didn't like, was intended to be danced to, and not listened to, and she thought that only savages danced to the trumpet. There are so many dance bands and they all sound alike—and all competing for the same amount of programme time. They all sound tired to me; the music is tired and it is played in a tired way. It is time that there was a drastic overhaul of the orchestral side of the BBC. Many of the bands are certainly not up to broadcast standard. Some of the vocalists sing with an adenoidal twang, and most of them are aping that frightful nasal Yankee-come-Canadian drawl with a strong flavouring of Negro accent. As for the songs themselves, they are just gutter rubbish. Just think of the nauseating tripe about Mary Ann sifting sand. Rocking through the Rye, Day-O and I Want to Go Home (wish they would), Don't Knock the Rock, etc. There is no composition, and the words are an insult to a five-year-old. Before the minds of the teenagers of this country are further polluted by this bilge water, the BBC should investigate the matter, yet the programme material, and tighten up their auditions. Some of the bands are booked time and again without audition. They should be made to toe the line and prove that they are kept up to scratch. All of the bands to-day seem to me to pander to these silly, screeching, hysterical teenagers who form themselves into fan clubs at the instigation of the publicity agents for the bands. When they appear on the variety stage these publicity hounds plant a suitable claque in the best French tradition to whip up the enthusiasm of the gallery. We wonder why the variety theatre is slowly dying on its feet. The reason is obvious. No programme is considered complete to-day unless a large chunk of it is occupied by some crooner or some fifth-rate dance band, appealing to the demented creatures. Very few of the programmes are planned for an adult audience. The enthusiasm of the teenagers soon wains. I repeat that the BBC have a duty not to make national characters and heroes out of nonentities, especially those who cannot sing, and they are in the majority. I recommend them to read the definition of jazz in Eric Blom's dictionary of music published by the Oxford University Press.

The Show

WITHIN a few weeks the Radio Show will open its portals and I shall commence my usual stand-to-stand trek. I have no doubt that the exhibition will be well organised, and even more interesting than in previous years. The industry will do its utmost to put on a good show, but this time it should tackle the Earls Court authorities to see that there is adequate seating, adequate ventilation, and that extortionist prices are not charged in the bars and restaurants, also that there should be adequate bar and restaurant service. West End prices are charged quite often for inferior food and the catering appears to be run on a shoe string. Perhaps my old friend, Andrew Reid, will take heed of my remarks. Needless to say, this and our associated journals will be prominently there. I shall hope to see *you* there.

Donegall Discs

LORD DONEGALL announces two new discs: DOM 1,000 33⅓, "Esterban and His Caballeros de Montevideo," well-known South American numbers, played by "Mr. Latin America" and featuring Albert Delroy on accordion, folk songs and calypsos with guitar, clarinet and bass accompaniment; and another, DOM 1,003 33⅓, "Dixielanders Anonymous." Tunes you Have Hummed, played in the New Orleans manner by a group of top British jazz men. Old favourites played in quiet rhythm for "roll up the carpet dancing" or unobtrusive listening with a drink and the evening paper. These, of course, are hi-fi discs. Lord Donegall has always been a hi-fi fan, apart from being an authority on Dixieland and dance music.

Fun at Whiteleys

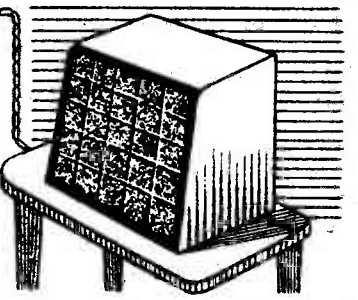
I AM not referring to the well-known loudspeaker manufacturers, but to the older firm enjoying that patronymic—William Whiteley, the universal providers. They have just celebrated their 94th birthday and the celebrations were given a send-off by Tommy Trinder, who cut a giant cake in the central dome. I was interested in the competition run by the electrical department in which customers were invited in a free competition to guess the length of wire in a mains transformer. The correct length was 760 yds. and the winner received a Decca record player. Great fun was had with the Mullard jumping coin device.

Mention of the name Whiteley, of course, reminds me that A. H. Whiteley, Ltd., the well-known speaker manufacturers of Mansfield, Nottinghamshire, are one of the very few firms which has remained in business from the earliest days of radio to the present time. My old friend Whiteley started business in a very modest way all those years ago with the fixed object not of getting rich quick by selling inferior goods to the avid public of that day but to found a business which was going to endure. His business year by year has continued to expand, as year by year he has ploughed back much of the profit, until to-day he employs several hundred people and "speakers" a goodly chunk of the industry. He has never forgotten the home constructors who were his main customers in those early struggling yet memorable and treasurable days. He is one of those whom I look forward to meeting year by year at the Radio Show.

FITTING RADIO EXTENSIONS

USING ADDITIONAL LOUDSPEAKERS WITH EXISTING RECEIVERS

By "Experimenter"



MODERN radio sets of other than portable or miniature type are almost without exception fitted with sockets from which an extension loudspeaker can be operated. This extension speaker can be in the kitchen, or any second room, or may be upstairs for listening in bed in the event of illness. Such an arrangement costs little to fit up and nothing to run, and in very many cases is definitely worth while. The advantage, for example, of having a speaker in the kitchen is at once apparent when there is only one radio receiver in the house, situated elsewhere.

Such extension systems can be installed easily, but it is necessary to keep in mind a number of important points if proper results are to be obtained. It is also possible to add some improvements, such as a volume-control for the extension speaker, and this is often a worth-while advantage.

The kind of loudspeaker to use first needs considering. For any ordinary present-day receiver, this should be a permanent magnet moving-coil loudspeaker. Its size is not of much importance, but a 5in. or 6in. model is most generally suitable, this dimension being the diameter of the cone. Very small speakers are not very suitable, especially for mains sets, while the expense of a large speaker is scarcely justified.

Speakers other than the type quoted are offered by advertisers, some being designated "M.E." speakers. These are mains energised units and are not suitable, even if mains is available. Other special speakers such as the electrostatic type are similarly not intended for extension purposes. The correct permanent magnet type is, however, readily obtainable in many sizes without any difficulty whatever.

The *impedance* of the speaker next requires consideration. Most receivers are intended for a two- to three-ohm speaker, but some are made for 15 ohm, or other impedances. The correct figure will be found in the receiver maker's leaflet, or may be marked on the chassis. If it is not known, then it is wise to have the new loudspeaker tried with the receiver before purchase. A two- to three-ohm model will *usually* be satisfactory. When the correct impedance is used, the extension speaker will work at about the same volume as the speaker in the receiver. The desirable state of affairs will not be achieved if a two- to three-ohm speaker is used on a 15-ohm set, or vice versa. In addition, wrong impedance matching will cause a deterioration in quality of reproduction.

By keeping these points in mind, unnecessary difficulty or expense will be avoided, and proper results will be obtained at once.

Extension Connections

In order to work the extension speaker it is only necessary to take two leads from the "Extension Speaker" sockets (often marked "E.S.") on the receiver to the unit as shown in Fig. 1. If the set has no such sockets, the leads can equally well be taken from the secondary of the loudspeaker transformer. This transformer may be mounted on the speaker in the receiver, or it may be situated on the chassis. The secondary leads can be identified because they will go to the receiver speaker, usually to tags near the cone. However, if there is any doubt, any radio shop should point them out. With mains sets it is particularly necessary that no error is made in connecting up if leads have to be taken inside the set in this way. No danger arises with the proper extension sockets, of course, and it is only necessary to connect the leads to suitable plugs and insert these.

If the leads will only be up to 20ft. or so, quite thin wire such as sold for bell wiring will do. But if the circuit is to be much longer, thin wire will cause a reduction in volume at the extension speaker. In this case it is best to use twin flex of the type employed for lighting fitments, standard lamps, etc. If the extension wires are to run permanently to one room, then it is in order to use solid insulated wires or cable of about 20 s.w.g.

The extension leads should not be run with mains wiring, but kept wholly separate. The shortest and most convenient route should be chosen, and the wire can usually be secured along skirting board, etc., as

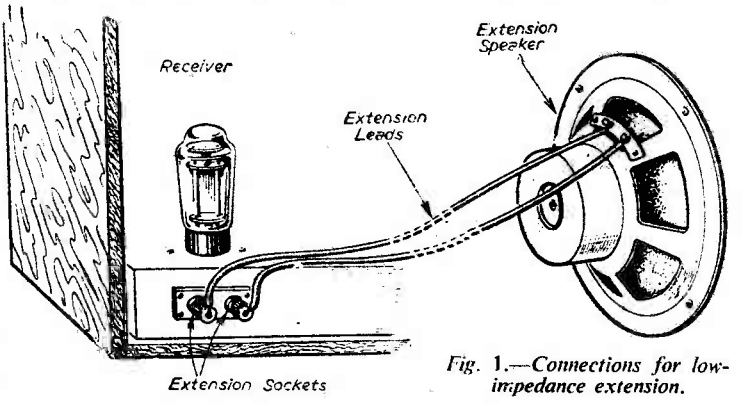


Fig. 1.—Connections for low-impedance extension.

shown at "A" in Fig. 2. If a picture rail is fitted, the wire may often be out of sight along this, as at "B," which is even better. Where required, insulating staples at 1ft. intervals will normally be sufficient, except at corners, where they will need to be closer together.

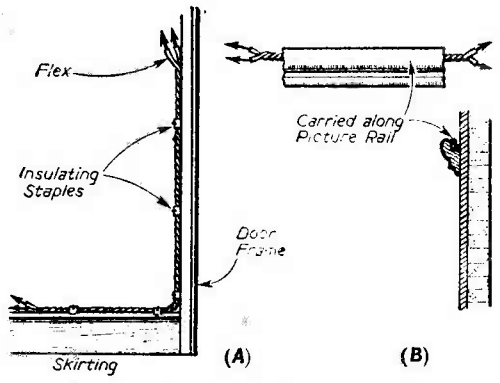


Fig. 2.—Methods of fitting leads.

It is worth while giving a little thought to the best run of wiring for permanent extension leads. Occasionally, it may help to move the receiver to simplify the run of wiring, while the position of the extension speaker can also be selected with this in view.

Baffle Mountings

A cabinet or baffle board is required, both to improve appearance and to allow the extension speaker to give best results. A baffle is merely a fairly strong board with aperture for the speaker, and a type suitable for corner suspension is illustrated in Fig. 3. Plywood can be used, but for preference it should not be less than ¼in. thick. If the baffle is shaped as shown, it will tilt downwards when suspended in a corner, provided support is given to the lower edge. If the lower corners can rest on small hooks in the wall, this will give a very secure mounting. If not, then two further cords of suitable length need to be taken up to the hook upon which the whole is hung.

A circular aperture is simplest to make, and the diameter can be found by measuring the diameter of the cone. A hole is then drilled to start a pad or key-hole saw, and the piece is removed, edges being glasspapered smooth. The baffle should then be varnished or stained. When dry, a piece of silk or speaker gauze is stretched across the aperture behind, and fixed by drawing-pins or glue. The speaker is then placed accurately in position, and secured by

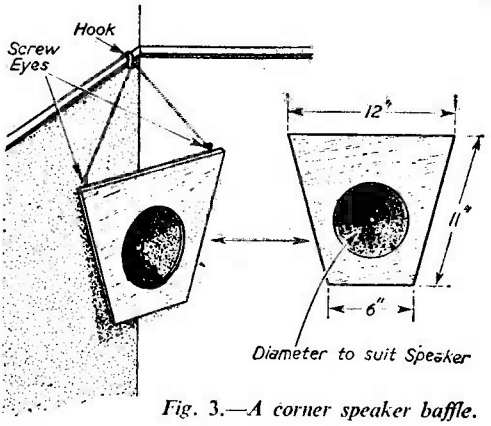


Fig. 3.—A corner speaker baffle.

wood-screws or small bolts. If the speaker is to be in a dusty position, it is helpful to place it wholesale in a small muslin bag, as this keeps dirt, etc., out of the speech-coil gap. This is also worth while if the unit is of the type with a covered gap, so that dust cannot in any case enter.

When a corner is not available, but a wall mounting is still desired, the arrangement shown in Fig. 4 is satisfactory. Here, sides are cut from ⅜in. or ½in. wood, and tilt the front downwards. No top is fixed to this type of baffle, but a bottom strip is added in the interests of appearance. If the cord is correctly placed, according to the balance of the speaker, no support will be necessary at the bottom of the baffle, and the sides will hang flat against the wall. The hanging cord can pass through small holes drilled in the sides, or be taken to screw-eyes inside.

When the extension leads are connected up, the extension speaker should operate simultaneously with that in the receiver, and at about the same volume. No signal at all probably shows a bad joint or broken lead exists. Great volume at the extension, and poor results at the receiver, indicate a two- or three-ohm

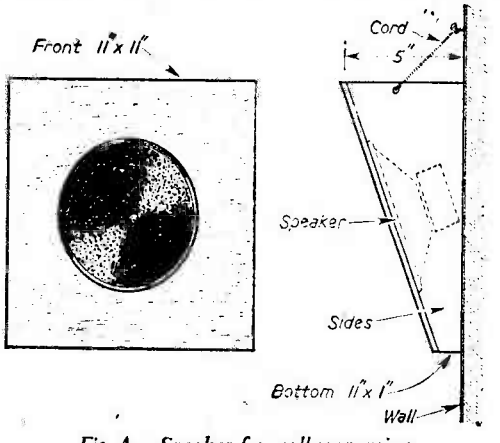


Fig. 4.—Speaker for wall suspension.

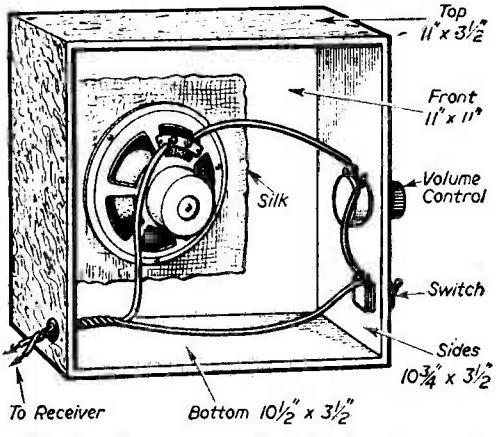


Fig. 5.—Extension switch and volume control.

extension unit is being used with a 15-ohm receiver circuit. Weak volume at the extension unit, however, shows resistance in the extension circuit is too high, either from the wrong type of speaker, or from using long, thin extension leads. If the details given earlier have been followed, none of these difficulties will arise. It will be noted that no further transformer is used on the extension unit, as the output transformer in the receiver operates in its place.

Separate Switching

Upon quite a number of occasions a person at the extension position may want to silence his speaker. This can easily be done by including an on/off switch in one lead. It can often be mounted on the baffle board, under the speaker. It may also be included at the receiver end of the circuit, if this is more convenient. Or the extension speaker can be silenced from here by withdrawing one or both plugs from the extension sockets.

Occasionally it may be desirable to run the extension speaker with the receiver speaker silenced. If so, then one of the leads in the receiver which pass from the output transformer secondary to receiver speaker should be cut. The two ends are then lengthened, and taken to an on/off switch, mounted upon the back or side of the cabinet. The switch must not be included in transformer primary circuit, or elsewhere in the receiver, as it is desired that only the loudspeaker be rendered inoperative.

In some cases it is convenient to be able to reduce volume at the extension speaker, and the simplest manner of doing this is to include a variable resistance in one lead, as shown in Fig. 5. This then acts as a volume control. The on/off switch already described can be included as well, if wanted. The control itself needs to be of very low resistance for this purpose, and is of the wire-wound type. A variable resistance will only have two tags, and connections are taken to these. The "potentiometer" type of control will have three tags, one from each end of the resistance coil and one from the slider. With these, connections are taken to slider and one resistance element tag or terminal, the other being disregarded.

For a two- to three-ohm speaker, a control with a maximum resistance of 5 to 10 ohms is satisfactory. For a 15-ohm speaker, a higher value is required, about 50 ohms being suitable.

Fig. 5 also shows a simple cabinet for standing on a table, dimensions being those required for ¼in. thick wood. A back is desirable to exclude dust, but it should have several large holes in it, to avoid unnecessary cabinet resonance. These holes can be covered with gauze glued on inside.

Strictly speaking, such a volume control arrangement does not provide a correct impedance match at all settings. But in practice this is of little importance, since the deterioration of quality resulting only becomes apparent at very low volume levels, while the correct circuit for matching at all settings is a more complicated one. For this reason, the method in Fig. 5 is satisfactory for all ordinary purposes.

Finally, it should be noted that some form of baffle or cabinet is required so that the loudspeaker can operate properly—not merely for appearance. If the speaker unit is used exactly as it stands, with no baffle or cabinet, volume will be reduced, and reproduction will sound thin and reedy due to the absence of the lower frequencies. Even a small baffle or cabinet will bring about a considerable improvement, and the designs shown are extremely simple to construct.

News from the Clubs

CLIFTON AMATEUR RADIO SOCIETY

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

ON March 8th members heard a talk by Mr. J. Dickinson of Advance Components, Ltd. on his company's range of test equipment, whilst on March 22nd a very successful Junk Sale was held.

In the club transmitting/receiving contest held during the week-end March 16th-17th, the respective winners in each section were D. Blakeley (G3KZN) and D. Veasey.

Meetings are held every Friday at 7.30 p.m. at the clubrooms, 225, New Cross Road, S.E.14, when new members and visitors will receive a warm welcome. Details of membership can be obtained from the Hon. Secretary.

INTERNATIONAL RADIO CONTROL MODEL SOCIETY

Hon. Sec.: Mr. D. Greene, 18, Fitzroy Street, Hull.

A HULL group of the above society has been formed with headquarters at Sportscraft, Beverley Road, Hull.

Meetings are being held fortnightly on Tuesdays at 7.30 p.m. The aims of the group are to promote, encourage and develop the radio control of models in Hull and district.

Any of your readers who are able to attend any of our meetings, whether beginners or old hands, will be most welcome, with no obligation to join.

BURY RADIO SOCIETY

Hon. Sec.: L. Robinson, 56, Avondale Avenue, Bury.

FORTHCOMING meetings of the above society will be held at 8 p.m. at the George Hotel, Kay Gardens, Bury, as follows:

June 11th—Junk Sale.

July 9th—Noggin and Natter Night.

The society will be holding a Hamfest on September 14th and it is hoped to announce details later.

CRAY VALLEY RADIO CLUB

Hon. Sec.: S. W. Coursey (G3JJC), 49, Dulverton Road, London, S.E.9.

THE next meeting of the Cray Valley Radio Club will be held at the Station Hotel, Sidcup, Kent, on Tuesday, June 25th, 1957, 8 p.m., when Mullard, Ltd. will give a lecture illustrated with films on their products. Among the films to be shown will be "Made for Life" and "Ultrasonics in Industry." The club meets on the fourth Tuesday in each month and non-members are cordially invited.

RAVENSBOURNE AMATEUR RADIO CLUB

Hon. Sec.: Mr. J. Wilshaw, 4, Station Road, Bromley, Kent.

SEVERAL of our members are interested in "amateur television" and one has obtained his licence as G3LNT T. On the normal bands the club Tx (G3HEV) operates occasionally with operator G2DHV, also as G3HEV/A. Field site will be at the same location as last year, at Chislehurst, Kent.

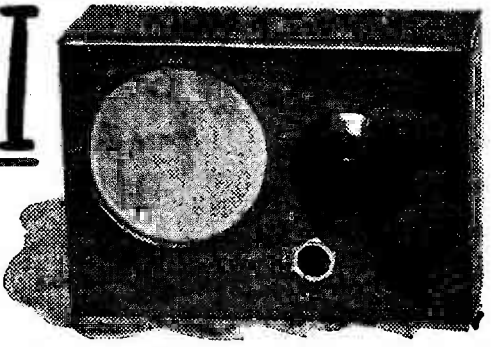
Club meets for Morse class, theory and practice every Wednesday, 8 p.m. in the Science Room, Durham Hill School, Downham. Next September a beginners' course will be attempted if sufficient enrolments.

THE AMATEUR RADIO CLUB OF NOTTINGHAM (G3EKW)

Hon. Sec.: F. V. Farnsworth, 32, Harrow Road, West Bridgford, Nottingham.

THE club meets every Tuesday, 7.15 p.m. to 10 p.m. at Woodthorpe House, Mansfield Road. Activities include the building of both transmitters and receivers with expert guidance by licensed members. Slow Morse practice in the clubroom using latest equipment; also transmitted slow Morse during week-ends by licensed members at special times. Prospective members will be most welcome and can obtain full details from the Hon. Secretary.

A.C. Double Triode I



A NOVEL SINGLE-VALVE SET FOR MAINS WORKING

THE comparatively few components required enable this receiver to be built in a very small cabinet, while sensitivity proves to be surprisingly good. The gain provided is much larger than with a battery type Detector-L.F. circuit, and local stations can be received well with even a few feet of wire as aerial. Current consumption is so low as scarcely to turn the mains meter, when other equipment in the house is switched off. Its simplicity makes the circuit particularly suitable for beginners, where a low cost, compact receiver is required.

The circuit is shown in Fig. 1, and is a straightforward two-stage arrangement with reaction, the latter contributing largely to sensitivity to weak signals. Condenser C1 must be of high-grade type, preferably with a 750 volt working rating. For short indoor aerials, any capacity from .0005 μF upwards may be used. With longer aerials the value should be reduced to .0001 μF. The .01 μF coupling condenser must also be sound, and a mica type is desirable. Any leakage in this component will upset the bias of the L.F. amplifier section of the valve.

COMPONENTS

Fixed condensers : C1, 200 pF, .005 μF, .01 μF, and two 8 μF 350 v.
Resistors, ½ watt : 1 K, 5 K, .25 megohm, .5 megohm and 2.2 megohm.
6SL7GT valve (Octal holder).
3½in. speaker and transformer (W/B Stentorian).
250 v. rectifier.
6.3 v. filament transformer.
Single-pole wavechange switch.
Double-pole mains switch.
Two .0005 μF solid dielectric condensers (Coventry Radio).
Dual-range coil, with primary and reaction (Astral Radio).
Large knob for tuning ; small knob for reaction.

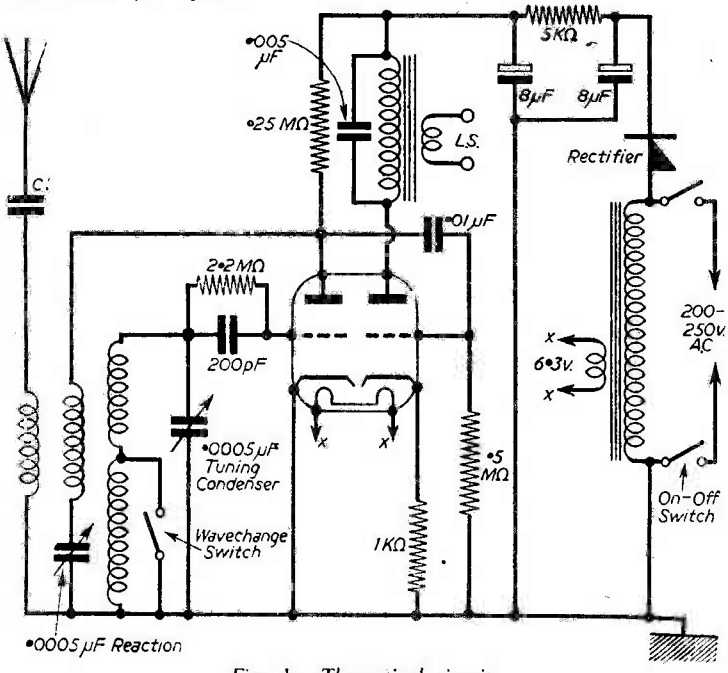


Fig. 1—Theoretical circuit.

If the dimensions given in Fig. 2 are to be followed, there is not a great deal of free space, and the components must be chosen with this in mind. Tuning and reaction condensers are solid dielectric. The two 8 μF condensers are of the small tubular type, 350 volt working. The valve only consumes .3 amp., but the usual 1½ to 2 amp. 6.3 volt filament transformer can be accommodated. A 6.3 volt indicator lamp could be added, if desired. The rectifier is of the slender pencil type, 250 volt rating. Such rectifiers are usually of 25 to 60 mA rating. Any rectifier able to supply more than 15 mA is satisfactory.

The loudspeaker is a 3½in. "Stentorian" type with miniature service output transformer. If a different transformer is used, it should have a high ratio —60 : 1 or 90 : 1.

If components other than these are used it may be necessary to change the dimensions of the cabinet slightly to accommodate the parts. This applies particularly to loudspeaker, rectifier, and smoothing condensers.

Building Details

The cabinet is of three-ply, secured with fret nails, glass-papered and varnished. A small piece of silk is glued over the speaker cut-out, inside. The location of the large components will be clear from the illustration. Viewing the receiver from the back, the rectifier

stands to the right of the speaker. The dual-range coil and .01 μF condenser are below the speaker, where the on/off switch is also situated. The output transformer is fixed to the left side of the cabinet, and the mains transformer similarly screwed to the cabinet top. A long bolt with locknuts holds the valveholder in position.

The valveholder and associated wiring is shown in Fig. 3, which may be followed when connecting up. Two leads from the mains transformer primary to switch complete the mains wiring, the remaining switch contacts going to a length of twin flex terminating with an adapter or plug.

Coil connections may be taken from the coil maker's leaflet or instructions, and will be as follows: "Grid" tag to fixed plates of tuning condenser; "Aerial" tag to C1; first "Reaction Coil" tag to detector anode; remaining "Reaction Coil" tag to fixed plates of reaction condenser; "Wavechange Switch" tag to wavechange switch. The earth tag of the coil, remaining wavechange switch terminal, and moving plates tags of both condensers are wired together and to the H.T. line, as shown. Care is necessary that all wires are properly insulated, and that no joints touch each other or other components. In Fig. 3 the valveholder is viewed from below.

Either a 6SL7GT or 6SN7GT may be used, the former providing most volume. Reaction is used to build up the volume of weak stations in the usual way.

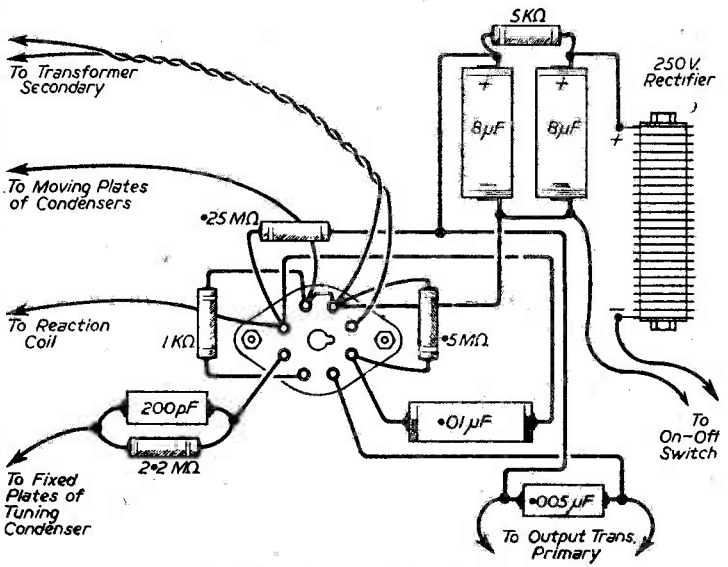


Fig. 3. — Essential wiring details.

Switches

Both switches *must* be of the kind with insulated bushes or of the usual mains type where there is no contact between bush and switch contacts. Suitable knobs are fitted to the condensers so that the bushes or nuts cannot be touched.

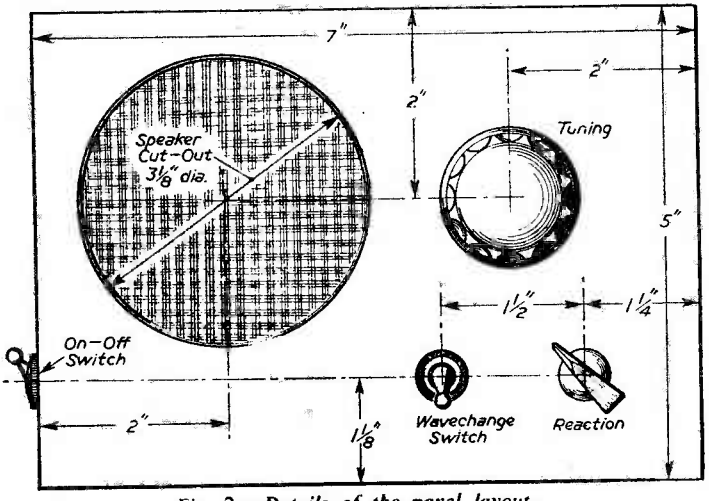


Fig. 2.—Details of the panel layout.

Ferroxcube for Computers

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Digital computers, working generally in binary scale, may be used directly in the factory in the control of manufacturing processes, e.g., in machine tool control; they may also be used to provide automatic office equipment.

The heart of a digital computer is its magnetic memory. Binary digital information may be stored as the direction of magnetisation of tiny magnetic toroids, which may conveniently be connected in the form of a chequer-board or matrix.

Magnetic toroids may also be used to form shifting registers and to provide the gating facilities required in the arithmetic units of the computer.

In all these applications it is necessary for the magnetic material to have a substantial rectangular hysteresis loop; it must also be completely stable, suitable for operation at high speeds and mechanically robust.

Mullard Ferroxcube rectangular loop material type D meets these requirements and a standard range of ring-shaped cores is available. The smallest cores are used in matrix planes and a technique has been developed for threading the cores and terminating them into printed circuits.

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Type A. Low leakage windings. Ratio 1 : 1.25 giving a 25% boost on secondary. 2 v., **10/6** ; 4 v., **10/6** ; 6.3 v., **10/6** ; 10.8 v., **10/6** ; 13.3 v., **10/6.**
Ditto with mains primaries. **12/6 each.**

Type B. Mains input 220/240 volts. Multi Output 2, 4, 6.3, 7.3, 10 and 13 volts. Input has two taps which increase output volts by 25% and 50% respectively. Low capacity, suitable for most Cathode Ray Tubes. With Tag Panel. **21/- each.**

Type C. Low capacity wound transformer for use with 2 volt Tubes with falling emission. Input 220/240 volts. Output 2-2¼-2½-2¾-3 volts at 2 amps. With Tag Panel. **17/6 each.**

NOTE.—It is essential to use mains primary types with T.V. receivers having series-connected heaters.

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WIRE-WOUND RESISTORS
5 watt, 10 watt, 15 watt } 25 ohms–10,000 ohms .... { **1/3**, **1/6**, **2/-**
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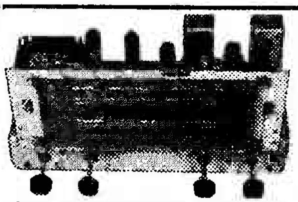
3V4	8/6	6V6G	7/6	ECC84	12/6	MU14	10/6
5U4	8/6	6V6GT	8/6	ECF80	10/6	PCC84	12/6
5Y3	8/6	6X4	7/6	ECF82	10/6	PCF80	10/6
5Z4	10/6	6X5	7/6	ECH42	10/6	PCF82	10/6
6AM6	8/6	7S7	8/6	ECL80	8/6	PCL82	10/6
6BS	5/6	12A6	7/6	ECL82	12/6	PL81	11/6
6BE6	7/6	12AH8	10/6	EF39	7/6	PL82	10/6
6BH6	10/6	12AT7	10/6	EF41	10/6	PY80	10/6
6BW6	8/6	12AU7	10/6	EF50	5/6	PY81	10/6
6BW7	8/6	12AX7	10/6	Equip.		PY82	10/6
6CH6	10/6	12BE6	10/6	EF50	8/6	SP61	5/6
6F6	7/6	12BH7	10/6	Sylv.		UBC41	8/6
6F6	7/6	12K7	8/6	EF80	10/6	UCH42	8/6
6H6	3/6	12Q7	8/6	EF92	5/6	UF41	8/6
6J5	6/6	3524	10/6	EL32	5/6	UL41	8/6
6J6	7/6	80	8/6	EL84	10/6	UY41	8/6
6J7	8/6						
6K6	6/6	954	1/6	EY51	11/6	U22	10/6
6K7	5/6	EA50	1/6	EZ40	10/6	U25	11/6
6K8	8/6	EABC80	8/6	EZ81	11/6	X79	10/6



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Starting a Service Department

NOTES BY A SERVICE ENGINEER FOR THOSE WHO WISH TO START A SERVICING BUSINESS

By F. E. Apps

(*Continued from page 246, June issue*).

AFTER use the Service sheets should be returned to their files. Leaving them about benches means torn and, eventually, illegible sheets. Modifications from makers are published from time to time, and if you are fortunate enough to be able to receive these, then it is advisable to see that the service sheets are corrected.

Records

Cards should be kept of all service jobs. A typical card should show customer's name and address, maker's name and type of set, serial number of set. Each time the set is serviced it should be entered on card, stating the work done, components supplied (if any) and the amount charged. This is an essential thing to do, as at any future date another fault occurs, one can check back and find out whether it is the same fault re-occurring or a new one. In some cases that the writer has come across, it has been the same fault again, and it has come to light that it is an inherent fault in the set and a modification is necessary to prevent it happening again.

Power Points

A good selection of different type power points is necessary. Sets come in with every conceivable type of plug on and, to save time in changing over, a board as in Fig. 3. (last month) should be made up and secured to front of service bench. Sockets should be added or left out according to requirements.

Efficient Running

The haphazard running of a service department leads to poor workmanship, uneconomical results and, eventually, loss of business. I therefore propose to deal with a set that has come in for service and follow it through until it is eventually returned to its owner in, we hope, a satisfactory condition.

When the set arrives for service it should be examined for condition of cabinet, if chassis bolts are in position and back and securing screws are not missing. Type of plug, if any should be noted and the mains voltage tapping. All these points should be entered on the card which should accompany the set until it is ready for return. It goes without saying that the customer's name, the type and make, should also be on this card which should be securely fixed to the chassis.

The set still in its cabinet should then be checked by an engineer who has been informed of customer's complaint. He can then decide whether he requires the set unboxed or not. If it has to be unboxed it should be turned over to the lad or trainee for unboxing and any necessary instructions regarding this should be given him.

The chassis can then be turned over to an engineer for service, or placed on a rack kept specially for sets awaiting service. The sets on this rack should be kept in order of arrival so that each set is serviced in its proper turn. If, as sometimes happens, sets have to wait for a component which is not in stock they should not be placed on this rack but on another which should be earmarked for this purpose.

Should more than one service engineer be employed do not, as already stated, keep one man to one type of set. It will be better if any engineer tackles any make. Should one get into trouble over a fault on a set he can always ask another who has perhaps had more experience with that make and can give him the "low down."

The other method where one engineer always does one make of set when it comes in for service may sometimes lead to delays should this one engineer be away for a period, and during that time several sets of this make come in and the rest of the staff are inexperienced with them.

Intermittency

The set we are dealing with may have an intermittent fault over a long period or a short one. If it is the former then it should go to the soak test position, be switched on and a watchful eye kept on it at frequent intervals.

A small high-resistance voltmeter is a useful instrument to have for this type of fault. One can be placed in a suspect portion of the circuit and the voltage reading noted when the set is O.K. and when the fault occurs.

This will often give a clue to the trouble. It is of no use applying a voltmeter across the suspected circuit after the fault has occurred, as in 99 cases out of a 100 the mere making of the contact of the voltmeter leads will correct the intermittency

Valve Faults

The writer is not a great believer in valve testers, although he agrees that for a general test of a valve to see if its heater cathode insulation, its emission and its amplification factor are O.K., they are very handy. The writer prefers the idea of having a selection of set-tested valves for substitution purposes. All these should be clearly marked and, after use, replaced in racks kept especially for them.

Power Pack Faults

These are generally of the rectifier valve, electrolytic reservoir and smoothing condenser, mains transformer or in an A.C./D.C. set, dropping resistor troubles. Most of these are easily located, although occasionally one may get an electrolytic condenser that is intermittently O.C. This is nearly always due to the earthy side breaking away inside the condenser and so making it open circuit.

Audio Circuit Faults

There are many troubles that can occur here, distortion of output being one of the most common. In obscure cases an oscilloscope is handy, as the distortion can be seen on the trace and watched whilst a process of elimination is carried out. Distortion can arise from many causes. First eliminate the valve by substituting a "set-tested" one. Check for positive volts on grid, bias changes, output transformer primary for short-circuited turns and also the negative feedback circuitry, if employed. There are various capacitors in the output valve circuit that need to be checked if trouble is apparent here. For instance, the grid coupling condenser, the tone compensating condenser and the bias condenser. Check also the grid leak which may go high or open circuit.

It will be noticed from the previous paragraph that a certain amount of stock, in the shape of various capacitors and resistances, is necessary. It is advisable to use reliable makes for these components. Nothing can "lead you up the garden," as regards a fault, more easily than unreliable replacement parts.

Detector and A.V.C. Section

Here the most likely fault is the valve itself. Substitution will assist here. If that does not cure the fault, then a careful check of all components is necessary. If the valve is of the double diode triode type, check the diode load and the triode bias resistor. The A.V.C. components should be checked through the A.V.C. circuit.

Intermediate Frequency Circuits

These should be checked with a signal generator and output meter for correct alignment. The gain should be equal to the maker's figures on the service sheet. If this is not the case, a "Q" meter is of great assistance. This will give you an idea of the state of the transformer itself. In some of the older sets a loss of "Q" in the transformers occurred with age, generally due to poor insulation in the coil windings. Unless you have the means for rewinding, this means replacement.

We will presume that the set under service has been cleared of any or all of these faults, but results are still unsatisfactory. We have now the oscillator and the aerial circuits left to investigate.

Oscillator Circuit Faults

Having eliminated the valve or valves, which may be a frequency changer or a separate oscillator and mixer, the faults generally can be traced to components, such as grid coupling condenser, grid leak or switch contacts, In some cases, failure to oscillate on certain portions of the frequency band employed may be due to low H.T. volts on the oscillator anode. Squegging troubles are in nearly all cases due to the oscillator grid leak changing value.

Aerial Circuit

Coils and switch troubles are the common faults here, although trimmers often have the knack of intermittently shorting. In the case of poor reception, allowing for the remainder of the set being O.K., re-alignment should be earried out and the figures obtained checked with those given on maker's service sheet.

F.M. Sets

So far this article has only dealt with the ordinary A.M. broadcast receiver, but as F.M. sets are now being used, it is reasonable to expect to receive some of these in for service.

As regards the mains pack and the output stage, service procedure remains the same for both A.M. and F.M. sets. It is in the stages before the output that the two types vary. With an F.M. set one has generally a limiter and a discriminator stage. Troubles here are mostly valvular. In an F.M. set there is generally a triple-diode triode valve. Two of the diodes act as a discriminator. Should either go low emission or should the resistors across vary in resistance, then trouble will be apparent.

The I.F. stages of an F.M. set are normally of a much higher frequency than an A.M. set. They are usually 10.7 Mc/s otherwise they are coupled the same as in an A.M. set.

In an F.M. set care should be taken, when fault finding, especially in the oscillator and aerial circuits, not to disturb the wiring to any extent. With an A.M. receiver, this can often be done with impunity, but F.M. works on a considerably higher frequency, and the layout of the wiring in these two circuits forms part of the L.C. value of these circuits. Consequently, any alteration of wiring will throw the circuits out of alignment.

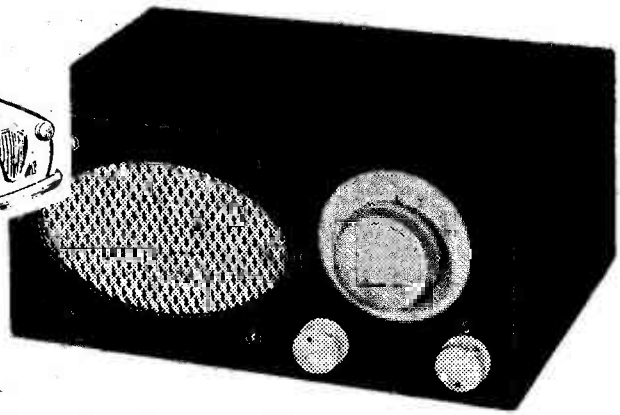
We will now presume that the set in question has had its fault or faults eliminated, has been reboxed and is given a final test. It is sometimes advisable to let the set run for a while on reduced volume as a final precaution. Check the cabinet and screws and accessories according to the card with the set, and if O.K. it is now ready for return.

Aerial

A service department should have an efficient aerial system for both A.M. and F.M. If the service station is in an area of high interference it is advisable to have an anti-interference aerial installed.

Sundry noises which a customer may complain about cannot be investigated if normal reception is very noisy. As regards noises, the writer had an unusual experience. A customer complained that his radiogram distorted on certain notes. The set was brought in for service. A thorough frequency check, right through the whole gamut of audio frequencies, was given. No signs of distortion were apparent. The set was returned as being O.K. The customer was back the next day saying that the fault was still apparent. I went to to his house and found he worked the set at almost full volume. After a while this peculiar noise was heard and investigation showed that a vase on his mantelpiece was vibrating at this frequency, quite enough to make itself heard. The removal of this vase cleared the situation.

A Car Radio



A MODIFIED VERSION OF OUR 1955 RECEIVER FOR A FORD "CONSUL"

By A. N. Robinson

IN the November, 1955/January, 1956, issues of PRACTICAL WIRELESS, details were given concerning the construction of a receiver for use in an Austin car. About that time the present writer was considering making a similar set for use in a Ford "Consul" saloon and, as earlier experiments had shown the desirability of including an H.F. stage, it was decided to base the design on the details provided.

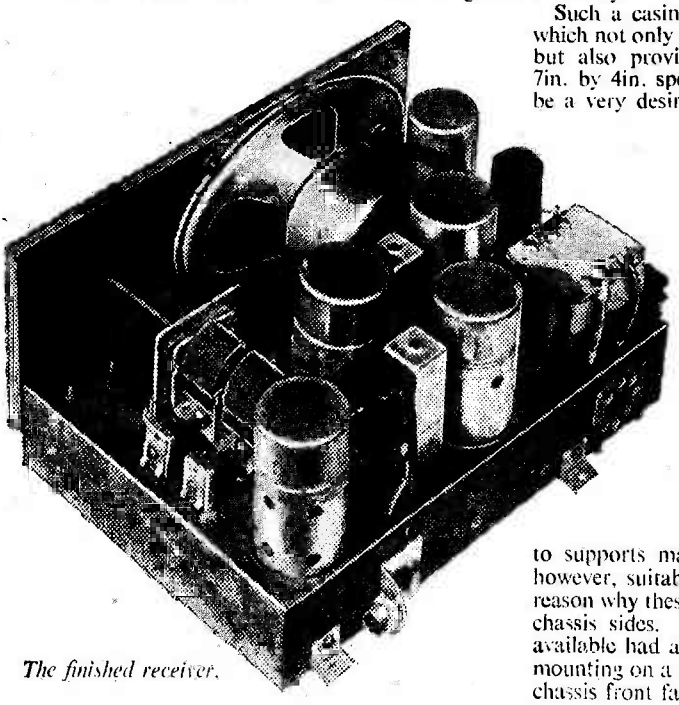
No apology is made for the use of Mr. A. E. Pardy's excellent circuit, as this has produced first-class results in range and quality. Minor electrical and layout modifications have been made to allow the use of existing components, particularly valves, but a certain amount of flexibility is possible in this direction without radically altering the basic circuit, and the average constructor should have no difficulty on that score.

The slightly modified circuit is shown in Fig. 1. The valves used were 12K7GT, 12K8GT, 12SK7, 12Q7GT and 12A6, simply because these were available. Full A.V.C. was applied throughout, because it was known that the set would be used in areas where dead spots were prevalent, and calculated bias was applied to the D.D.T.

Beyond commenting later on choice of components, it is not proposed to deal further with the electrical side of the receiver, as this has already been adequately covered by Mr. Pardy. Testing and alignment should follow the procedure laid down in the original articles.

Of much more importance to the constructor are the physical alterations to the layout. For installation on the shelf of the Consul the maximum height available is only about 5in. In order to ensure that fitting would be simple the dimensions of the casing were fixed at 4¾in. outside height by 10¼in. inside width by 8in. depth.

Such a casing will accept a 10in. by 7in. chassis which not only gives ample room for the components, but also provides adequate space for an integral 7in. by 4in. speaker. This latter was considered to be a very desirable feature.



The finished receiver.

Choice of Components

While considerable latitude is available concerning the choice of components, the layout calls for the use of a Rola 7in. by 4in. speaker. If another make is used, the plywood panel and the chassis cut-out will have to be suitably modified. Midget I.F. transformers and a midget tuning condenser are required. An Elstone output transformer has been specified, but other makes can be used provided that fitting can be arranged in the available space. When the prototype was constructed it was impossible locally to purchase trimmers with insulated mountings and it became necessary to fix these to supports made from 1/16in. thick paxolin. If, however, suitable trimmers are available there is no reason why these should not be secured directly to the chassis sides. Again, the only wavechange switch available had a short spindle, which necessitated its mounting on a bracket a little distance back from the chassis front face to provide room for the extension

spindle coupling. A switch with a spindle of normal length could, of course, be mounted directly on the chassis.

Normal conventions link the on/off switch to the volume control, but in the present design a separate toggle switch is preferred for the L.T. control, since this must also handle the vibrator load amounting to nearly 3 amps.

No attempt has been made to "miniaturise" the sub-chassis assembly, as normal size components

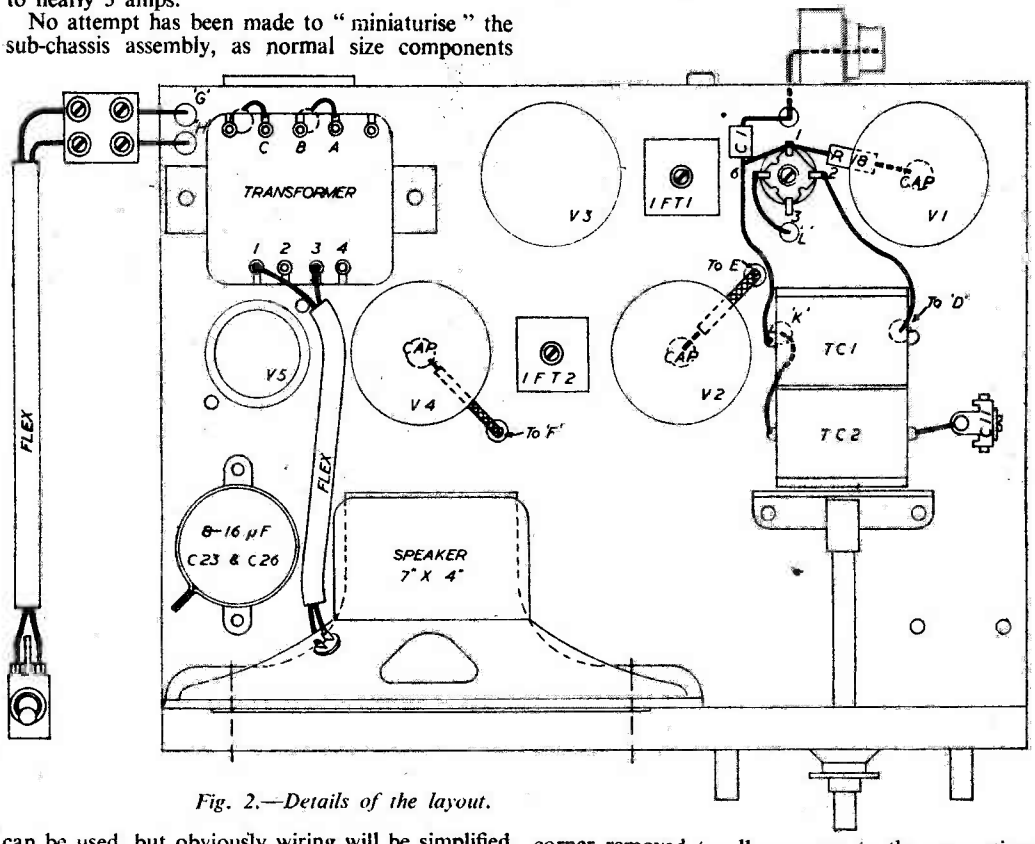


Fig. 2.—Details of the layout.

can be used, but obviously wiring will be simplified if small size components can be employed.

Chassis and Layout

A plan view of the layout is given in Fig. 2 and it will be seen that this does not differ materially from the original version, but the use of miniature I.F. transformers allows the length to be reduced by ½in. to 10in. The prototype chassis is in steel but, on account of non-rusting and ease of working, aluminium would be better. If the corners are not already strengthened it may be necessary to reinforce the front L.H. corner where the speaker cut-out has most effect.

Drilling details are given in Fig. 3. Mention was made earlier that existing valves were being used and, because of the height of these, and also because of the height limitation on the casing, it was necessary to sink the valveholders for V1, V2 and V4 below the chassis top to depths of 7/16in., 11/16in. and 7/16in. respectively. This accounts for the three 1⅛in. diam. holes which are just large enough to clear the screening cans. These three valveholders are mounted on square "platforms" of sheet aluminium which, in turn, are attached to the chassis with ⅛in. diameter bolts passing through tubular distance pieces, or stacks of washers, of the required length. The platforms for V2 and V4 have one corner removed to allow access to the connections on IFT2.

If suitable blanking punches are not readily available for the larger holes, the writer can recommend the use of an abrasive saw used in a hacksaw frame.

Stressing again the limitation on casing height, the chassis depth was fixed at 1¾in. to leave reasonable space for the sub-chassis components without too much room being occupied by the sunken valveholders.

It must be made quite clear that such "codging" resulted solely from the use of existing valves. If miniature valves had been used a chassis of normal depth would have been possible. Nevertheless, ample room is available for wiring.

Speaker Panel

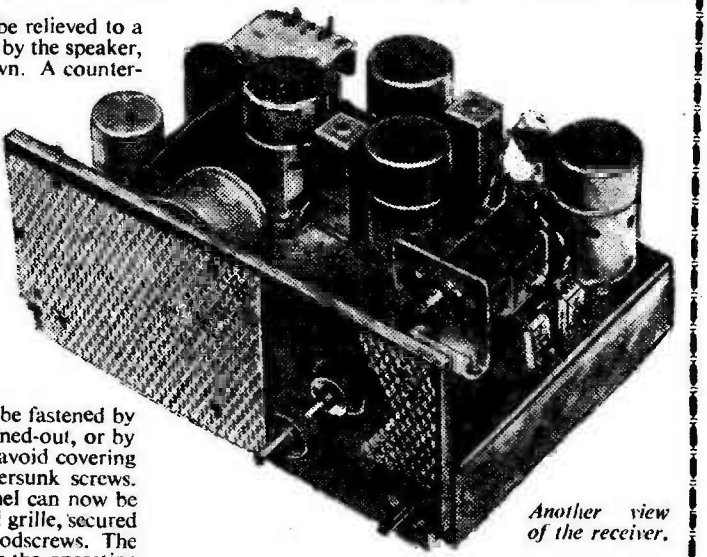
Details of the speaker panel, between which and the front chassis face the 7in. by 4in. elliptical speaker is sandwiched by 3/16in. diam. countersunk screws and nuts, will be shown next month. Since the speaker

frame and magnet housing project through the chassis, it will be necessary to carve away part of the chassis top and front face for clearance. The general shape of this cut-out is shown in Fig. 3. Chassis weakness as the result of this cut-out will be compensated by the stiffness of the panel on final assembly.

The inner face of the panel should be relieved to a depth of one-ply over the area covered by the speaker, to allow the latter properly to bed down. A counter-bored hole is provided to locate and sink the epicyclic slow-motion drive, which is mounted on the tuning condenser spindle extension, but the final dimensions will depend on the type and size of drive employed. Clearance holes are also provided for the volume control and wavechange switches and their associated locking nuts.

For neatness it is suggested that the panel assembly be completed by stretching a piece of fabric over the oval speaker opening. The colour of the fabric should be chosen to match the interior trim of the car, and it can be fastened by means of a stapling machine, used opened-out, or by small tacks. Care should be taken to avoid covering the heads of the 3/16in. diam. countersunk screws. The whole of the front face of the panel can now be covered with a piece of expanded metal grille, secured at the corners by small countersunk woodscrews. The grille must be cut away locally to clear the operating spindles, the slow-motion drive, and the woodscrews which ultimately will pass through the casing for clamping the plywood panel to the casing. This last operation is best accomplished by marking off, through the casing, on a trial assembly.

The set is secured to the casing by fillister-headed chrome-plated woodscrews driven from the casing outer front face into the plywood panel. These screws also sandwich the speaker grille and prevent any undesirable rattle.



Another view of the receiver.

LIST OF COMPONENTS

Condensers

C1, C5, C15—1,000 pF silver mica.
C2, C7, C14—.05 μF (100 v. w.).
C3, C8, C16—.1 μF (350 v. w.).
C4, C9, C17, C18—.1 μF (100 v. w.).
C6—50 pF trimmer. C10—50 pF silver mica.
C11—30 pF trimmer. C12—250 pF trimmer.
C13—500 pF trimmer.
C19, C20—150 pF silver mica.
C21, C24—25 μF 50 v. electrolytic.
C22—.05 μF (1,000 v. w.).
C23+C26—8 μF+16 μF (350 v. electrolytic).
C25—.001 μF (1,000 v. w.).
C27—30 pF silver mica.
TC1, TC2—2 gang—.0005 μF tuning condenser.

Resistors

All ½ watt unless otherwise stated.

R1, R15—91 K ohms.
R2—1,500 ohms.
R3—330 ohms.
R4—27 K ohms—1 watt.
R5, R20—39 K ohms.
R6—270 ohms.
R7—56 K ohms.
R8—220 ohms.
R9, R16—270 K ohms.
R10—3,000 ohms.
R11—4.7 K ohms.
R12—430 ohms.
R13—390 K ohms.
R14—330 K ohms.
R17—1.2 megohms.
R18—1,200 ohms.
R19, R23—47 K ohms.
R21, R22—560 K ohms.
R24—500 K ohms volume control.

Valves

1—12K7GT. 1—12K8GT. 1—12SK7.
1—12Q7GT. 1—12A6.

Coils

1 pair of superhet coils—long and medium waves. Osmor, QA170 and QOS170.
1 pair of 465 kc/s I.F. transformers—13/16in. square.
1 465 kc/s I.F. filter—Osmor, Q1F1.
1 wavechange switch—2-way, 3-pole.

Sundries

5 octal valveholders.
Chassis—10in. x 7in. x 1¾in.
Output transformer—Elstone MRT.
Tag strips, nuts, bolts, shakeproof washers, grummets.
1 Belling-Lee 7-pin plug and socket.
1 television coaxial plug and socket.
Aerial coaxial cable.
Heavy section coaxial cable (feed lines).
Screened lead for flying grid connections.
1 loudspeaker—Rola P.M., 7in. x 4in.
Slow motion drive for tuning condenser.
4 screening cans and bases.
Plywood panel, 10in. x 4⅝in. x ⅜in.
Loudspeaker grille material.

Power Supply

1 Vibrafor unit or rotary converter for 12 volt input, with output of 210 volts x 50 mA, fully smoothed. (The Pye unit referred to in the text gives the above output with a 1,000 ohm 5 watt dropping resistance in the H.T. line, the dropper being mounted inside the vibrator unit casing.)

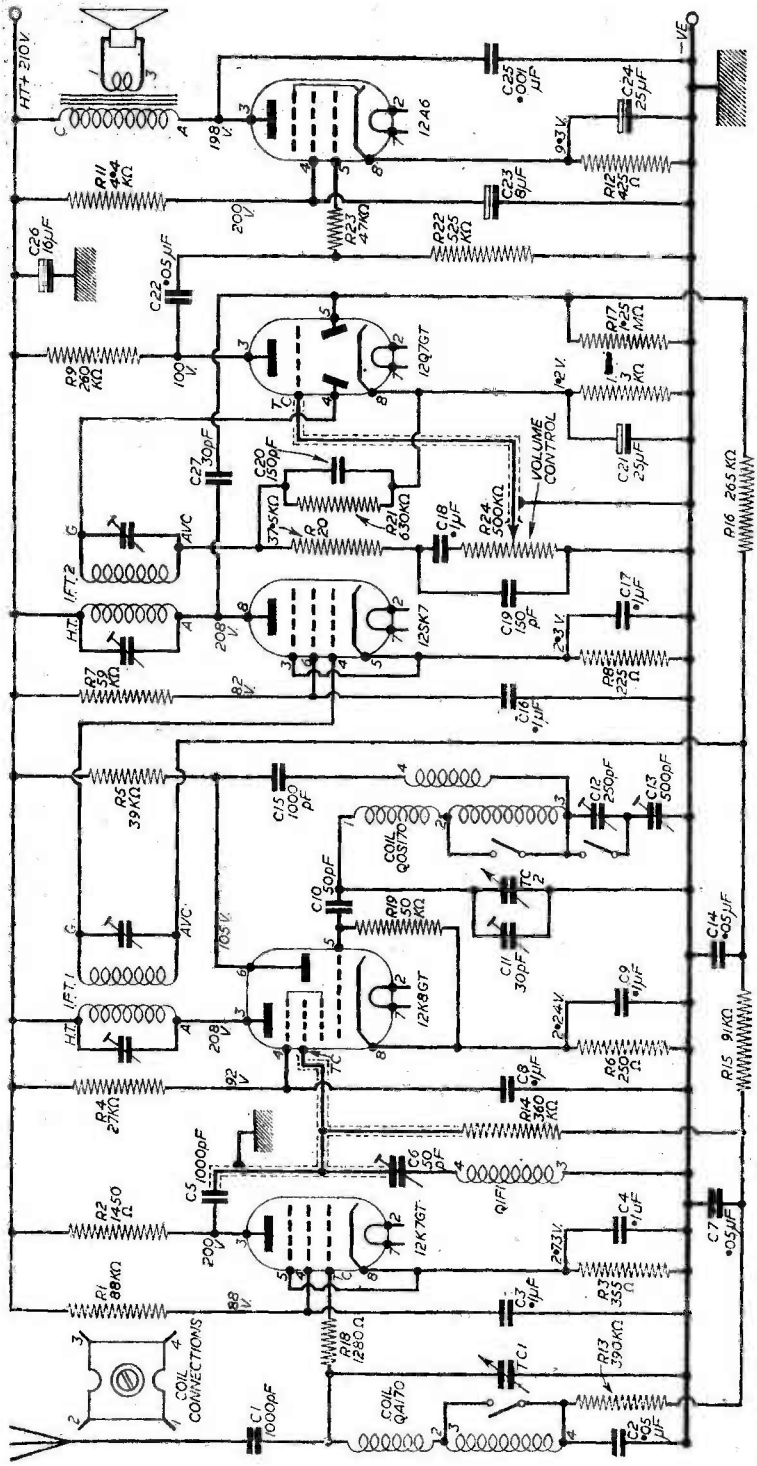


Fig. 1.—Theoretical circuit. The list of parts on page 323 gives preferred values, whilst on the above diagram the actual measured values are shown.

Wiring

Two separate wiring diagrams will be shown next month as it will be found convenient to wire the set in two distinct stages. It will be simpler to delay the insertion of the trimmers, wavechange switch, filter, and oscillator coil until the first stage is completed, all installed components being kept as close to the chassis as possible. The first section to be wired should be the I.T. transformer circuits.

Before starting the second stage it is advisable to solder lengths of wire to the wavechange switch and oscillator coil connections as these may not be easily accessible after installation unless a pencil bit iron is used.

Some worthwhile wiring hints are offered. Soldering tags should be fastened under the heads of all bolts fastened to the chassis. It is an advantage to wire up "sub-assemblies" before installation, and this particularly refers to bias condenser/resistor combinations. Coil connections should be carefully verified before soldering, since the writer has found that these do not always agree with the maker's literature on the subject. The writer has made a practice of giving each condenser and resistor its circuit number with little paper discs, such as are made by a paper punch, secured by cellulose tape. This not only simplifies the sorting out of such components but makes the checking of completed wiring very much easier.

Casing

The case for the prototype used was built up by welding out of 16 s.w.g. aluminium sheet, but as it could conveniently be painted to match the car, any suitable sheet metal can be used, particularly as corner joints are not

(*Continued on page 327*)

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WIRELESS SET 19—30/-

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CRYSTAL MICROPHONE

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Contains a clock movement less hands and balance. Makes and breaks heavy duty contacts. Sale price 9/6. Post & ins. 3/6.

PORTABLE CABINET 19/6

Product of a famous maker. Complete with top board and speaker grille. Sale price 19/6.

VARIABLE RHEOSTAT

This is a heavy duty slider resistor rated at 25 amps., but easily capable of twice this load. Basic resistance is .4 ohms, but by the removal of one wire this becomes .8 ohms, alternatively it can be rewired to suit individual requirements. Adjustment is by rotating a Bakelite knob which couples to a heavy duty slider, ideal for dimmer circuit. Price 8/3, post and insurance 3/6.

VALVE HOLDERS

Amphenol type B7G-B9A and int.-octal. Sale price 5/- doz. as you want them. Nylon loaded 7/6 doz.

MORGANITE POTENTIOMETERS

Standard size with good length spindle, most values, sale price 1/- each, plus 3d. postage. 1 each of 10K, 25K, 50K, 100K, 250K, 500K, 1 meg. and 2 meg. 7/6, post free.

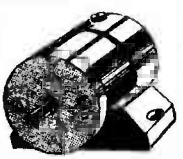
AMPLIFIER CASE 62/-

A robustly made cabinet in the modern style of two tone fabrics, will comfortably house speaker and amplifier in the end compartment and has uncut motor board for tape recorder or record changer, lacquered fitting and plastic handle. Sale price 62/-, carriage and ins. 7/6.

AMPLIFIER FOR ABOVE

Uses three valves one of which is low noise pentode E.F. 86, mains transformer isolates chassis. Sale price £3.15.0, plus 2/6 post and packing.

MAINS MOTOR



Powerful electric motor, size 3in. long by 2¼in. diameter, with speed varier suitable for operation on/off standard A.C. mains. Ideal for driving fan, model, car heater, dryer, etc., etc. Don't miss this snip. 12/6, plus 2/- post and insurance.

Stand not included.

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ORGANTONE PARCEL 39/6

Here is an opportunity to build a fine set at a low figure, the parcel contains all the essential parts as follows: Punched and prepared chassis with scale pan—coloured glass dial with fixing cushions—drum drive and spindle—mains transformer—volume control—tone control—5 valve holders—circuit diagram and instructions. Limited quantity only for 39/6, plus 3/6 post and ins.

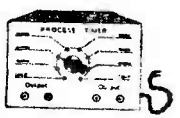
MISCELLANEOUS SALE BARGAINS

500 micro amp. basic 2½ moving coil meter **17/6**, post 1/6. **RF 25 Tuning Unit,** new condition with all valves **9/6**, post 2/6. **Hand Magneto** generator **9/6**, post 1/6. **Miniature Dynamic Microphones,** American made **3/6**, post 9d. **Powerful Blower with** motor **15/-**, and **22/6**, post 2/6 and 3/6. **12v.-24v. Rotary Convector,** will work 12 volt appliances off 24 volt and vice versa. **45/-**, post 3/6. **Twin Screened** FM Feeder **6d.** yd. **400 watt Step Down Transformer,** tapped for output 110-155v. **37/6**, post 7/6. **500 watt Isolation Transformer** (make servicing safe) 200/250 in. 200/250 out **47/6**, post 6/6. **Mains Operated Contactor** with economy resistor and relay **12/6**, post 1/6. **Low Loss T.V. Co-ax 8d.** yard.

MANY OTHER BARGAINS

There will be special bargains for callers at all branches and it will definitely be worth your while to pay each branch a visit.

PROCESS TIMER 15/-



Make a useful time switch to work off mains (A.C. or D.C.), all the parts (less case). Sale price 15/-, post and insurance 2/6.

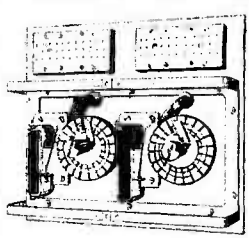
FLUORESCENT LIGHTS

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

Single 40. 4ft. 3in. long, uses a 40 watt tube. Sale price 35/-, complete with tube.

Twin 20. Uses 2 20-watt standard tubes. Sale price 35/-, with tubes. Carriage and ins. up to 150 miles, 5/6; up to 250 miles, 7/6.

TOWARDS AUTOMATION



Rotary switch—Ministry Ref. No. AP57579, this is a motor-driven switch, the driving motor being a synchronous type for working on 110 volts 50 cycles. The two switches have 20 positions each and are enclosed by a Perspex fronted lid, separately operated relays providing interlocks. Sale price 27/6 each. Carr. 3/6.

SAVE £2-10-0

The **Cleveland** Band III Converter is one of the best on the market—literally thousands are in use all over Britain. Original price £7.10.0, sale price **£4.19.6**, plus 5/- carriage and ins.

IMPORTANT

The goods advertised on this page are not repeatable once cleared, so before journeying especially to collect an item please telephone to ensure that it is in fact in stock.

ELECTRONIC PRECISION EQUIPMENT, LTD.

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

266, London Road, Croydon.
Phone : CRO. 6558.
Half day, Wednesday.

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Half day, Wednesday.

152-3, Fleet Street, E.C.4.
Phone : FLEet 2833.
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29 Stroud Green Rd., Finsbury Park, N.4.
Phone : ARChway 1049
Half day, Thursday.

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

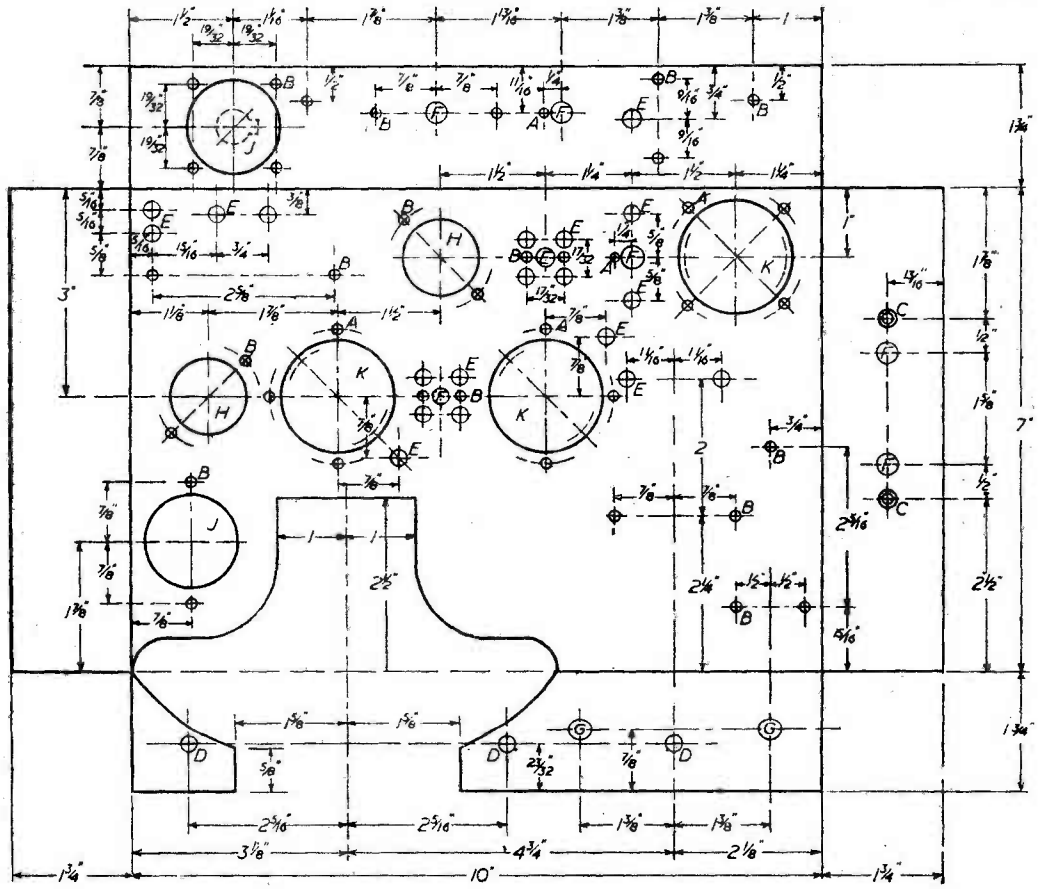

Fig. 3.—Chassis Drilling Data. For hole sizes see table below.

readily visible after installation. An oval hole must be cut in the front face to match the speaker opening, and clearance holes for the control spindles. The prototype is finished in black "Panl," with white control knobs. Black dots have been added to the V.C. and W.C. knobs by drilling dimples and filling with black paint to give an indication of the operating positions. The tuning dial is graduated 0/100, but the provision of station names is a matter for individual choice.

Since the main bulkhead comes between the set and the engine, no back has been provided for the casing. For additional ventilation, three rows of holes have been drilled through the sides of the casing, just above the top of the chassis. On a ourney lasting three hours, with the set continually in use, the casing does get warm, but inspection has shown that there is insufficient heat below the chassis to cause any concern.

One further refinement should be mentioned. It is advisable to drill additional holes through the top, bottom, and right-hand side of the casing to line up with trimmers and aerial coil cores to allow final adjustments to be made with the set in its casing inside the car. Those for core adjustment can conveniently be ⅜in. diam. and will be out of sight after final installation.

Power Supply Connections

The incoming leads comprise L.T. from the A.I connection on the car junction box, outgoing L.T. to the power pack, incoming H.T. from the power pack and earth. A Belling-Lee 7-pin plug was used for this purpose, some of the pins being used in pairs to spread the load. The socket is mounted on the rear chassis face below the O.P. transformer. Some excess length should be left on these cables.

CHASSIS DRILLING

A	¼in.	F	5/16in.
B	5/32in.	G	⅜in.
C	5/32in. csk.	H	1⅛in.
D	13/64in.	J	1⅜in.
E	¼in.	K	1⅝in.

(To be continued)

Built-in Metering

CHECKING PERFORMANCE WITH A FIXED METER AND SWITCHING

By A. M. St. Clair

BUILT-IN metering is a feature of practically all studio recording equipment, and is found frequently in professionally designed electronic apparatus of any kind—from transmitters and computers to audio amplifiers—where more than a very few valves are involved. It is a time- and labour-saving device which will increasingly commend itself to the amateur as his rigs, particularly in the field of recording, grow in scope and ambitiousness.

A switch and a meter on the panel. A flick of the switch, and a fault is diagnosed without the necessity of any dismantling.

Principles

The principles of built-in metering are simple. But they entail some precautions which are not always clearly recognised. It would seem all too easy to decide which voltages you would like to measure, and to bring leads from the appropriate points to a panel switch and meter, supplied with the necessary shunt and series resistors. This would normally result in a more or less serious modification to the performance of the apparatus, perhaps in complete loss of function due to wild oscillation. I have seen a built-in metering system, started off in this hopeful fashion, finish up in a mass of decoupling condensers, R.F. chokes, L.F. chokes, and screened leads—and still not work correctly. All because of interference between the metering leads.

To avoid all this trouble, we must observe the following rules:

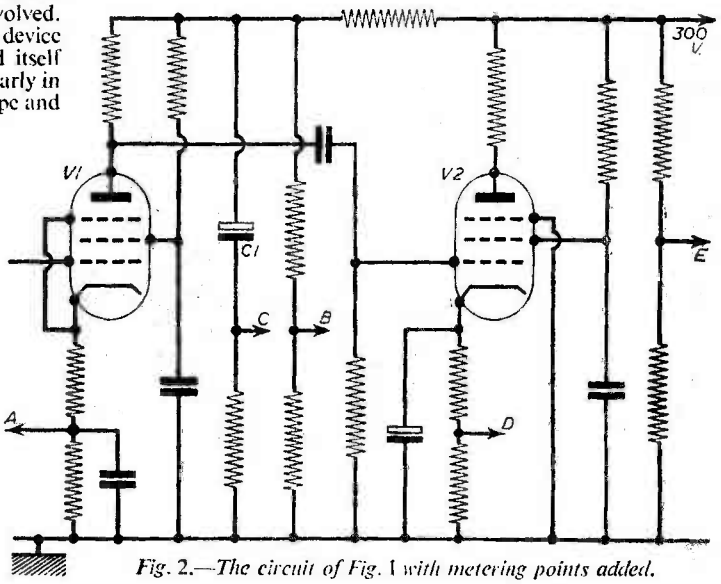

Fig. 2.—The circuit of Fig. 1 with metering points added.

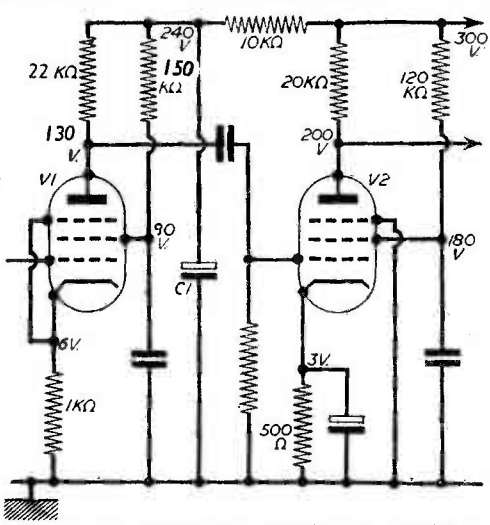

Fig. 1.—A portion of a simple L.F. amplifier.

Wherever possible, and it is almost always possible with a little thought:

1. Metering leads should carry only D.C.
2. Voltage on a metering lead should not exceed 0.1 volts.
3. All voltages metered should have one side earthy.

On rare occasions it may prove necessary to waive one of the above rules in respect of a certain lead; with care we can get away with this. But if we infringe more than one, or if two leads in the same system break one rule each, we are asking for trouble. In particular, if two or more leads in the same bundle carry other than D.C., either signal or 50 c/s., we should think again.

Let us apply these principles to a simple circuit. Fig. 1 shows a portion of an amplifier. Normally we should, in checking this, want to know the two anode voltages, the corresponding screen voltages, and the cathode voltages. Let us assume that each valve is passing 5 mA anode current, and 1 mA screen current. These voltages will then be as shown. It will be seen that all are considerably above 0.1 volt, and that three of them, the two anodes and the first cathode, carry a signal component. None is a suitable measurement for a built-in metering system.

(*Continued on page* 331)

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

Suitable for London, Birmingham and Northern Transmissions

£2-5-0 post free

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

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

Volume Controls

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

No Sw. S.P.Sw. D.P.Sw
3/- 4/- 4/6

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

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

TWIN-FEEDER, 80 ohms, **6d.** yd.; 300 ohms, **5d.** yd.

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

50 OHM COAX CABLE, **8d.** per yd., ¼in. dia.

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

RESISTORS.—Pref. values 10 ohms 10 megohms.

CARBON		WIRE-WOUND	
20% Type, ½ w., **3d.**; ¼ w., **5d.**; 1 w., **6d.**; 2 w., **9d.**	5 w.	25 ohms—10,000 ohms	1/3
	10 w.		1/6
	15 w.		2/-
10% Type, ½ w., **9d.**; 1 w., **1/-**;	5 w.	15,000—33,000 ohms	1/9
5% Type, ½ w., **1/-**; 1 w., **2/-**.	10 w.		2/3
Ditto Carbon Track 50 K. to 2 Meg., **3/-**.			

CONDENSERS.—Mica or S. Mica. All pref. values 3 pf. to 680 pf., **6d.** ea. Ceramic types, 2.2 pf.-5,000 pf. as available, **9d.** each. **Tubulars**, 450 v., Hunts and T.C.C., .0005, .001, .005, 0.1 and 1 350 v., **9d.** .02, .05-1/500 v. Hunts T.C.C., 1/-. .25 Hunts, 1/6. .5 Hunts, **1/9.** .1 1,500 v. T.C.C. (Simplex), **3/6.** .001 6 kV., T.C.C., **5/6.** .001 20 kV., T.C.C., **9/6.**

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

SOLON SOLDERING IRONS (200/220 v. or 230/250 v.) 25 watt Instrument type, **21/6**; 65 watt Pencil Bit Type, **26/6**; 65 watt Oval Bit Type, 25/-. Comprehensive stock of spares available.

80 ohm CABLE COAX

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

8d. yd.

SPECIAL — Semi-air spaced polythene. 80 ohm **Coax** ¼in. diam. Stranded core. Losses cut 50%.

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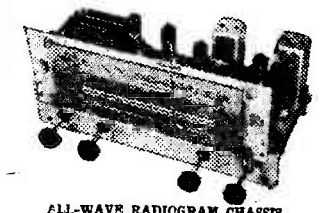

ALL-WAVE RADIOGRAM CHASSIS

3 WAVEBANDS **5 VALVES**

S.W. 16 m.—50 m. LATEST MIDGET

M.W. 200 m.—500 m. B.V.A.

L.W. 800 m.—2,000 m. SERIES

Brand new and guar. A.C. 200/250 v., 4 pos. W/C sw. Short-Medium-Long-Gram. P.U. socket. High Q dust core coils. Latest circuit technique, delayed AVC and neg. feedback. O/P 4 watts. Chassis size, 13½ x 5½ x 2¼in. 10in. x 4¼in. hor. or vert. station names. Walnut or Ivory knobs to choice. Aligned and calibrated ready for use. **Sensitivity and Quality at Low Cost.** Chassis isolated from mains. **BARGAIN PRICE 9½ gns.** Carr. and ins., 4/6.

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

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

RECORD PLAYER BARGAINS

Latest Model U.A.9. BSR Monarch 4-speed auto-changer £9.15.0, carr. 4/6. **B.S.R. Three-speed Single Player Model T.U.8, £4.12.6,** carr. 3/-. **Cut mounting board 5/-,** carr. 1/-. **Garrard and Collaro 4-speed Changers from 9½ gns.,** carr. & ins. 4/6. Ditto **4-speed Single Players** from **£7.10.0,** carr. 3/6. As available.

SCOTCH BOY, EMITAPE, etc., 1,200ft., **30/-.** Long playing, 1,800ft. reels, **45/-.** Paper tape, good quality, 1,200ft., **12/6.** Reels only, 5in., **3/9,** 7in., **4/3.**

I.F. TRANSFORMERS—465 kc/s

Brand new ex-manufacturer's midget I.F.T. Size 2¼in. x 1in. x 1in., dust core tuning. Litz wound coils. High Q. Bargain offer, **7/6** pair.

NEW BOXED VALVES ALL GUARANTEED

1R5, 1T4	7/6	DAF96	9/-	ECH80	10/6
1S5, 1S4	7/6	DF96	9/-	EF41	10/6
3S4, 3V4	8/-	DK96	9/-	EF80	10/6
5Y3	9/6	DL96	9/-	EF85	12/6
6AT6	8/6	35L6	10/6	EF91	8/6
6K7	6/6	EABC80	9/6	EL38	15/6
6K8	8/6	EB91	6/6	EL41	10/6
6Q7	9/6	EBC33	9/6	EL84	11/6
6SN7	9/6	EBC41	10/6	EY51	10/6
6V6	7/6	ECC84	12/6	EZ40	8/6
6X4	7/6	ECF80	12/6	EZ80	8/6
6X5	7/6	ECF82	12/6	MU14	9/6
7C5	8/-	ECH42	10/6	PC84	10/6
7Y4	9/6	ECH81	10/6	PCF80	10/6
				PCF82	10/6
				PCL82	12/6
				PL81	11/6
				PL82	10/-
				PL83	11/6
				PY80	9/6
				PY81	9/6
				PY82	8/6
				U22	8/6
				UBC41	9/6
				UCH42	10/6
				UF41	10/-
				UL41	10/6
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SPECIAL PRICE PER SET

1R5, 1T4, 1S5, 1S4 or 3S4, or 3V4 ... ... **27/6**

DK96, DF96, DAF96, DL96 ... ... **35/-**

6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5 ... ... **35/-**

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

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

ELECTROLYTICS ALL TYPES NEW STOCK

Tubular Wire Ends		32+32/350 v. B.E.C.	5/6
25/25 v., 50/12 v.	1/9	**Can Types, Clips 3d. ea.**	
50/50 v., 16/500 v.	2/-	8/450 v.	2/6
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8+16/450 v. T.C.C.	5/-	32+32/275 v. Hunts	4/6
16/450 v. B.E.C.	3/6	32+32/450 v. T.C.C.	6/6
16/500 v. Dub.	4/-	250/350 v. B.E.C.	8/6
16+16/450 v. T.C.C.	5/6	60/350 v. T.C.C.	6/6
32/350 v. Dub.	4/-	60+100/350 v.	11/6
32/500 v. Dub.	5/-	100+250/275 v.	12/6
50+50/350 v. B.E.C.	6/6	100+200/275 v.	12/6

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

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

ENGRAVED CONTROL KNOBS for ¼in. Spindle. 1¼in. diam. Walnut or Ivory. Gold filled. 16 Standard engravings, **1/6** ea. Plain knobs to match above, 1¼in., **10d.** ea., 1¼in. dia., **8d.** ea. Superior Walnut or Ivory with gold ring, 1¼in., **1/-** ea.; 1in., **9d.** ea. Pointer Knobs, Black with White Line, **9d.**

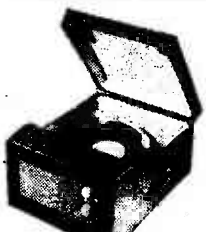
MAINS TRANSFORMERS.—Made in our own Workshops to Top Grade spec. Fully interleaved and impregnated. **RADIO AND AMPLIFIER TYPE.**—250 v. 60 ma., P.W. sec., 5 v. or 6.3 v. 1 a. rect. 6.3 v. 2.5 a. set Htrs., **22/6**, etc. **C.R.T. HTR. ISOLATION TYPE.**—Low leakage with or without 25% sec. boost voltage. Ratio 1 : 1 or 1 : 1.25. 2 v., 4 v., 6 v. or 13 v., **10/6** ea. Ditto with mains primaries 200/250 v., **12/6.** Special to order.

L.F. CHOKES.—10 H. 65 mA., **5/-**; 15 H. 100 mA., **10/6**; 10 H. 120 mA., **10/6**; 20 H. 150 mA., **15/6**; Simplex, **10/6**; Soundmaster, **10/6. OUTPUT TRANSF.**—Standard pentode, **4/6**; ditto tapped prim., **4/8**; small pentode, **3/9**; Midget battery pentode (1S4, etc.), **4/6.**

LOUDSPEAKER.—PM.3 OHM 5in. R. and A. **16/6**; 6in. Celes., **18/6**; 7 x 4in. Goodmans Elliptical **18/6**; 8in. Elac., **20/-**; 10in. R. and A., **25/-**; 12in. Plessey, **35/-**; 12in. Goodmans heavy duty Audiom 50, 15 ohms, **85/-**; 24in. Elac., **17/6.**

8in. P.M. SPEAKER

Ex-mfr's. units. Rola, Elac, Celestion, etc. All reconditioned and guaranteed. Ideal ext. unit. 7/6, post and packing 1/-.



RECORD PLAYER CABINET

Cabinet size 18¼in. x 13¼in. x Ht. 8¼in., with m.c.ut motor board 13¼in. x 12¼in., **£3.3.0,** carr. 2/6. 2 valve amplifier to fit above, ready wired and tested with 6½in. speaker. **£3.12.6,** carr. 2/6. Record changers available to suit this cabinet.

F.M. TUNER-UNIT (87 mc/s—105 mc/s) by Jason. As described in *Radio Constructor*. Designer Approved Kit of parts to build this modern highly successful unit, drilled chassis and J.B. dial, coils and cans, 4 BVA miniature valves and all components, etc., for only **£6.10.0** post free. **SUPERIOR TYPE GLASS DIAL** (as illustrated).—Calibrated in Mc/s and edge lit by 2 pilot lamps, **12/6** extra. Illustrated handbook with full details, 2/- post free.

TRS RADIO COMPONENT SPECIALISTS (Est. 1946)

70 BRIGSTOCK ROAD, THORNTON HEATH, SURREY (THO 2188)

50 yards Thornton Heath Station. Buses 130A, 133, 159, 166 & 190.

Listed above are only a few items from our very large stock. **Send 3d. stamp today for Complete Bargain List.**

Hours : 9 a.m.—6 p.m., 1 p.m. Wed. OPEN ALL DAY SAT.

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

But look at Fig. 2. Here we have the same amplifier section, with suitable metering points added.

It will be seen that there are five points, marked on the diagram A, B, C, D and E. A and E will give a measure of the *total* current of V.1 and V.2 respectively. B will check the H.T. to V.1, and D that to V.2. C, which is optional but very valuable, gives the leakage of the H.T. decoupling condenser C.1. These measurements will give a very complete diagnostic

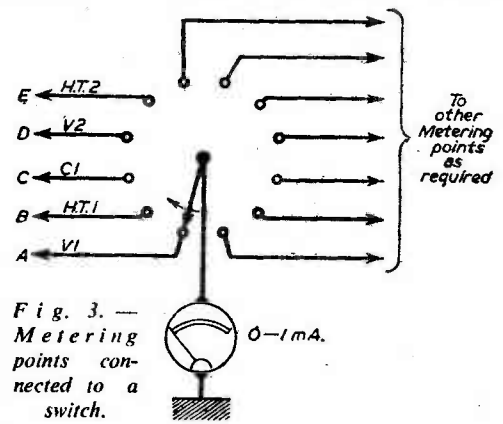


Fig. 3. — Metering points connected to a switch.

picture of the condition of the circuit—better, perhaps, than that obtained with a multi-range voltmeter.

What values are we to use for the various resistances? This depends entirely upon the panel meter to be used. A very suitable meter, and one readily obtainable on the surplus market, is a 1 mA 2in., with an internal resistance of 100 ohms. We shall use these figures in our calculations, although, of course, the calculations will serve, with the appropriate figures inserted, for meters of other characteristics.

Such a meter will require 0.1 volts for full-scale deflection (1 mA × 100 ohms = 0.1 volts). If we agree to use a centre-scale deflection for a "normal" reading, this means that we need 0.05 volts at each metering point *when the meter is connected*. In the case of A and E (Fig. 2) we see that we have a current of 6 mA (5 anode plus 1 screen) with which to develop this voltage. By Ohm's Law we get $E/I = 0.05 \times 1{,}000/6 = 8.7$ ohms approximately. This is the value of r.1 or r.7 in parallel with the 100 ohms of the meter. Therefore, r.1 and r.7 = $8.7 \times 100/(100 - 8.7) = 9.5$ ohms, approximately. Wattage = I^2R., $= 36 \times 10^{-6} \times 9.5$, approximately a third of a *milliwatt*; nothing big required here! Select a 10 ohm a little low on tolerance.

Make r.3 100 ohms. When the switch puts the meter across it, the net resistance between B and earth will then be 50 ohms. To produce 0.05 volts we therefore require 1 mA. An extra drain of 1 mA through r.8 will drop the voltage at the low end of it to 230 volts. (This drop will be unimportant in most cases; if it is not, r.8 must be changed to a slighly lower value). Hence, by Ohm's Law again, r.2 must be 230 K ohms. Wattage = $10^{-6} \times 230{,}000$, approximately a quarter-watt. Select a half-watt 220 K a little high on tolerance.

Make r.6 100 ohms. Then, as in the case of r.3, we require 1 mA. Here, however, we have a total voltage of 300. Hence r.5 is 300 K ohms. A half-watt 330 K low on tolerance will be used.

The voltage on r.3 and r.6 will rise to 0.1 volts when the meter is switched to some other position. Hence we are still within our requirements, and the wattage here is only a tenth of a milliwatt; so that any resistor of suitable stability may be used.

In the case of r.4 we hope that it will have a negligible voltage developed across it, since it is only passing the leakage current of C.1. Here, the "normal" reading will be zero, and we want to arrange things so that a "dead short" in C.1 will give a centre-scale reading. Leakage will be indicated by intermediate readings. In the event of a dead short, r.8 and r.4 will form a divider across 300 volts. From this, by simple proportion, we get: r.4/r.8 = 0.05/300, from which r.4 = 1.67 ohms approximately. This is so low a value that it is not worth while correcting it for the effect of the meter resistance. It will have to be wound from a piece of resistance wire, according to the value in ohms per foot given in the tables. It should be corrected in practice by making the experiment of *briefly* short circuiting C.1, since the voltage applied may not remain at 300 when a short is in existence.

In the circuit used as an example, three of the metering points—A, C, and E—will have small alternating components in the voltages developed. That at E will be too small to cause any trouble. That at C will be either 50 or 100 c/s., depending upon the rectification system employed in the power pack. It will also be small, and, since it cannot be effectively decoupled, will have to be tolerated. A should be decoupled as shown. If the circuit is working at audio frequencies, 50 μF will give good decoupling down to 1 kc/s, and lower frequencies will not give appreciable trouble. At R.F. a 0.5 μF would be adequate.

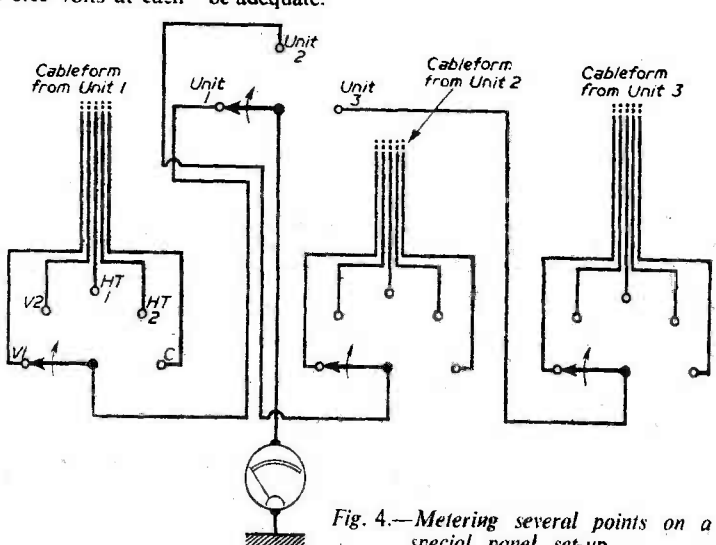


Fig. 4.—Metering several points on a special panel set-up.

Connections

The method of connecting the points to the switch and meter is shown in Fig. 3. The switch must be of the non-shorting, i.e., break-before-make type. All the leads from a given unit may be made into a twisted bundle, and if the distance from the meter to the unit being monitored is more than a foot or so, the bundle could with advantage become a multi-cored screened cable. If several units are being monitored on a single meter—and many amateur recording outfits now boast quite a few units—each unit should have its bundle of metering cables terminated on a separate switch. It then becomes possible to have a check-point panel, an example of which is shown in Fig. 4.

It is thus seen to be the fundamental principle of built-in metering that we must develop from the voltages and currents to be measured: low voltages, across low impedances, with one side earthy. If ingenuity is used in selecting suitable check-points, a very high diagnostic value can be obtained. The onset of leakage in electrolytic condensers, and small changes in total valve currents will often, being discovered, enable us to anticipate trouble and avoid major breakdowns and damage. If it is thought desirable in a given set-up (though it is seldom necessary) to monitor an alternating voltage such as heater volts, or the output of an amplifier or oscillator, similar principles should be followed. The voltage concerned should be broken down by means of a pair of resistors forming a divider, and the output of the divider should be rectified by means of a germanium diode, adequately smoothed, and fed to a switch point This should be attempted sparingly, however, and two such leads should never form part of the same bundle.

With a bare minimum of mathematics, and very few additional components, a little ingenuity will enable us to add a valuable facility to many types of apparatus.

TRACKING THE EARTH SATELLITE

(*Concluded from page 305*).

easily built types is the solid-dielectric cable (70 ohm) type shown in Fig. 3. With balanced line the type shown in Fig. 4 is feasible. Other types can be made by using lumped constants. The hybrids should be made so that the crossarm isolation is at least 30 db.

A low-noise pre-amplifier is an ecessity for either tracking system. The pre-amplifier built for the Minitrack system uses type 6299 valves and, with some valve selection, has a noise figure of less than 3 db.

It is possible that for the simple signal-minimum detection system an ordinary communications receiver and frequency converter could be used in conjunction with the pre-amplifier to make a satisfactory receiving system. A special double receiver is being designed specifically for this application. It will amplify both hybrid outputs, using a common local oscillator and a combined automatic-gain-control voltage derived from the larger signal. In addition to the greater convenience afforded by this receiver a further advantage in output indication and signal-to-noise ratio can be obtained by combining the two receiver I.F. outputs in a product detector.

While a large number of recorders that would be suitable are manufactured, all are expensive. For a single-axis system, an accurate time standard recorded with a single channel of data would have value. The position of the minimum with respect to time should be found to a few milliseconds. A pen recorder may be adequate, and a string oscillograph or oscilloscope recorder using strip film run at about 3 in. per second would quite certainly be suitable.

Calibration of the tracking system appears to be a most difficult task. Evaluation of methods using transmitters in balloons, helicopters and aeroplanes is being made at the present time, and consideration is being given to a plan for employing a roving calibration team.

Conclusions

Amateurs throughout the world could make a real contribution to the scientific earth satellite programme by building systems to receive the radio emissions from the satellite. Although considerable thought and effort has gone into the design of a tracking system which could be adapted for use by amateurs, the design has not gone very far, and much more design thought is needed. It is felt that amateurs can add much to the system that has been described, especially those able to make a real effort to measure satellite positions accurately. In addition to the support of western hemisphere amateurs, support is sought from amateurs living in the 36 degree latitude regions throughout the world.

Although this article has been written especially for radio amateurs, it should be emphasised that aid from universities, industrial firms, and laboratories would be welcomed.

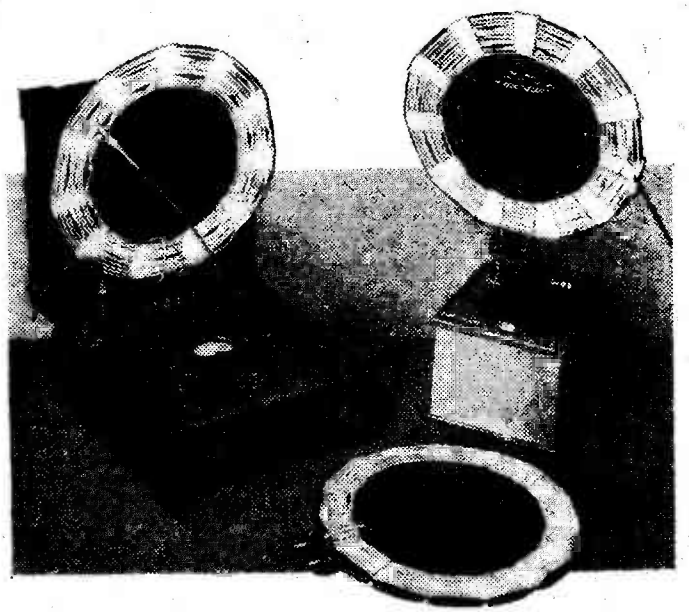
The simplified Minitrack electronic tracking system is the result of work by a large number of engineers. Some of those working on the system are Edward Bissell, C. B. Cunningham, Dr. J. J. Freeman, Edmund J. Habib, John B. Martin, John T. Mengel, Victor R. Simas, and Martin J. Votaw, all of the Naval Research Laboratory.

FOR THE BEGINNER

A Diode & 3 Transistor PORTABLE

THIS RECEIVER IS SIMPLE TO MAKE, IS SENSITIVE, FIDELITY IS EXCELLENT AND IT IS VERY ECONOMICAL ON BATTERIES

By Capt. R. F. Graham



The receiver in an experimental set-up, with test coils.

THE circuit is made up as follows: L1—Aerial Coil is tapped 1/5th turns or less for a 30-yards outdoor, in the loft, or a flex in a room, zig-zagging from picture rail to opposite rail. Do not use a co-axial lead but the same aerial wire away from walls. Capacitance by-passes R.F. current wanted for transistors, which are wattage working devices, not like a valve where voltage on the grid suffices. The longer and higher the aerial the greater the range applies to any receiver. On vacation four yards helps a lot if a short earth lead with a metal spike is driven into the ground.

C1—Tuning Capacitor is in a separate box for moving L1 away from L2 to reduce input. Usually one to three feet away.

L2—Diode Coil is centre tapped and it is tuned by any suitable type C2.

D—The Diode must be sensitive to very weak signals and yet have as low D.C. resistance as possible to forward current, but definitely no leakage to reversed current at higher voltage. Small germanium junction types are quite satisfactory, but some point contact types are better in spite of higher resistance which is detrimental. The diode is connected with its cathode to coil tap to pass R.F. negative half cycles and stop all positive halves or any part.

Tr1—The first transistor may be any small, low-noise, or R.F. p-n-p type. It works on the flat part of its curve near zero. Its base accepts the negative half cycles, these are amplified, unhampered by the positive ones which would neutralise a large proportion, because a junction transistor is sluggish and a bad type of rectifier. Test by shorting diode.

C3, C4, R1, R2 and R3—C3 by-passes R.F. C4 is not essential, but helps to smooth R.F. ripple, leaving audio modulations. It also builds up a small negative bias due to the unmodulated portions of the R.F. carrier. Very weak signals from distant stations do not produce enough of this bias so R1 is pre-set for desired bias. Too much of this bias reduces efficiency, very little is needed to move the working point slightly away from curve zero. R2 limits battery drainage and R3 supplies bias for Tr3.

Tr2—Driver Transistor may be any small audio p-n-p. type. It works on the steep straight part of the curve efficiently. Input is primarily to base then emitter at + 1½ volts. As audio rises to a peak Tr1 collector and Tr2 base become more positive due to increasing potential across R4 and R5, thus Tr2 output current falls. Tr2 bias is audio modulated within pre-set limits on the steep curve. Excessive input to L2 cannot damage Tr2 as it could damage Tr1, but R4 limits Tr1 output. Both transistors are quite safe. Excessive input will drop Tr2 working point below the bend, distorting fidelity like an over-biased tube does.

R4 and R5—High Resistor R4 and variable R5 in series have many functions. Briefly, R4 limits bias input to Tr2 when R5 is at zero ohms. It also limits Tr1 output. Bias for Tr2 is adjustable by R5 which also alters Tr3 bias. Both R4 and R5 act like R.C. feed in a valve circuit, but there is no capacitor. It is a D.C. amplifier with excellent fidelity.

C5—C5 by-passes stray R.F. heterodyning, etc., but it may be omitted.

Ch—The Choke may be any audio type provided that its D.C. resistance is not so high as to produce excessive bias for Tr3. A tap ratio 3 : 1 or more

provides matching. The impedance to audio should be 10 to 20 H.

Tr3—Output Transistor may be OC72 or any ½ to 2½ watt p-n-p type. As audio rises to a peak the Tr2c and Tr3e become more positive, but in this case the input is primarily to Tr3 emitter then base at −1½ volts. Bias to Tr3 increases and its output increases. Tr3 works from near the bottom of the load line across its Ic-Ec curves up to the maximum current or wattage. It requires little bias so it keeps cool. Efficiency is better than by transformer coupling. The emitter cannot be said to be grounded, it is common to input from one battery and has another battery for output.

C6—Electrolytic. C6 by-passes audio and prevents overloading M1.

C7—C7 has a stabilising effect on the sensitive D-Tr1 junction.

The Output Transformer should be a good fidelity type. Miniatures are no good. The best for home use was out of my spares box. It is a mains power type for a transmitter, has many taps to match a speaker, has good fidelity due to well interleaved windings, and in spite of excessively heavy laminations it works in a large speaker cabinet. All windings are in series for better Z; it acts as an auto-transformer. Windings should have low D.C. resistance and high impedance to audio, impossible in a miniature.

M1—D.C. Meter 5 or 2 mA moving coil is a useful tuning indicator, shows bias, excessive input, optimum distance between coils, etc. etc., but if all resistors are pre-set or fixed, it may be omitted together with C6. If and when required it can be

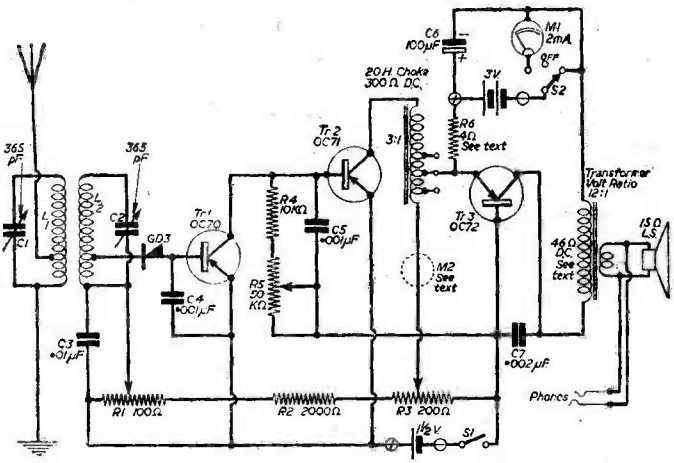


Fig. 1.—Theoretical circuit of the portable.

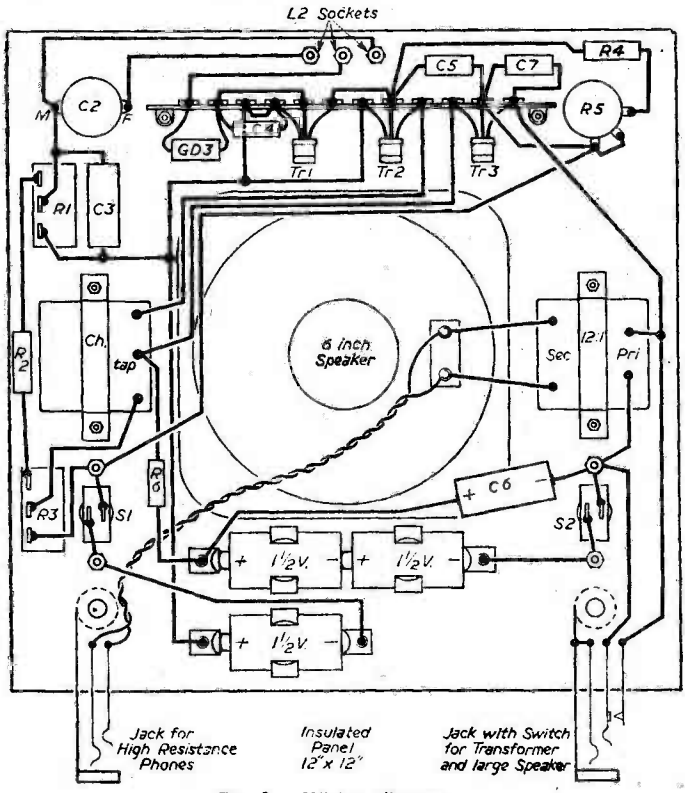


Fig. 2.—Wiring diagram.

connected across an open switch, S1 or S2.

L.S.—The loudspeaker is the most inefficient item. It should be a large moving-coil type for use at home, or a large power horn. The larger the magnet and the freer the cone the better. Small ones are disappointing, so one was ordered specially at extra cost and now lies in the spares box. Six balanced armature earphone inserts are used in preference, as illustration shows. They are held between two panels bolted together with distance tubes.

Batteries may be of any type, 1 to 2½ volt for Tr1 or Tr2 and 3 to 6 volt for Tr3 depending upon type and transformer D.C. resistance. Normal D.C. consumption is less than 3 mA total. Audio peaks take 100 mA with OC72, average is about 12 mA at loud organ, on an A.C. meter.

Construction and Tests

Before buying a box, fix components on a board approximating circuit positions.

L1 and L2—Loop coils are easily made from square sheets of insulating material 1/16in., but thin plywood will do. The 15 radial slots at 24 deg. angles are cut out ⅛in. wide. M.W.185μH coils have 24 turns .036 tinned Cu polythene insulated. The inside diameter is 6½in., outside

(*Continued on page 339*)

TRAWLER BAND R.1155s.—The latest version of this famous Communications Receiver to be released by the Air Ministry. Covers 5 wave ranges : 18.5-7.5 Mc/s, 7.5-3.0 Mc/s, 3.0-1.5 Mc/s, 1.5 Mc/s-600 kc/s, 500-200 kc/s. As used by Coastal Command, Air Sea Rescue Launches, etc. All sets thoroughly tested and in perfect working order before despatch, and on demonstration to callers. Have had only slight use, and are in excellent condition. ONLY **£12.19.6.**

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RF UNITS TYPE 26. For use with the R.1355 or any receiver with a 6.3 v. supply. This is the variable tuning unit which uses 2 valves EF54 and 1 of EC52. Covers 65-50 Mc/s (5-6 metres). Complete with valves, and BRAND NEW IN MAKER'S CARTONS. ONLY **25/-** each.

CLASS D WAVEMETER. Another purchase of this famous crystal-controlled wavemeter which has been repeatedly reviewed and recommended in the "R.S.G.B." Bulletin as being suitable for amateur transmitters. Covers 1.9-8.0 Mc/s, and is complete with 100/1,000 kc/s, crystal, 2 valves ECH35, two 6-volt vibrators and instruction manual. Designed for 6 v. D.C. operation, but simple mod. data for A.C. supplied. BRAND NEW IN MAKER'S TRANSIT CASES. ONLY **£5.19.6.** Transformer for A.C. modification, **7/6.**

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3S4	7/3	12AH8	10/6	DF96	9/6	EL42	10/9
5U4G	7/11	12AT6	8/11	DK96	9/6	EL84	10/3
5Y3GT	7/6	12K7GT		DL96	9/6	EY51	9/6
5Z4G	8/3		8/11	DM70	7/11	EY86	10/3
6AQ5	6/9	12J7G	9/6	EABC80	7/6	EZ80	8/3
6AT6	7/11	12Q7GT	9/3	EB91	6/11	PCF80	9/11
6BA6	7/3	12SJ7	7/11	EBF80	9/-	PCF82	9/11
6BJ6	7/11	12SK7	5/11	EBC41	9/11	PCL83	11/9
6B8G	3/6	12SH7	5/6	ECC81	8/11	PCC84	
6J5M	3/11	14S7	10/6	ECC82	7/6		10/11
6J6	5/11	19AQ5	11/6	ECC83	8/3	PL81	11/3
6K8GT	9/6	25L6GT	8/6	ECC84		PL82	8/11
6SN7	7/11	25Z4G	8/11		10/11	PL83	11/6
6SK7	4/11	35A5	10/6	ECC85	9/-	PY81	8/3
6Q7GT	8/3	35W4	8/11	ECF82	10/11	PY82	8/3
6V6GT	5/11	35Z3	10/3	ECH42	9/11	UBF80	9/3
6X4	6/11	35Z4GT	8/3	ECH81	8/11	UBC41	8/11
6X5GT	7/6	50L6GT	8/6	ECH35	9/-	UL41	9/11
7B7	7/11	954	1/6	ECL80	8/11	UY41	7/11
7C5	7/11	955	3/11	EF80	8/3		
7C6	7/11	956	2/11	EF86	11/6		
7H7	7/11	958	3/11	EF89	9/6		

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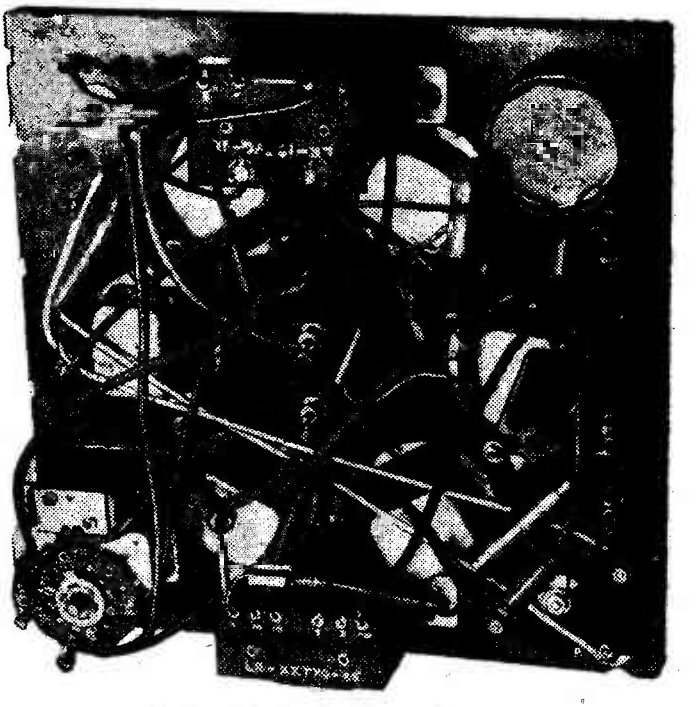
BIET

about 10in. L.W.4500 μH coils 110 turns Litz 9/.003 enamel and silk covered have 7in. inside diameter. But .018 or .022 enamelled wire can be used if slot edges are smoothed round. One shorted turn ruins the coil. S.W. coils have three well-spaced turns of thick wire for 10 to 7 Mc/s. One coil is in the lid of the box and can work in series for 7 to 5 Mc/s or more turns for 5 to 3 Mc/s, etc. These disc coils could be 12in. diameter with advantage. They can be carried like gramophone records, are easy to tap and are definitely more efficient than many loopstick types tried. Make a pair fitted with phone jacks for plugging in and rotating the directional coil. Three turns are self-supporting spaced by Sellotape. Stations come in with just one large turn flat on a table.

Stage 1—Wire up 1st stage. L1 - C1 - L2 - C2 - C3 - R1 - R2 - R3-S1-D-Tr1, not C4 and R3 slider not connected. Select best diode by test with a 3 volt meter in series with a 3 volt battery. Best diode will give highest reading and no movement from zero when connections are reversed. Do not solder diode or transistor leads, use fixed bolts and extra nuts. Test transistor same as diode, d to e, b to c, but e to c should be zero both ways. Connect a pair of 1,000 ohms phones in series with a 5 mA meter in place of R4 and R5 and switch on with R1 slider at plus end, no bias. Tune in a station with aerial and earth as you would have for a crystal set. Note that meter readings rise as a station is tuned in. Over 0.4 mA is too much when Tr2 and Tr3 are used. Do not exceed 1.4 mA. Move away L1 for very weak reception and adjust R1. Now weak stations which could not be heard will come in.

Stage 2.—Wire up stage two, R4-R5-Tr2, not C5. Connect low-resistance 'phones in series with 5 mA meter in place of choke. Fifty ohm balanced armature is best here, or transformer and speaker will do. Test R4 by reducing R5 to zero, meter must not exceed 2.4 mA, change R4 if necessary, or if you use a 2 volt battery. Adjust R5 for 1.6 mA; more will not increase volume. Note that meter readings now drop when a station is tuned in. Readjust R1 at very weak signal and note that too much bias does reduce volume. Optimum distance between coils for selectivity and sensitivity is found by accurately tuning L1 and L2 far apart for very weak reception, and then slowly move L1 closer for peak meter dip. The same applies to small coils closer together.



A view of the underside of the receiver.

Stage 3.—Measure choke D.C. resistance. Max. permissible is measured with a 500 ohms variable resistor in place of choke, and 5 mA meter at points

LIST OF COMPONENTS

C1 and C2—365 $\mu\mu$F variable and dial.
C3—.01 μF moulded plastic.
C4—.001 μF mica.
C5—.001 μF moulded plastic.
C6—50 or 100 μF electrolytic, 25 volt.
C7—.002 μF ceramic.
R1—100 ohm wire-wound variable.
R2—2,000 ohm ½ w. carbon.
R3—200 ohm wire-wound variable.
R4—10,000 ohm ½ w. carbon.
R5—50,000 ohm wire-wound variable.
R6—See text. (500 ohm variable.)
Diode—Germanium, Brimar GD3 or OA70.
Tr1—OC70.
Tr2—OC71 or similar.
Tr3—OC72 or Sylvana ½ w. 2N68 or 2½ w. 2N242 or any between.
Ch. and Trans.—See text. John Bell and Croyden, 117 High Street, Oxford.
Ch. type LR—XXTYQ—85.
Trans. Type LR—TYQ—21 for 15 Ω L.S.
S1—Switch s.p.s.t. any type.
S2—Switch s.p.d.t. with centre OFF.
M1—Meter 2 mA D.C. moving coil.
M2—Meter 5 mA D.C. temporary use.
Battery 1 to 2½ volts, any type.
Battery 3 to 6 volts, any type.
Phones jack and socket, any type.
Panel, Bakelite or equivalent.
Box or carrying case to suit components and personal taste.
L.S.—Loudspeaker, see text.

M2, in series. Connect Tr3 emitter direct to Tr2-C and to 3V plus. Another 5 mA meter is at M1 between S2 and direct to Tr3-collector; no transformer. Set 500 ohms to be *zero* ohms. Wire up Tr3 base, switch on S1 and S2 and adjust R5 and test resistor for both meters to read 1.6 mA. Switch off, remove and measure the test resistance. A choke with a 3 : 1 ratio tap may have less than three times the measured resistance, allowing final adjustment by R3. If a tapped choke is not obtainable use a small mains transformer, all windings in series for desired tap and D.C. resistance. Measure transformer primary D.C. resistance. This D.C. load must be sufficient to limit wattage specified by transistor manufacturers. If an additional load is necessary it is better to put R6 as shown for some D.C. and A.C. feedback. If audio feedback is not wanted the C6 is connected direct to Tr3-E then transformer will give a greater output to L.S. If the transformer has more D.C. resistance than necessary it will waste wattage. With a 3 volt battery and 50 ohms correct load for 45 mW OC72, peak audio will rise to 110 mA and voltage at collector will drop to near zero. A 4 volt battery requires 90 ohms load or 4½ volts—113 ohms for OC72. A 6 volt must have 200 ohms —13 volts—935 ohms is not recommended for OC72. Other type transistors must be safeguarded from overload by calculating safe load to be used. There are two formulæ and the higher resistance of the two must be used as load. 1 : To avoid current overload Icp. ; load equals battery voltage multiplied by peak rating. 2 : To avoid wattage or dissipation rating ; load equals battery voltage squared and divided by four times milliwatt rating.

$$RL \quad \frac{Vc \cdot Vc}{4\ Pcp}$$

This is usually the higher, except when inefficient low voltage is used.

Having selected the choke (less than 400 ohms for other reasons) and transformer, complete all wiring except C4-5-6 and 7 and temporarily add a meter at M2. Set R1, R3, R5 at minimum bias, switch on S1 and S2. Adjust R5 and R3 for both M1 and M2 to read 1.6 mA. Apply D.C. input (L2 shorted) by increasing R1 bias. Write down M2 readings when M1 reads 1.6, 1.4, 1.2, 1.0 and 0.8 mA for use when M2 is removed. Tune in a weak station at low volume and adjust R1 for peak meter readings and best volume. Readjust R5 and R3 for meters again to read 1.6 mA. Remove M2 and finally readjust R3 for M1 to return to 1.6 mA. Do not alter R1 and R3 unless battery or transistor is changed. Use only R5 for reducing bias in due proportions for Tr2 and Tr3. Fidelity is good down to 1 mA on M1 if input is not excessive. Test D-Tr1 sensitive junction by touch with finger ; L.S. will shriek. Connect C7 test and note improvement. Repeat after connecting C5, then C4. If C4 or C5 increases L.S. noise remove it. Keep D-Tr1 away from other components in the final assembly in the box.

If output is matched to speaker M1 will give a steady reading (C6 disconnected). If there are too many turns for LS, M1 will kick up on louder sounds and output will sound muffled. If there are too few turns M1 dips and output is crisper but harsh. Meter movements due to loud percussion sounds are ignored. Somewhat the same applies to match between choke and Tr3 by watching M1 and M2. Excessive inputs cause meter flutter up and down. Do not match up with too much volume or input. Correct input produces a drop of 0.3 mA on M1 and OC72. 2½ watt type will take a bigger drop, with more bias to Tr2. Correct input will produce maximum watts with no distortion. Everybody who has heard this receiver remarked on its excellent fidelity and no background noise. Connect up C6 to complete circuit.

After tests the selected components should be housed in a suitable case. Layout and wiring may differ much with equally good results. Illustration shows a switch too complicated for details with wires to all parts, yet receiver works well. This switch enables author to test and compare several speakers with or without meter, etc., with the object of finding a good one for another portable.

TAPE RECORDER MAINTENANCE

(Continued from page 302)

While still on the amplifier system, weak playback can be traced fairly easily, as the erase and bias circuits are switched out and we are actually left with a Hi gain amplifier, which consists of nothing more than any amplifier, and it is usually due to faulty valves or components.

The next problem is to avoid wow. This is the wavering of the reproduction, and if recording is made on a recorder suffering from wow it will sound much worse when played back on the same recorder. This wow is due to many little things, e.g., friction, belts needing renewing (where used), oil on tape guides or capstan drive, capstan running slightly eccentric, tape pressure wrongly adjusted, faulty braking system or recording speed too slow.

These faults again can easily be traced. For music the maximum speed must be used to avoid the wow, e.g., 15in./sec. or 7½in./sec. For speech any of the slower speeds will be sufficient and therefore we have longer playing time. We have another cause of wow as in Fig. 2. In this case the ballbearing at the bottom of the shaft wears the spindle to a concave ; therefore we have more surface area and the thrust is not taken up as it should be. The solution in this case is either to grind or file the spindle flat and to adjust the thrust by the thrust screw.

An endless loop can be easily made for the purpose of testing any recorder by joining about 21in. of tape with adhesive and laying in the heads and around the spools. This is useful for tests, as it is automatically erased as it passes the heads. Another gimmick is where a second recording can be superimposed on an already recorded tape, to get the "Les Paul Effect," or where music is recorded and speech can be superimposed on top of this, so that we get music and speech the same time. The method of this is to record the first part, then to remove the pressure on the erase head pad, so that the tape does not come into contact with the erase head. We can then use the erase head to feed a separate low gain amplifier which feeds earphones for monitoring. When we allow for the difference in the distance between the heads we can record on top of the first recording.

The deck can also be fitted to give announcements by fitting two tape guides on the case of the recorder and to run an endless loop around the case. This gives a verbal announcement to last up to 11 minutes—this has been used for exhibitions.

Radio and Automation

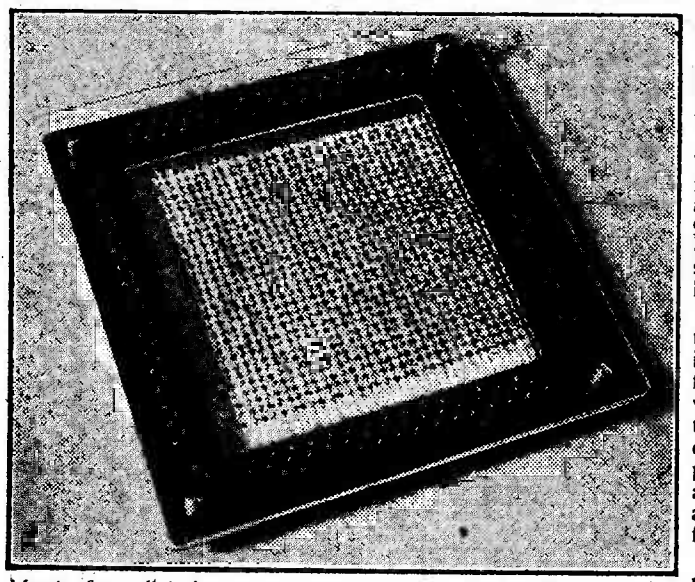
RADIO APPARATUS IS FINDING INCREASING USE IN MODERN COMMERCIAL PRACTICE. SOME DETAILS ARE GIVEN HERE

By F. E. Sonn

IT is due to the discovery of the valve that automation, as we know it to-day, is possible, so it is perhaps essential that the method by which this occurred should be stated.

The valve was discovered by Edison who, whilst carrying out experiments with carbon filament lamps, had noticed that they became black very rapidly. To effect a cure for this fault he sealed a metal plate inside the bulb and found that if he connected this plate to a positive potential, current flowed through the valve from filament to this plate, but only if the plate was positive with reference to the filament. This led to investigation of this phenomenon, and it was found that the filament when heated gave off electrons that were attracted to the positive plate.

Nothing was done about this for a while until Dr. Fleming realised that here was a method of receiving radio signals. Thus was the birth of the diode or two-electrode valve.



Matrix for a digital computer, as shown at the Automation exhibition.

A few years later an American, Lee de Forest, introduced a third electrode, called a grid, between filament and plate, and it was found that at last here was the true valve, for experiments showed that a very small signal or change of voltage applied to this grid caused large changes of current between filament and anode. Also, these changes of current, if transformed to change of voltage, are identical in form with the very small voltage change or signal applied to the grid, but greatly amplified.

Here, then, was a means of controlling large forces with a very small input, but no action was taken for a few years, as nobody realised that fact, and only considered the valve as a means of receiving radio signals.

However, during the years of war much time was spent in research on electronics, as this side of electrical engineering was known. This research work resulted in combining valves with other circuit elements so that they performed specific functions. This was really the beginning of automation and, in fact, the valve had at last come into its own.

Little Inertia

Now a valve has little or no electrical inertia and therefore can alter its working very rapidly indeed, in fact at the order of a millionth of a second. Also, as only a very small input voltage is required, with negligible power and with several valves in an amplifier circuit, this small input can be raised to a high level, with the result that a very small part of a watt is able to switch, by means of suitable relays, thousands of watts and thus control large machines.

Automation has now reached a point where production, inspection, packaging, etc., can be effected automatically without the human element.

Is there any advantage in this? The answer is "Yes," for it has been found that automation means a great saving in time, and cost, and conserves valuable labour, besides bringing in a degree of efficiency, standardisation and precision hitherto unattainable.

Now it is not to be considered that amplifying a small input voltage is the only function a valve performs in automation. A valve is a very versatile component and is able to rectify, frequency multiply or divide, phase discriminate, produce pulses of variable duration and amplitude, oscillate, act as a trigger, and in fact do many complex functions at phenomenal speed.

If, therefore, we select valves to perform any of the above effects and combine them with the necessary suitable circuits we have a means of effecting any of the desired effects, in the output stage.

In this output stage the electrical energy is converted into mechanical energy which generally consists of electrically-controlled equipment, such as relays, which, although using small power to operate, are able to control many kilowatts of power.

Transistors in Automation

Although the transistor is still in its very early stages of progress, it is already being used to perform certain functions of valves in automation. Now although the transistor has many properties in common with valves, it cannot be used to replace them indiscriminately. The transistor has its own special properties for some applications, but in other cases the valve has no alternative.

Let us consider the advantages and disadvantages of a transistor.

Transistors are basically amplifiers, where a small amount of power applied to the input can control the release of a much larger amount of power from the battery. In this they do not differ from the valve, but they are able to work at much lower power levels than the valve, due to the fact that the valve requires filament current.

The main advantages of the transistor over the valve are that they consume very little power and require only one low voltage supply. They are light and small, are inherently robust and able to withstand reasonable mechanical shocks. They are instantaneous in action, not requiring any warming up period, and should have a very long life. They do not suffer from microphony and hum and when used at low signal levels their input impedance makes them free from electrostatic pickup and similar effects. Their low voltage of operation removes all hazards of electric shock.

It can be thus seen, from the foregoing advantages over the valve, that the transistor is ideally suitable in many fields of automation.

In the electronic computer and other machines used in business of this type, the transistor offers a large reduction in the size of the machine and a substantial reduction in power consumption. This latter can, in some cases, rise to the remarkable figure of 99.5 per cent. reduction of input power required. In addition, since the transistor has no heater or filament, it does not suddenly cease to function halfway between calculations.

The transistor has also made portable machines and test gear really portable.

Limitations of Transistors

At the present moment it has not been found possible to make a transistor operate at high radio frequencies. Up to the present about 20 megacycles is the limit.

Transistors have also their maximum temperature of operation. Germanium types operate easily up to an ambient temperature of about 45 deg. C. to 55 deg. C., but may in the future go as high as 65 deg. C.

The new transistor material, silicon, should extend the ambient temperature range to 100 deg. C., but, at the moment of writing, they are very difficult to make and consequently very expensive.

Besides the ordinary function transistor, there are many more semi-conducting devices capable of amplifying, switching or rectifying electric currents. Photo-transistors capable of giving enough current to close or open a relay when exposed to a light beam are now being used, especially in counting objects on a moving belt, for quality control and inspection of finished parts, or to check whether flasks or bottles are full or empty.

Both germanium and silicon rectifiers are being used in battery chargers, power supplies for machinery, and offer serious competition to the selenium types. Again silicon diodes are now being used to provide high stability reference voltage sources for automatic control in many industial processes.

Automatic Control

Consider a synchronous electric clock motor which follows with precision the motion of the generator in the power house which, by this means, controls remotely the hands of the clock. Should the hands vary, then an error signal could be sent which could correct them. This error signal is the method employed in automation. One can say that the device looks at the goal, takes action to approach it more closely, checks the result, and issues further instructions.

In one application, the output temperature of a fluid being heated is compared with the standard temperature and the error or difference is fed back by some form of data processing device, which in turn issues a control signal sufficient to operate the valve controlling the heat input.

(To be continued)

Two New Transistors

R.C.A. (England) announce two new transistors. They are the 2N301 and 2N301-A and are hermetically sealed alloy-junction power transistors of the p-n-p type. They are designed specifically for use in class A single-ended and in class B push-pull of power output stages of automobile radio receivers and military or commercial communications equipment. The 2N301-A differs from the 2N301 only in that it has a higher maximum D.C. and peak collector-to-base voltage rating, and is intended for use in those military and commercial applications requiring such high voltages.

In class A amplifier service at an ambient temperature of 55 deg. C. and with a zero-signal collector dissipation of only 5.4 watts, the 2N301 or 2N301-A can deliver a maximum-signal power output of approximately 2.7 watts with a power gain of 32.5 db. In class B push-pull service under the same ambient temperature conditions, but with a collector dissipation per transistor of only 3 watts, two 2N301's or 2N301-A's can deliver a maximum-signal power output of approximately 12 watts with a power gain of 30 db.

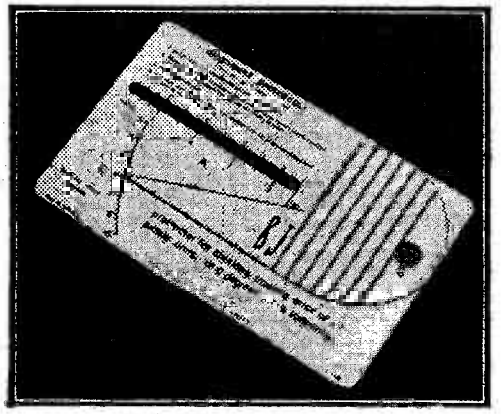
The design of the 2N301 and 2N301-A utilises a special mount structure in which the collector is electrically and thermally connected to a mounting flange. This mounting arrangement provides for good electrical contact and excellent transfer of heat from the transistor junctions to the heat sink. The base pin and the emitter pin are positioned off-centre with reference to the mounting holes to ensure proper indexing.

The 2N301 and 2N301-A feature an exceptionally high large-signal D.C. current transfer ratio of 70 which is approximately linear to 2 amperes. This excellent current-gain linearity over the full range of the collector current helps to minimise distortion in applications requiring high power outputs at low supply voltages. The collector saturation current of less than 50 microamperes at a D.C. collector-to-base voltage of 0.5 volt ensures good operating stability under conditions of varying ambient temperatures. These features in addition to low leakage currents, high alpha-cutoff frequency, excellent uniformity of characteristics, and a maximum transistor dissipation of 12 watts at a mounting-flange temperature of 55 deg. C., all contribute to the dependable performance of these transistors in audio-frequency power applications.

News from the Trade

B.-J. ALIGNMENT PROTRACTOR

MANY otherwise good gramophone record reproducers are spoilt by having the pick-up arm wrongly positioned. It is realised, of course, that the pick-up must be placed in such a position that the sideways movement of the needle caused by the modulated grooves in the record should be at all positions a true right-angle action, but if the needle is placed at the beginning, the end and in the centre of the grooved portion of a disc it will often be found that the position changes from one point to another. Any movement which is not at right-angles may damage the pick-up or the disc (dependent upon the type of pick-up which is used), or at least will not transfer to the amplifier a true reproduction of what is on the disc. Hitherto it has not been a simple



B.-J. Alignment Protractor.

matter to mount a carrier arm correctly or to check an existing installation, and Messrs. Burne-Jones, makers of the well known B.-J. arm, have now produced the protractor illustrated above, which enables one to check very quickly the tracking error at any position. The slot is simply placed over the spindle and the instrument slid along to the point from where checking is to be carried out and the needle then placed in hole B. The top portion of the protractor is then turned with the finger tip in hole C until the ruled lines are parallel with the pick-up head and the error is shown on the scale at D. The protractor, in stout Perspex sheet, may be obtained for 7s. 6d. from Messrs. Burne-Jones at Sunningdale Road, Cheam, Surrey.

SELLOTAPE'S NEW POLYTHENE ELECTRICAL TAPE

A RECENT addition to the range of Sellotape self-adhesive tape products is polythene electrical tape.

The tape, with a tensile strength of 16 lbs. per in. width, has been developed with a number of new special characteristics to provide a reliable, waterproof insulating tape, with enough elasticity to enable it to conform closely to surfaces and ensure a tight seal. Its elongation at breaking point is 175 per cent.

Good ageing properties are provided by an adhesive which is immune from corrosive effects. Plasticiser migration from the tape is eliminated by the absence of plasticisers in the polythene film.

The tape, which has an insulation resistance of 5,000,000 megohms and a dielectric strength of 13,300 volts, is available in red, black, blue, green, yellow and white rolls of 25 yards. Widths are ½in., ¾in. and 1in., and increasing widths at ¼in. intervals.

It is marketed by the Industrial Sellotape Division of Gordon & Gotch, Ltd., 8-10, Paul Street, London, E.C.2.

AR88 INSTRUCTION BOOKS

NEW instruction books are just off the press on the popular RCA AR88 and AR88LF general purpose communication receivers.

These two new publications are of a most comprehensive nature and include full maintenance, installation and performance data. They are only available direct from RCA Great Britain Ltd., at Lincoln Way, Windmill Road, Sunbury-on-Thames, price 27s. 6d., post free.

LOW-MICROPHONY PENTODE FOR A.C./D.C. AUDIO EQUIPMENT

A NEW addition to the Mullard range of 100 mA. A.C./D.C. valves opens up important possibilities for the design of high quality audio amplifiers for A.C./D.C. operation.

Until now, lack of a suitable low-noise pentode for the pre-amplifier or mixer stages of high-gain amplifiers has made really low hum and microphony levels difficult of achievement in A.C./D.C. equipments.

The UF86, which has just been announced by Mullard, is a low-hum, low-microphony pentode with a heater rating of 12.6 volts at 100 mA. Its characteristics are virtually identical with those of the well established World Series pentode type EF86. Used in circuit with other Mullard 100 mA. valves it makes possible the design of compact, economical A.C./D.C. equipments having signal-to-noise ratios approaching those of the best A.C. equipments.

For example, a UF86 feeding two UCL82 triode-pentodes, and with a UY85 half-wave rectifier, would form the basis of an inexpensive push-pull amplifier giving a sensitivity of 10 mV. for 7 watts output at a low distortion level, and a signal-to-noise ratio of 55 db.

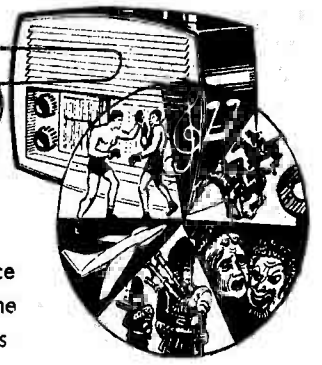
The UF86 is available for immediate delivery. Mullard, Ltd., Mullard House, Torrington Place, London, W.C.1.

NEW ELECTRAN TRANSFORMER

THIS new transformer has been designed specifically for use with the modern television set, incorporating V.H.F. receiver. It is a 1 : 1 output transformer suitable for installation in the set as an isolator, in conjunction with an external loudspeaker. It has been designed and vacuum impregnated for full mains insulation between windings, to obviate the danger of shock on the external circuit.

The catalogue No. is SOP.6, and the list price is 15s. 8d. The usual trade terms apply.—Electran Coil Winding & Transformer Co. Ltd., Lichfield Road, Aston, Birmingham, 6.

Programme Pointers



Our Critic, Maurice Reeve, Reviews Some Recent Programmes

AS Aeschylus's great drama of man's struggle against the forces of tyranny and dictatorship —"Prometheus Bound"—proceeded on its way (in the last of the Monday evening "Against the Wind" series of plays), the BBC's "effects" department unleashed a battery of noise-producing weapons which were truly astonishing in their variety and comprehension. As, metaphorically speaking, we turned up our coat collars and slammed the doors to, we were assailed with howlings and rushings that alternately reminded us of work on the Dartford-Purfleet tunnel, a jet coming into London Airport and a dog pleading for mercy on the Great West Road.

The drama itself was majestically unfolded by Malcolm Keen, Leon Quartermain, June Tobin, Trevor Martin, Brewster Mason and Ralph Truman, produced by Val Gielgud.

Another strikingly rendered classic—this time unaccompanied—was Strindberg's grim play, "The Father." Jack Hawkins as the husband whose belief in the paternity of his own daughter is sapped and destroyed by his wife until he is driven mad: and Googie Withers as the dominating wife, were quite terrific. This was on the Third.

Another "Third" item of much interest was "The Trial of 'Madame Bovary'." Flaubert's famous novel of that name. Read by millions today without a qualm, it caused, apparently, far more stir when written in 1857 than, say, "Forever Amber" did in our own day. The arguments as to what constitutes a "moral" or an "immoral" book were fascinating and entertaining. It was well acted by Robert Baldick, Anthony Jacobs, Denis McCarthy, John Glyn-Jones and Russell Napier. It was by Robert Baldrick.

The "Third"

So the "Third" has not been actually sentenced to death, but, Samson-like, shorn of its locks. And, talking of death decrees, I am reminded of the capital punishment abolition Bill which, after passing the House on a free vote, was eventually torpedoed, leaving certain qualifications for a speedier departure from this "wail of tears" than is usual—fewer than hitherto, but some, nevertheless. It is, presumably, to be shorn of its most "thirdy" items, and extended where the exigencies of full-length opera, etc., compel. The new workings have met with a good deal of criticism in the press; it remains to be seen how they will react on public opinion.

The last instalment of "Askey Galore" I listened to didn't strike me as being excessively funny. It was largely based on the strikes of a few weeks back, entirely topical and at the expense and good names of the participants. Consequently, it was completely ephemeral. Unlike Itma and an occasional number of "Take It From Here," "Askey Galore" fails to deal with the foibles and frailties of everyday people and things as they are met with on our daily rounds, and which make the salt of real humour.

Music

It is a far cry from "Askey Galore" to Mozart Galore—with Mozart's music of course. The "Third" had an interesting 45 minutes on "Mozart and his Critics" devised and well narrated by A. Hyatt King. It comprised opinions of his music by musicians and men of letters extending from his own to the present day together with three or four excerpts from his works. One wonders whether this is the kind of item which will be squeezed out under the new régime?

Another "Third" *chef d'œuvre* was three programmes of Palestrina's choral music, beautiful stuff sung by the BBC Midland Chorus conducted by John Lowe.

Plays

"The Hoffmann Episode" made an exciting and well constructed play about a miscarriage of justice in Germany under the Allied Control Commission just after the war and the conscience of one British Intelligence Officer. Confession is obtained that a certain character, a musician, is living under an alias. To obtain this, and against his false plea that he is ignorant of music, a piece of classical stuff is played with a deliberate mistake in it. He spots it at once. This scene was very contrived; we knew exactly what was going to happen from the very first note.

It is a pity that, as I write, the resuscitation of "Dr. Morelle's" cases should coincide, on the Light, with "My Word" on the Home. Both are good entertainment, more especially the latter, and therefore regrettable that a choice has to be made between them.

The first of the Doctor's new series largely concerned Miss Frayle getting her job back with him (she apparently had left his service when the last case books closed). It is inconceivable that, in real life, such a charming, "frayle" person should be fascinated by a tycoon seemingly devoid of all chivalry and likeable qualities such as the Doctor is made out to be in these sketches. But women were ever incalculable creatures, and these portraits, admirably played by Cecil Parker and Sheila Sim, make amusing and restful evening entertainment.

The late Ernest Bevin formed the subject of a full hour's "Candid Portrait," based on recollections of men and women who knew him as van driver, Trades Union leader, Minister of Labour and Foreign Secretary.

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

Early Tape Recording

SIR,—In a recent edition of your journal I read an article on tape recording and the general opinion seems to be that the first system used was the Blattnerphone system—developed by Dr. Stillé. I am not at all sure of dates when the Blattnerphone system was first used, but I have in mind somewhere in the 1930s. Actually, this type of recording is much older than that and I have some very old books edited by Rankin Kennedy that appear to have been reprinted in 1913 in which a system of magnetic recording on a wire is described and also illustrated. The inventor was a Mr. Poulsen. The build-up is similar to the tape recorder but, of course, the radio valve had not been developed at that time and the actual magnetising of the wire was via microphone and solenoid. Anyway, it worked.—W. A. STEELE (Smethwick).

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

Earliest Licence?

SIR,—In your early editions of PRACTICAL WIRELESS for this year, you made a comment on the early Wireless Amateur's Licence. Having seen no comment in your columns I am curious to know if any of your readers can beat my licence date, which was granted to me by the London Postmaster General on December 16th, 1905.

At that time there were restrictions in force, as your instrument was only for experimental purposes and no outside aerial was allowed.—J. W. BROOKS (Norwich).

An F.M. Tuner

SIR,—In making an F.M. tuner according to the very clear and practical articles by "Mark Time," I am trying out a modification which may make it more suitable for those who live in fringe areas or have heavy ignition interference to cope with.

A small (2in. x 2in.) chassis is added at the R.F. end, and on this are mounted V1 and the aerial coil. The latter is *not* wound on an I.F.T. core, but on a new ½in. former with dust core, and its own screening can. Thus three of the original I.F.Ts are left, and two I.F. stages can be used to give extra sensitivity: or the second I.F. valve can be connected as a limiter, two limiters in series giving better suppressionof interference.

This arrangement has the advantage that, if the unit is bought with valves, all the valves are used—R.F. EF91, mixer EF91, first and second I.F. EF92, limiter EF91, detector EB91. Probably a single EF92 as I.F. would not give enough gain, but two will certainly give more gain than a single EF91.

In the original circuit the negative bias at the grid of the limiter is used to provide A.V.C. for the R.F. valve. I propose to see whether there is enough voltage available to operate a "magic eye" (tuning indicator. Has any other reader tried this?—B. POOLE (Hitchin).

SIR,—I would like to thank you and your contributor for the article on making an F.M. tuner from a surplus I.F. strip, which appeared in the last two issues of PRACTICAL WIRELESS. I followed the instructions precisely without deviation. Aligning took 10 minutes and I got all three Sutton Coldfield stations within five minutes of plugging in the aerial. The sensitivity and gain are excellent and I get Wrotham with little loss of quality though rather faintly, of course. It is an excellent unit and I am thoroughly pleased with it. I am situated, by the way, some 13 miles from the local transmitter, and use an indoor dipole.—PETER GRANTHAM (Birmingham).

Replacing the Line-cord

SIR,—With reference to the article "Replacing the Line-cord" (page 189, May, PRACTICAL WIRELESS), the following will probably be of interest.

One can have a little mains autotransformer wound for less than £1 to supply the valve heaters in series, thus making it unnecessary to change the output and rectifier valves, and having a tapping to supply the dial bulb(s) separately. I recently had one made for a small 5-valve set. It has the usual mains tappings (200-230-250 v.), a tapping at 69 v. 0.3 amp. for the valve heaters (three 6.3 v. and two 25 v. valves in series), and another at 12 v. 0.3 amp. for two 6 v. dial bulbs in series.

If it is decided to drop the H.T. to the correct voltage by fitting a resistor in the anode lead of the rectifier, the following interesting effect should be taken into account. Any appreciable resistance in the anode circuit of the rectifier produces a voltage drop across the valve itself, and the higher the resistance the greater the drop. As an extreme example, I came across a set with a 2,200-ohm resistor in the rectifier anode circuit which dropped the 240 v. A.C. mains to 150 v. on the anode, but at the rectifier cathode the D.C. voltage was only 40! The reservoir capacitor was in order and replacing the rectifier with either of two others gave just the same result. Tapping the H.T. into the line-cord reduced the voltage drop across the rectifier to 30 (there was still about 280 ohms in circuit), giving at

the cathode 110 v. at 73 mA (a parallel fed energised speaker was used). So the voltage should be checked at the rectifier cathode rather than at the anode.

If a line-cord or dropper is used it is wise to fit a "Brimistor" (connected between the line-cord or dropper and the rectifier heater) as this completely eliminates the switching-on surge, which is so damaging, especially to dial bulbs. Valve heaters have a lower resistance when cold and therefore pass more current, but a "Brimistor," on the other hand, is a special resistor that has a very high resistance when cold and this falls to a low value as it warms up. Type CZ1 (1¼in. long) should be used for 0.3 amp. heaters, its resistance when hot at this current being 44 ohms, and this may need to be deducted from the line-cord or dropper. Type CZ2 (¾in. long) is best for lower currents, as there is less delay after switching on; for currents of 0.1, 0.15 and 0.2 amp. it has a resistance when hot of 170, 90 and 66 ohms, respectively. I usually fit the "Brimistor" on a small tagboard mounted on top of the chassis because of the heat, and at least ½in. of wire should be left between the body and the tags for the same reason.

In some cases it is a good idea to put the dial bulb (with or without a shunt resistor, depending on current) in series with the mains switch and chassis, as the H.T. current flowing through it makes it brighter after the valve heaters have warmed up. A low-current bulb connected across one of the valve heaters may sometimes be used.—R. V. GOODE (Isle of Wight).

Sound Reproduction

SIR,—I cannot let pass unchallenged the statement by your correspondent, P. Sharp (N.14), in the May issue of PRACTICAL WIRELESS, that "The so-called 'Bass' response of pre-war sets was due to deliberate resonance at 150 c/s the lowest frequency these sets could handle."

It might have applied to table models, but the larger sets, No! In fact, the larger loudspeakers had a natural resonance of around 70 c/s and some 50 c/s in the lower register, and there has been no appreciable progress in the loudspeaker lower register since.

I am not including bass-chambers and specialised labyrinths, etc., which are in a different category and expensive.—J. FELLOWS (Exeter).

Midget Receivers

SIR,—The subject of midget radio receivers is one which interests me greatly and one to which I have given both time and thought. Being also a "quality" enthusiast, it is the reconciliation of this with sub-miniature dimensions which I find particularly intriguing and I only wish I had more time to devote to this fascinating sideline to a fascinating hobby.

You only recently published a detailed article of mine dealing with the conversion of a hearing aid into a miniature receiver. This article was based on work done in this field last summer, since which time I have managed to produce a smaller and more compact receiver on similar lines.

I have always contended that where music is concerned it is not possible to obtain satisfactory quality from very small speakers and I personally advocate and always use 'phones. At least this prevents one being a nuisance to others in public places not wishing to share the programme! 'Phones which are specially matched to the output impedances of hearing-aid valves are capable of giving a very high standard of quality. The bass response is unexpectedly good and the upper frequencies and transients are reproduced with a quite remarkable clarity, unobtainable except with the elaborate speaker systems of modern high-fidelity equipment which would hardly fit into the pocket! The important factor (besides correct matching) is, as I have pointed out in my article, to get a good airtight connection with the ear, for only in this way can a proper bass response be obtained with 'phones. I use two hearing-aid earpieces in series. Incidentally, with a good aerial signal I can make my little set drive a 12in. speaker! (The power rating of a DL66 is 2.7 mW, with 10 per cent. distortion.)

Originally I considered making a very small power pack to eliminate the H.T. battery, but I am now quite convinced that this is absolutely unnecessary as the specific batteries for this type of equipment are very small, very cheap and have an exceptionally long life. (Nearly 300 hours of intermittent listening for 22.5 volts at 300μA, the cost being 2/6.) The one I am now using was purchased in July, 1955, and has had intermittent use ever since, including some long periods of daily use for an average of half to one hour at a stretch (during lunch hours, etc.) and I have been carrying round a spare for over nine months! For the L.T. an ordinary 3d. pen-torch cell will serve, but tends to run out suddenly after a rather short life and the Vidor Kalium cell is preferable in every way, being 1.3 volts for the 1.25 volt filaments.

I hope you will agree that this little set does comply with most of your criteria. The set itself could easily be carried in one's pocket, unnoticed, the cost of power supplies is almost negligible and the longevity of the H.T. battery is almost unbelievable. The musical quality is excellent and leaves little to be desired (except possibly in loud orchestral passages, but even then the distortion is no worse than on most domestic receivers).

Before concluding, I feel the subject of the Rx BC-1206 is relevant when considering small equipment. Originally this little receiver consisted of a complete five-stage superhet circuit, comprising six valves (the two output valves were wired in parallel). The valves were *ordinary international octals* of the GT or metal series, and there is a three-gang tuning condenser a delight to see for its minute size, complete with slow-motion drive. The size of the complete receiver is 4¼in. x 4¼in. x 5½in.! The entire thing worked off 28 volts D.C. for both H.T. and heaters. (The latter 6.3 volts being wired in series.) It is not an insuperable task to convert this set to work off a normal 250 volts H.T. and 6.3 volt heaters.—MICHAEL J. DUNN (Cambridge).

Correspondents Wanted

SIR,—I shall appreciate very much to correspond with experimenters, technicians and amateurs.—KHWAJA MAQBOOL HASAN, III/C, 8/7, Nazimabad, Karachi-16 (Pakistan).

SIR,—Would anyone, with the time and energy, correspond with me? I am *most* interested in every aspect of radio construction and operation.—A. BARKER, 5, Glenthorne Ave., Brickfields, Worcester.

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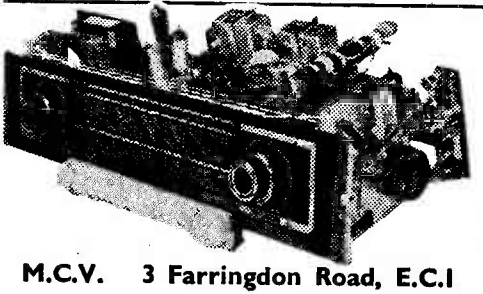

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