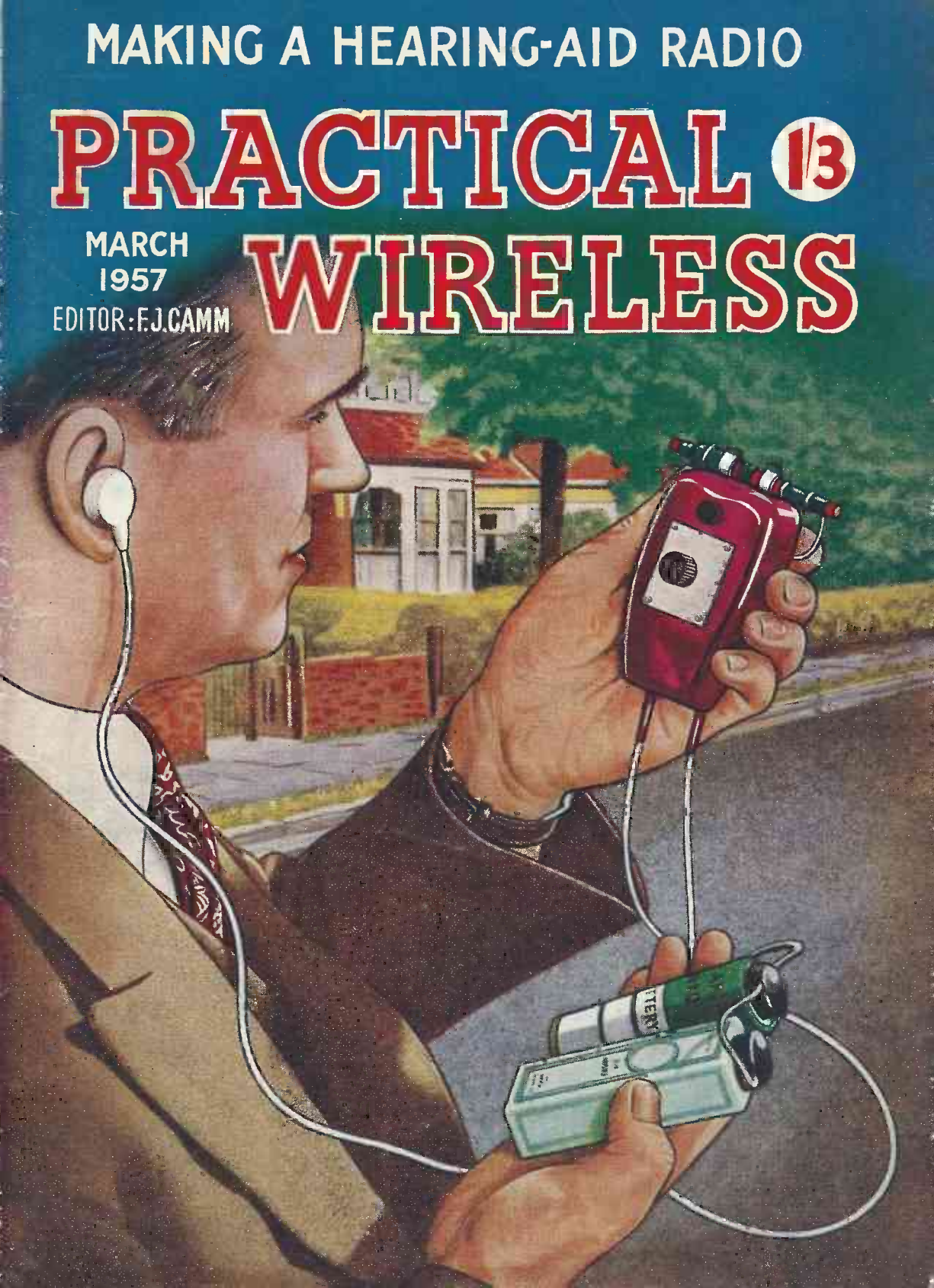
MAKING A HEARING-AID RADIO

PRACTICAL WIRELESS

1/3

MARCH
1957

EDITOR: F.J.CAMM



URS FOR 30 - DOWN

MULLARD AMPLIFIER "510"

A Quality Amplifier designed by Mullard. Power output exceeds 10 watts. Frequency response almost flat from 10 to 20,000 C.P.S. For use with the Acos "Hi G" and other good pick-ups. Made up and ready to work is **£12/10/-** or **£1/10/-** down and 6 payments of **£1/10/-**, plus 10/- carriage and insurance.

W.D. CIRCUIT DETAILS

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

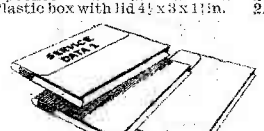
American Service	
Sheets	R.109
A.1134	78 receiver
BC.348	76 receiver
BC.312	R28/ARC5
R.103A	R1116/A
BC.342	RA-1B
RA-1B	AR88D
R-208	AN/APA-1
R-1155	78
R-1124A	76
R-1132A R-1481	R.T.18
R-1147	CAY-46-AAM-RADAR
R-1224A	A.S.B.-3
R-1082	Indicator 62A
R-1355	Indicator A.S.B.3
B.C.1206-A.B.	Indicator 62
B-455-A (or -B)	Indicator 61K
B-454-A (or -B)	R.F. unit 24
B-453-A (or -B)	R.F. unit 25
Transmitter T1154	R.F. unit 26
Fifty-eight walkie talkie	R.F. unit 27
Frequency meter B.C. 221	Wireless set No.19
	Demobbed valves

MINIATURE COMPONENTS

for transistor sets, deaf aids, etc.

Made by Fortiphone and other famous firms.

Intervalve transformer, N22 ...	10/-
Intervalve transformer, N23 ...	10/-
Push pull input transformer, A203	15/6
Push pull output transformer, A204	15/6
Earphone Type "L" 250 ohm ...	18/-
Plastic eartip	2/9
Tinsel flex and Plug for earphone	5/-
Slide switch ref. SW5	4/-
Pots with switch ½ meg.... ...	2/-
Very small resistors, many values	6d.
Very small condensers, prices from	6d.
Tinsel leads without plugs	6d.
Deaf aid cases with clip for pocket	2/6
Plastic box with lid 4½ x 3 x 1¼in.	2/6



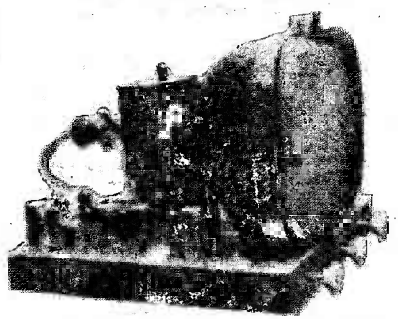
SERVICE DATA

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

INSERT MICROPHONE

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

THE UNI—T.V.



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

- ★ Made up units if required.
- ★ All miniature valves.
- ★ Metal rectifier.
- ★ No expensive transformers.
- ★ 13-channel circuitry.
- ★ Multi-vibrator time bases.
- ★ Ferruxcube, E.H.T. and scan coils.
- ★ 34/38 Mc/s I.F.
- ★ Suitable for any modern 12, 14 or 17in. tube.
- ★ Modern contemporary cabinet if required.

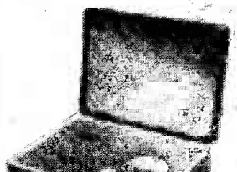
The building cost (less tube) is only **£31/10/0**, plus 10/- carriage and insurance. All parts guaranteed 12 months. **Full information and data, price 3/6.**

FREE THIS MONTH

To all "Practical Wireless" Readers who send S.A.E. we will present free a copy of our booklet:

MAKING AN ELECTRIC BLANKET

The "CRISPIAN" Portable Radio



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

5-VALVE SUPERHET

Yours for only £1 down

Chassis size approx. 9½ x 7½ x 8½ in. First-class components. A.C. mains operation. Three waves (medium and two shorts). Complete with five valves, ready to work. New and unused. Cash price **£5.19.6** or £1 down and 6 payments of **£1** (carr. and ins. 7/-).

TELETRON COILS

Customers please note that all our branches carry good stocks of Teletron components.

Wrap our heater cable around the pipes in your loft to prevent a freeze up.

Minor pack 14 yards, £1.

Major pack 21 yards, £1 10 -.

DON'T BE CAUGHT LIKE THIS

CAR STARTER CHARGER KIT

All parts to build 6 and 12-volt charger which can be connected to a "flat" battery and will enable the car to be started instantly. Kit comprising the following.

Mains transformer	22 6
5-amp rectifier	17 6
Regulator Stud Switch	3 6
Resistance Wire	2 -
Resistance Former	2 6
Mains on/off Switch.	2 6
0-5 am. Moving Coil Meter ...	12 6
Constructional Data	1 6

or if bought all together price is **62 6**, plus 2/6 post and packing.

THIS MONTH'S SNIP

Midget ceramic condensers, tubular wire ended. 2,000 pf. 5/- per doz. 500 pf. 4/6 per doz. 1,000 pf., lead through ceramics, 8/- per doz. All post free. Special quote for 1,000 lots.

TRANSISTORS

Red spot replaces Mullard OC71, etc., **10/-**. Blue spot suitable R.F. up to 1.6 Mc/s, **15/-** each.

Mullard OC71 **20 -**

Mullard OC72 **30 -**

METER MOTORS

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

MULTI-METER KIT

Parts suitable for making a multi-meter to measure volts, milliamps and ohms. Kit comprising all the essential items including moving-coil meter, resistors, range selector, calibrated scale, etc., etc., is only **15/-**, plus 1/- post and packing.

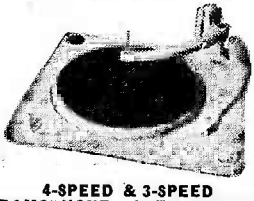
HUGE MINISTRY PURCHASE

R.1155—yours for £2 down

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

Carr. & transit case 15/- *ex.*

SENT FOR £1.10.0 DOWN



4-SPEED & 3-SPEED GRAMOPHONE AUTO-CHANGER

Latest types by all famous makers are invariably in stock at competitive prices. B.S.R. Monarch, Garrard, etc. Latest models from **£3/10/-** or deposit **£1/10/-** and 8 payments of **£1**, plus 5/- carriage and insurance.

FLUORESCENT LIGHTS

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

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

Twin 20. Uses 2 20-watt standard tubes. Price **29/6** less tubes. Carriage and ins. 4/6.

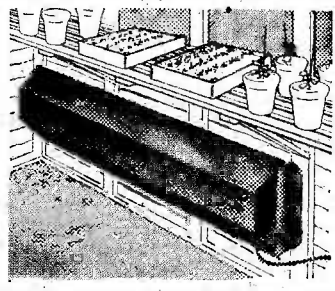
CONNECTING WIRE

P.V.C. covered in 100ft. coils—2/9 a coil, or four coils different colours, **10/-** post free.

12in. T.V. CABINET—15/-

We are offering these at not much more than the cost of the plywood they contain. If not wanted for TV, many useful items can be made — record storage cabinet, H.F. loudspeaker case, book case, etc., etc. Price **15/-**, carriage 3/6.

GREENHOUSE CONVECTOR HEATER



Practical Convector heater 1 kW, 4ft. long, made from heavy gauge sheet steel (galvanised). Can be used for any size house; up to three heaters can be controlled by one thermostat. **GUARANTEED FOR FIVE YEARS.**

Price **£2/10/-** or with thermostat **£4/5/-** carriage 5/-. Soil heaters and other gardening devices available.

Send for Horticultural List.

T.V. Commercialising Outfit

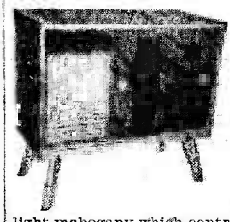
Do it yourself—it's really quite easy. You will manage it in an evening and we guarantee

SUCCESSFUL RESULTS OR MONEY BACK

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

A special bargain price for all the above items if bought together is **£8/10/-** (Post and Insurance 4/6). Or **£2/10/-** down and 7 payments of **£1**. Instructions free with parts or available separately.

CABINETS FOR ALL



The CONTINA

Another addition to our range of cabinets. This is of new revolutionary design, styled after the best of continental radios. Externally, it is finished in highly polished dark walnut veneer, with panelling picked out in gold. Interior is of same very high standard, its veneer being light mahogany which contrasts nicely with the dark walnut and generally gives a very pleasing appearance. The doors slide on metal runners and are fitted with gold insert finger plates. A really excellent cabinet for any home—size 3ft. 1¼in. long, 1 ft. 3in., deep, 2ft. 1½in. high, including legs which are 10in. from floor. Motor board 12½in. x 17in., equipment aperture 17⅞ x 9½in. gives ample space for 8in. speaker. Ample storage space for recordings. Price **£19/19/-** carriage and insurance 20/-.

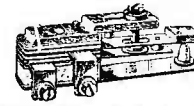
BLACK HEAT ELEMENTS

Ideal to use as a heating unit for airing cupboard, clothes drier, bathroom towel cabinets, etc. Complete in outer metal case, which is designed to keep at a "non-burning" temperature. 5 year guarantee. 500 w. size approx. 24 x 4 x 4 in., **30/-**. 1,000 w. size approx. 48 x 4 x 4 in., **50/-**. Carr. and ins. 500 w. 3/6, 1,000 w. 5/-.

19/6 AMPLIFIER

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

THERMOSTATS

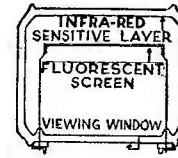


Useful for the control of appliances such as convectors, gluepots, vulcanisers, hot plates, etc. Adjustable to operate over the temperature range 50-550 deg. F. 1½ amp., 3/6; 5 amp., 8/6; 2 amp., QMB, 5/6; 15 amp. QMB, 15/-.

ELECTRIC BLANKET WIRE

Waterproof P.V.C. covered, so blanket washable. 16½ ohms per foot—1/6 per yard. 14 yards, ideal for average blanket. £1 post free.

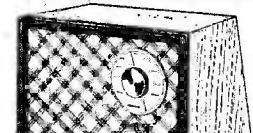
"SNIPERSCOPE"



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

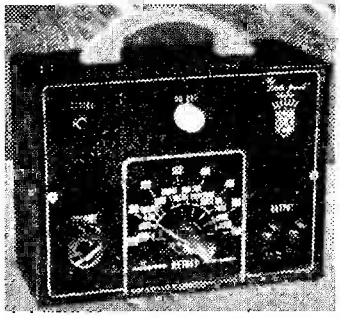
THE SKYSEARCHER

An all mains set for 19/6



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

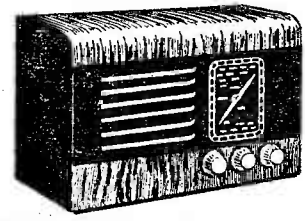
BEGINNERS!—BUILD A CHEAP EASY-TO-MAKE SET



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

LOOK! **BUILD THIS POCKET RADIO FOR ONLY 37/6**

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

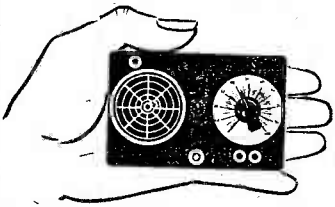


107/6 Total building cost including choice of beautiful walnut veneered cabinet or ivory or brown bakelite. **This is the lowest possible price consistent with high quality. No radio knowledge whatever needed . . . can be built by anyone in 2-3 hours,** using our very simple easy-to-follow diagrams. The terrific new circuit of the **"OCEAN-HOPPER"** covers all medium and long waves with optional negative feedback, has razor-edge selectivity, and exceptionally good tone. Price also includes ready drilled and punched chassis, set of simple easy-to-follow plans—in fact, everything! All parts sparkling brand new—no junk! **Every single part tested before despatching.** Uses standard octal-base valves: 6K7G high-frequency pentode feeding into 6J5G anode-bend detector triode, coupled to 6V6G powerful output beam-power tetrode, fed by robust rectifier. For A.C. Mains, 200-250 Volts (low running costs—approximately 18 Watts!). Size 12in. x 6in. x 5in. **Build this long range powerful midget NOW. All parts and set of plans, £5.7.6.** (Post and packing 3/6.) Parts sold separately. Priced Parts List, 1/6.

BUILD THIS *A.C. MAINS* **'FRYING-PAN' SET FOR ONLY 77/6**

BUILD YOUR MOTHER OR WIFE this frying-pan radio! Highly sensitive circuit covering all Medium and Long Waves. Has normal size, speaker and gives excellent tone due to wall "baffle" effect. Ideal for the kitchen, bedroom, etc. Robust design. For A.C. mains 200-250 volts. **TOTAL BUILDING COST including mirror-finish frying-pan, double-triode valves, step-by-step beginner's plans, nuts, bolts, etc., ONLY 77/6.** Postage, etc. 2/6. C.O.D. 1/6 extra. (Parts sold separately. Priced parts list, etc., 1/6.) **SEND NOW!**

Build This TRANSISTOR POCKET SET

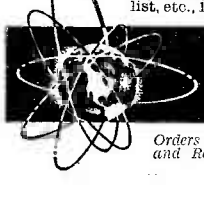


FOR ONLY 49/6

WE'VE DONE IT AGAIN! . . . our design department in response to a great many requests have designed this **"SKYPIXIE" Vest-Pocket TRANSISTOR RADIO** which gives a superb performance. It is powerful and highly sensitive. Size only 4¼in. x 3¼in. x 1¼in. 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!**

COMPONENT BARGAINS!

LOUDSPEAKERS.—Permanent Magnet, new 5in., only **19/6!** New 2½in., only **18/6.**
RECORD CHANGER UNITS.—3 speed, autochange **ONLY £7.17.6.**
METAL RECTIFIERS.—Contact-cooled, 250 volts, 50 mA. midget. Only **7/3.**
CABINETS.—Beautiful walnut veneer, normal midget type, with drilled and punched chassis, dial, backplate, drum, pointer, screws, etc. **ONLY 23/6.**
HEADPHONES.—Brand new high-resistance boxed (not surplus). Bargain at **14/6.**
COILS.—Pair of matched T.R.F. coils medium and long waves with reaction. Only **8/-.**
FILAMENT TRANSFORMERS.—200/250 volts in 6.3 a. 4 amp. out, **6/-.**
OUTPUT TRANSFORMERS.—Midget type new, matching to 3 ohms, **5/6.**
MIDGET COILS.—Medium and long waves with reaction and iron-dust core, bargain, **4/-.**
TRANSISTOR AND CRYSTAL DIODE COILS.—Triple wound, give exceptional selectivity and high "Q." Only **4/-.**
CRYSTAL DIODES.—Wire-end, very sensitive, similar to OA70, Only **4/6.**
TRANSISTORS.—Junction type, very sensitive, each one tested before despatch. Only the best at **12/6.**
POST AND PACKING please add 1/6 up to 10/-; 2/- up to £1; 2/6 up to £2. All enquiries enclose S.A.E. (C.O.D. 1/6 Extra.)



CONCORD ELECTRONICS
69, PRESTON STREET, BRIGHTON **Dept. PWG**

Orders receive prompt attention. Cheques accepted. Cash on delivery 1/6 extra. 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. 56/9
Above ready for use. Carr. 2/9.
With mains and output leads.

HEAVY DUTY KIT

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

BATTERY CHARGER KITS

Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case, Fuses, Fuse - holders, Grommets, panels and circuit. Carr. 2/6 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. 49/9

BATTERY CHARGER KIT

Consisting of F.W. - Bridge Rectifier 6/12 v. 5 a. Mains Trans., 0-9-15 v. 6 a. output and variable charge rheostat with knob. Only 45/9.

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. 3/6.

Assembled 6 v. or 12 v. 4 amps. Fitted Ammeter and variable charge selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Well ventilated steel case with blue hammer finish. **69/9**

Ready for use with mains and output leads. Carr. 3/6.

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
300-0-300 v. 70 mA, 6.3 v. 2.5 a. 16/9
350-0-350 v. 80 mA, 6.3 v. 2 a. 5 v. 2 a ... 18/9
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a. 22/9
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a. 22/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a. 22/9
350-0-350 v. 100 mA, 6.3 v. 4 a, C.T. 0-4-5 v. 3 a. 23/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a. ... 29/9

FULLY SHROUDED UPRIGHT

250-0-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a, Midget type 2½-3-3in. 17/6
350-0-350 v. 70 mA, 6.3 v. 2 a, 5 v. 2 a. ... 19/9
250-0-250 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a. 26/9
250-0-250 v. 100 mA, 6.3 v. 6 a, 5 v. 3 a, for R.1355 conversion 31/-
300-0-300 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a. 26/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a. 23/9
350-0-350 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a. 27/9
300-0-300 v. 130 mA, 6.3 v. 4 a, 6.3 v. 1 a, for Mullard 510 Amplifier 35/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a. 33/9
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**

E.H.T. TRANSFORMERS

2,500 v. 5 mA. 2-0-2 v. 1.1 a. 2-0-2 v. 1.1 a for VCR97, VCR517, etc. ... 36/6

ELIMINATOR TRANSFORMERS

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

CHARGER TRANSFORMERS

All with 200-230-250 v. 50 c/s Primaries : 0-9-15 v. 1½ a, 11/9 ; 0-9-15 v. 3 a, 16/9 ; 0-3.5-9-17 v. 3 a, 17/9 ; 0-3.5-9-17.5 v. 4 a, 18/9 ; 0-9-15 v. 5 a, 19/9 ; 0-9-15 v. 6 a, 22/9.

SMOOTHING CHOKES

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

OUTPUT TRANSFORMERS

Midget Battery Pentode 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
Multi-ratio 40 mA, 30:1, 45:1, 60:1, 90:1, Class B Push-Pull 5/6
Push-Pull 10-12 watts 6V6 to 3Ω or 15Ω 15/9
Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω 16/9
Push-Pull 15-18 watts, 6L6, KT66 ... 22/9
Push-Pull 20 watts, sectionally wound 6L6, KT66, etc., to 3 or 15Ω 47/9
Williamson type exact to spec. ... 85/-

SPECIAL OFFERS

32-32-32 mfd. 250 v. Dubilier small can electrolytics. 2/9 ea. Small .0005 mfd. 2-gang, 4/9 ea. Westinghouse Rectifiers 250 v. 250 mA., 7/9.

MANUFACTURERS' SURPLUS MAINS TRANSFORMERS. Primaries 250-250 v. 50 c/cs. Fully shrouded upright mounting 425-0-425 v. 150 mA. 6.3 v. 3 a, 5 v. 3 a. 29/11, post 2/9. Wearite 325-0-325 v. 100 mA. 6.3 v. 2.5 a, 5 v. 2 a., 19/9. Drop Through Chassis type 250-0-250 v. 70 mA. 6.3 v. 2.5 a, 10/9.

EX-GOVT. TRANSFS. 230/250 v. 50 c/cs. 460 v. 200 mA, 6.3 v. 5 a, 25/9 ; 300-0-300 v. 150 mA, 4 v. 3 a, 9/9.

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
L.T. type 1 amp. 2 ohms 2 9

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 ; 4 mfd. 1,500 v., 5/9 ; 8-8 mfd. 500 v., 6 9 ; 8 mfd. 500 v., 4/9 ; 10 mfd. 500 v., 4 9 ; 4 mfd. 400 v. plus 2 mfd. 250 v., 1/11.

EX-GOVT. ELECTROLYTICS. Removed from unused equipment. 8-16 mfd. 550 v., 1-3 ; 1.500 mfd. 6 v., 1/9 ; 50 mfd. 50 v., with clip, 9d.

EX-GOVT. DOUBLE WOUND STEP UP/STEP DOWN TRANSFORMER 10-0-100-200-220-240 v. to 5-0-75-115-135 v. or REVERSE. 30/100 watts. Only 11 9, plus 2/9 post.

EX-GOVT. CASE. Well ventilated black crackle finished, undrilled cover. Size 14 x 10 x 8in. high. IDEAL FOR BATTERY CHARGER OR INSTRUMENT CASE. OR COVER COULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 postage.

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	KT44	8 9
6K7G	5/9	12A6	7/9	EZ90	8 9
6K8G	9/9	15D2	4/9	EZ80	9.6
6SJ7GT	6/9	2524G	9/9	EL84	10 6
6SLGT	8/9	MH4	4/9	SP61	2 9
6SN7GT	8/9	ECC83	9/9	3524	8 9
6AT6	7/9				

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

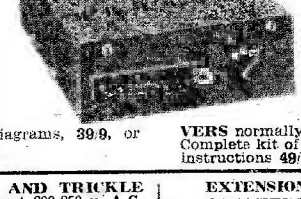
ELECTROLYTICS (current production) NOT EX-Govt.

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

Many others in stock.

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

R.S.C. BATTERY TO MAINS CONVERSION UNITS



Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 3in. approx. Completely replaces batteries supplying 1.4 v. and 90 v. where A.C. mains 200-150 v. 50 c/s. is available. **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types.

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

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

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

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

MINIATURE MOTORS. 24/28 v. D.C. or A.C. made by Hoover Ltd., Canada. Size only 2½ x 1¾in. Spindle ¼in. long, ¼in. diam. Brand New. **9/9**.

EXTENSION SPEAKERS

Ready for use in walnut veneered cabinet.

6½in. 2-3 ohms, **29/6**.
8in. 2-3 ohms, **35/9**.
Very limited number.

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

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

NEW 1956 Model 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 ± 3 db. 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.

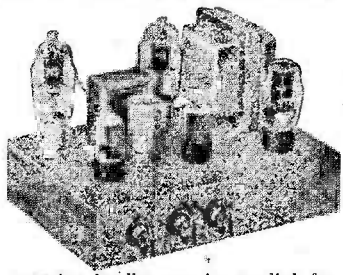
For STANDARD or LONG-PLAYING RECORDS. For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. OUTPUT SOCKET with plug provides 300 v. 20 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. Size approx. 12-9-7in. For A.C. mains 200-230-250 v. 50 c/cs. Outputs for 3 and 15 ohm speakers. Kit is 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 A6

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, and separate Bass and Treble controls. Minimum input required for full output is only 30 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.** 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. An extra input with associated vol. control so that two separate inputs such as Gram. and Mike can be mixed, can be provided for 13/- extra. The amplifier can be supplied, factory built with 12 months' guarantee, for 50/- extra. **TERMS** for assembled two input model: **DEPOSIT** 28/9 and 9 monthly payments of 28/9.

ONLY 9 GNS.

Carr. 10/-

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.

GARRARD 3-SPEED MIXER AUTO-CHANGER RC110. For Standard A.C. mains 200-250 v. 50 c/cs. Current Model. Brand new, cartoned. Provision for taking 10 records. Fitted High-Fidelity turnover pick-up head with dual sapphire point stylus for Standard or Long-playing records. Very limited number at only £7.19.6. Carr. 3/6.

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 convenience when mounted in cabinet, mains switch is incorporated in control. 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. Guaranteed 12 months. Only £5/19/6.

ELLIPTICAL P.M. SPEAKER, 7 x 4in. Goodmans. Suitable for above, 19/6.

LINEAR 'DIATONIC' 10 WATT HIGH FIDELITY, PUSH PULL, ULTRA LINEAR AMPLIFIER. For 200-230-250 v. 50 c/cs. A.C. Mains. Valve line-up ECC83, ECC83, EL84, EL84, EZ81 miniature Mullard. The unit has self contained Pre-amplifier/Tone Control stages and separate Bass and Treble Controls. Independent 'Mike' and Gram input sockets are provided. 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 Gold/Bronze hammer. Only 12 GNS. or Deposit 26/9 plus 10/- carr. and 9 monthly payments of 26/9. Send S.A.E. for full details.

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. 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.

PLESSEY 10in. P.M. 3 OHM SPEAKER with High Flux Density Magnet Recommended for use with above A5, A7, or Linear L45 Amplifiers. Price 28/9.

B.S.C. TA1 HIGH QUALITY TAPE DECK AMPLIFIER. For ALL Tape Decks with High Impedance, Playback and Erase Heads, such as Lane, Truvox, etc. (Unit can now be supplied for use with latest Collaro Tape Transcriptor: refer to TA1C). For A.C. Mains 230-250 v. 50 c/cs. **Ready for Use. ONLY 11 GNS.**

Positive compensated identification for recording level by Magic Eye. Recording facilities for 15, 7½ or 3¾in. per sec. Automatic equalisation at the turn of a knob. **Linear frequency response of** ± 3 db., 50-11,000 c/cs. Negative feed-back equalisation. Minimum microphony and hum. High output with completely effective erasure and distortionless reproduction. Sensitivity is 15 millivolts so that any kind of crystal microphone is suitable. Only 2 millivolts 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. R.M.S. Carriage 7/6. Illustrated leaflet 6d.

R.C.A. 20 WATT RE-ENTRANT SPEAKERS. 15 ohm or 600 ohm matching. For Outdoor work. Only 8 GNS. **P.M. SPEAKERS.** All 2-3 ohms, 5in. Goodmans, 17/9. 6½in. Plessey, 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, high-fidelity type. Highly recommended for use with our A8 amplifier, £4/10/9. 12in. Plessey 15 ohm 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.F. SPEAKERS 2-3 ohms, 8in. R.A. Field, 600 ohms, 11/9.

COAXIAL CABLE 75 ohms, ½in. 8d. yard. Twin Screened Feeder, 11d. yard.

SELENIUM RECTIFIERS

6/12 v. 1 a.	4/11	6-12 v. ½ a. H.W.	2/9
6/12 v. 2 a.	8/9	H.T. Types H.W.	
6/12 v. 4 a.	11/9	150 v. 40 mA.	3/9
6/12 v. 4 a.	14/9	250 v. 50 mA.	5/9
6/12 v. 6 a.	19/9	250 v. 80 mA.	7/9
6/12 v. 10 a.	25/9	250 v. 150 mA.	9/9
L.T. Types H.W.		300 v. 250 mA.	12/9

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 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, 6F6G. Selectivity and quality are well up to standard, and simplicity of construction is a special feature. Point-to-point wiring diagrams, instructions and parts list, 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 5½ in.

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.

RADIO SUPPLY CO. (LEEDS) LTD. 32, THE CALLS, LEEDS, 2

PRACTICAL WIRELESS

EVERY MONTH
VOL XXXIII, No. 603, MAR., 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

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Inland - - - 18s. per annum.
Abroad - - 16s. 6d. per annum.
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CONTENTS :

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

AMATEUR TRANSMITTING

AMATEUR transmitting was an established hobby in this country long before broadcasting was introduced in 1922. In fact, the first amateur transmitting licence was granted in 1905 and it was largely as a result of the work of these pioneers that broadcasting finally came into being. It was natural that they should band themselves together into a society which would act as a clearing house for information and foster interest in the new science. The pioneers of the radio industry and of broadcasting were all drawn from the ranks of the early amateur transmitters and radio experimenters. Strangely enough it is not a hobby which has attracted amateurs to the same extent as the construction of and experiments with radio receivers. This is surprising because amateur transmitting has a never-failing fascination and interest not equalled by experiments with receivers. Perhaps the main reason is that it is necessary to pass an examination in the morse code and in other subjects before an experimenter is entitled to transmit. This is a very necessary precaution. Otherwise transmitting on the amateur bands would be impossible if those with no knowledge of transmitting processes and without reasonable skill in transmitting morse were allowed free licence to transmit. Those of our readers who have appealed for a less rigid examination are asking for something which for those reasons alone cannot be granted.

We have in this journal for over 24 years encouraged amateur transmitters, and we have regularly featured the subject. One or two readers, however, have suggested that in view of the comparatively small number of amateur transmitters the space would be better occupied by information and articles relating to reception, and we therefore invite our readers to express their views on this subject, by sending us a postcard stating whether they are in favour of a continuance of the feature or not

LATE DELIVERY OF GOODS

IN view of the transport difficulties brought about by petrol rationing we would ask our readers to be indulgent with advertisers who are not now able to dispatch their goods with the same promptitude as hitherto. There is considerable delay on the railways, and where goods are despatched by road petrol rationing alone restricts the number of journeys a delivery van can make in one month.

INDEX TO VOLUME 32

THE index to Volume 32 is now ready, and copies are available from the publisher (address as on this page) for 1s. 1d. by post. Loose leaf binders are available for 10s. post free from the PRACTICAL WIRELESS Binding Department, Tower House, Southampton Street, Strand, W.C.2.—F. J. C.

Our next issue, dated April, will be published on March 7th.

Round the World of Wireless

By "QUESTOR"

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of November, 1956, in respect of wireless receiving stations situated within the various Postal Regions of England Wales, Scotland and Northern Ireland.

The numbers include Licences issued to blind persons without payment.

Region	*Total*
London Postal	1,243,600
Home Counties	1,231,229
Midland	966,228
North Eastern	1,249,342
North Western	944,341
South Western	779,942
Wales and Border Counties ...	493,460
Total England and Wales ...	6,908,232
Scotland	882,285
Northern Ireland	200,302
Grand Total	7,990,819

America Honours W. S. Barrell

DURING his recent visit to the U.S.A., Mr. W. S. Barrell (E.M.I. Studios Ltd.) was elected an Honorary Member of the Audio Engineering Society of America—this being the first time that the honour has been conferred on anyone other than an American citizen.

The Society's constitution provides that the Board of Governors may elect to Honorary Membership "persons of outstanding repute and eminence in the science of Audio Engineering or any of its allied arts," and (to quote the citation) it is "in recognition of Mr. Barrell's contributions (over a period of many years) to improvements in disc recording and the equipment used therefor."

Mr. Barrell is a well-known figure in the industry, having joined he Columbia Gramophone Co. Ltd. in 1925 as chief engineer of their recording department. After the merger of "His Master's Voice" and Columbia in 1931 to form Electric & Musical Industries Ltd., Mr. Barrell was in charge of the recording engineering activities of the group, and in 1945 he became manager of the E.M.I. Recording Studios. He retired from that position at the end of last year and is now recording technical liaison officer for the E.M.I. Group.

Electronic Brain Selects Motor Car Colours

THE "electronic brain" has been applied to a new problem—the painting of motor cars. E.M.I. Electronics Ltd. have been commissioned to furnish electronic control gear for an automatic conveyor system to be installed by Geo. W. King Ltd., of Stevenage, Herts, in the body-painting plant of the new factory being built by SIMCA at Poissy in France.

After exhaustive enquiries in the U.S.A. and in Germany, SIMCA decided that the combination of E.M.I. control with the King conveyor produced a system well in advance of anything available anywhere else in the world.

The "electronic brain" will allow the factory staff to decide each evening exactly how many cars, in each possible combination of colours, they wish to produce next day. On receiving this information it will control the whole elaborate conveyor system, six miles long, so that the right coloured bodies are automatically produced in the optimum order.

The total value of this order is likely to be over £500,000, which gives an indication of how important "automatic" equipment is likely to become in our export trade.

New British Standard Supplement

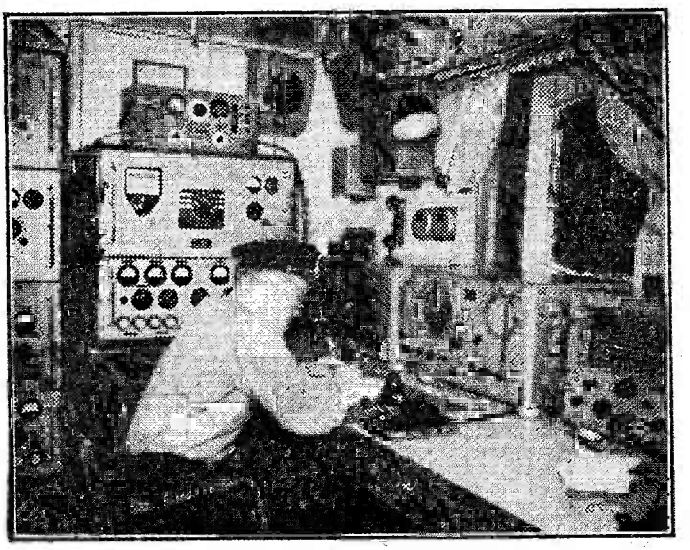
THE British Standards Institution announces the publication of Supplement No. 4 to B.S. No. 530 (1948).

While B.S. 530 was being revised, an Inter-Service list of symbols was issued which differed from those in the British Standard. Later the Services agreed to use, instead, B.S. 530 (and its supplements), together with an addendum listing these differences.

Supplement No. 4 has been drafted mainly with a view to removing these differences, and it will now be possible for the Services to reduce substantially the size of their addendum.

Supplement No. 4 contains guiding principles for the preparation of circuit diagrams which are additional to those on pages 5 to 15 of B.S. 530, and new or modified symbols which reflect advances in technique.

Symbols for transistors and allied devices, keeping pace with



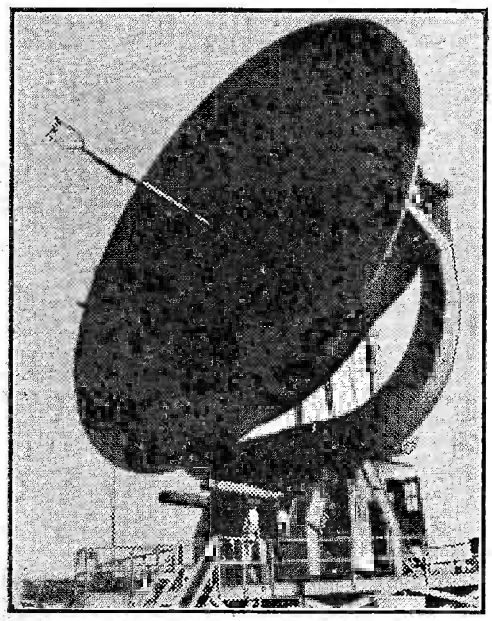
The radio room and the radio officer, Mr. J. G. Madsen, on the "Magga Dan" now on the way to the Antarctic. The apparatus aboard includes an 800-watt transmitter and a short-wave receiver.

recent advances in semi-conductor developments, form an important part of the Supplement. In drafting these, attention has been paid to American practice.

Copies of this Supplement may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, W.1, price 3/6.

Mars Contacted

THE planet Mars was contacted for the first time by the U.S. navy's 600-in. radio telescope during the week of Sept. 9th, 1956. T. P. McCullough and R. M. Sloanaker, radio astronomers at the Naval Research Laboratory, detected the radio waves from the planet. The radiations, measured at a wavelength of 3 cms., are related to the surface temperature of the planet. Results of the study on Mars indicate an average temperature for the planet slightly lower than the freezing point of water.



The 600-inch radio telescope with which the planet Mars was contacted. See paragraph above.

R.C.E.E.A. Technical Secretary

MR. J. F. RICHARDSON has been appointed technical secretary of the Radio Communication and Electronic Engineering Association. He will work under Mr. H. E. F. Taylor, whose appointment as Executive Secretary of the Association was announced recently.

Since 1952 Mr. Richardson has been technical assistant to the director of the Electric Lamp Manufacturers' Association, where he was largely responsible for the technical work and was acting secretary to the technical committees concerned with lamp specifications. Before that, from 1947, he was with the London Transport Executive as a technical assistant in the Signal Engineer's Office, Earls Court.

Mr. Richardson began his engineering training in 1939 with Standard Telephones and Cables, Ltd., North Woolwich, testing carrier telephone and telegraphy equipment. During the war he was transferred with the company to Leicester, returning in 1946, and while there studied electrical engineering at Leicester College of Arts and Technology. He obtained the Higher National Certificate and was elected a Graduate, I.E.E., in 1951.

A.A. Radio Network Now Covers Jersey

THE Automobile Association announces the extension of its radio-controlled breakdown service to the island of Jersey.

From the control room in the St. Helier headquarters of the A.A. continuous radio contact can be maintained with all road patrols on the island.

A.A. members in trouble can obtain immediate assistance, either from an A.A. patrol or from a garage operating the A.A. free breakdown scheme by telephoning Central 544 or Central 2464.

The radio control centre in Jersey is the 22nd to be opened since the A.A. began using radio in London in 1949, and completes the 20 per cent. radio expansion scheme announced for 1956.

B.I.R.E.

THE following meetings will take place during February, 1957:

London Section: Wednesday, February 27th, at 6.30 p.m. London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1. "Some Applications of Nucleonics in Medicine"—a paper by E. W. Pulsford, B.Sc.(Associate Member), and N. Veall, B.Sc.

West Midlands Section: Wednesday, February 13th, at 6 p.m. Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton. "An Automatic System for Electronic Component Assembly"—a paper by K. M. McKee, B.Sc.

Merseyside Section: Thursday, February 14th, at 7 p.m. Council Room, Chambers of Commerce, 1, Old Hall Street, Liverpool, 3. "Radioactivity and Its Measurement"—a paper by E. W. Pulsford, B.Sc. (Associate Member).

North Eastern Section: Wednesday, February 13th, at 6 p.m. Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle-upon-Tyne. Details from Local Secretary: J. Bilbrough, c/o Microwave Instruments Limited, West Chirton Industrial Estate, North Shields. Note: The paper originally announced in the Programme Booklet for this date has been brought forward to January 9th.

Indian Railway Radiophone

A CONTRACT for the first VHF Multi-channel Radio-telephone system in India has been placed with Marconi's Wireless Telegraph Company Ltd. by the Government of India on behalf of Western Railways. The order is for Multi-channel Terminal Units, Type HM.102, with amplifying units and Multi-Channel Terminal Units Type HM.104.

Two radio-telephone links will be established, one between Bhavnagar and Surat and the other between Jamnagar and Rajkot, in the Western Railways network. The system which will have a potential capacity of 48 two-way telephone channels between Jamnagar and Rajkot and 24 between Bhavnagar and Surat will be equipped initially to provide four circuits.

The HM.102 and HM.104 Terminal Units are two of a series developed by Marconi's for use in terrain unsuitable for the construction of line or cable routes. They are designed to carry up to 48 telephone channels any of which may be sub-divided to give either 18 or 24 telegraph channels.

Converting a Portable Gramophone

BY E.V. KING

THE CONVERSION OF AN OLD GRAMOPHONE TO A RECORD PLAYER

THE writer came across an ordinary portable gramophone measuring 11in. x 16in. x 6in. and experienced no difficulty in converting it, using full-sized and therefore low-priced components. The portable gramophone had the usual coarse tone, no control of volume and was heavy on records. The finished player was fully portable as long as mains were available, tone was very good and volume fully controllable; the wear on records was negligible. The components are not critical—most of the parts will be found in the average spares box. If the pick-up and speaker are available this conversion will cost about £2. The writer fitted an old magnetic pick-up, but a head could be fitted to the old tone-arm (this would have to be moved to another support).

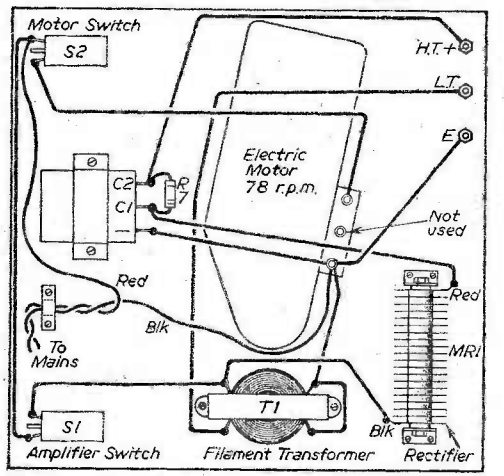


Fig. 1.—This layout is unimportant (see text).

The player uses the original spring motor, although the writer later fitted a standard Collaro motor from an old radiogram. This motor fits with ¼in. depth to spare. A two-valve amplifier using two EF50s, one as an L.F. amplifier and one as an output valve, provides about ½ watt output, which is ample for an ordinary living-room party. A small plug is provided in the pick-up leads so that a microphone may be plugged in for social use, baby alarm, crystal set amplifier, etc.

Stripping the Old Gramophone

Remove the motor panel and the exponential horn.

Fit an electric motor or move the old one as near to the front as possible, so that the lid will still close.

Make sure the turntable is a little above the edge of the box so that 12in. records may be played (with the lid open). If using an electric motor it may be necessary to use the old (small) turntable.

The writer had to make a small cone of tin from a cocoa container (see Fig. 10) so that the turntable fitted neatly on to the smaller spindle of the electric motor.

If possible mount the motor on rubber grommets to prevent motor buzz. If the old spring motor is used, tighten the screws of the centrifugal bob weights and well grease with car grease.

If the spring is broken it is often possible to effect a repair by softening it in a small gas flame, drilling any necessary hole, heating again and plunging it in cold water. Patience and care are necessary in refitting the spring.

H.T. and L.T. Supplies

The units for these supplies are mounted on the

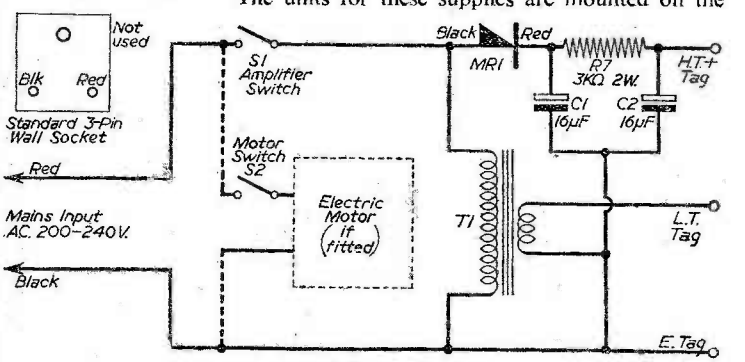


Fig. 2.—Mains power unit.

motor panel in any convenient position (see Fig. 1), provided the filament transformer is not underneath the pick-up when it is on a record. The L.T. of 6.3 volts is taken from a small filament transformer, although the writer used a large speaker transformer which gave just under 6 volts on load with 240 volts mains fed into the old anode windings. The thick

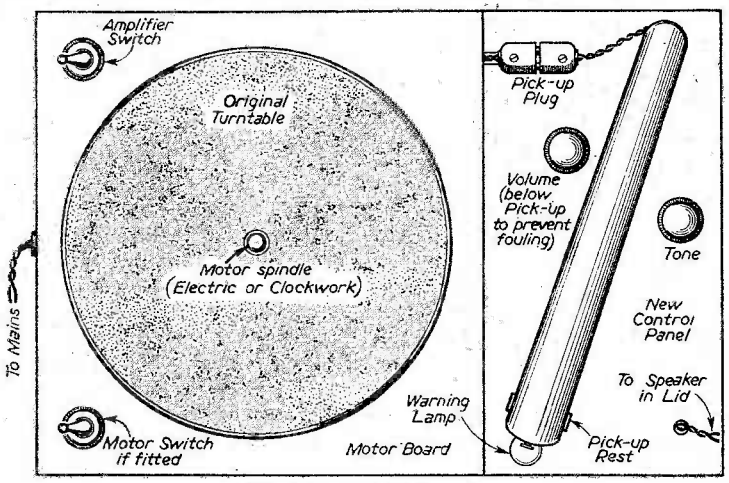


Fig. 3.—Plan of layout.

secondary winding, of course, providing the 6 volts. This transformer is perfectly satisfactory and does not overheat even when left on for four hours. The H.T. supply is direct from the mains via a metal rectifier and resistance smoothing. A three-way tag strip is mounted under the motor board (or a multi-pinned plug may be used) as terminals for H.T., L.T. and Earth—no *actual* earth is, however, used. A mains lead is taken out from a hole either in front or in the motor panel. The red wire of the mains lead should go to the switches as shown (see Fig. 2) and the black wire to the filament transformer and the negative side of the smoothing condenser or condensers. This is sometimes a tag, but is often the case itself, in which event the clip holding the condenser in place will make a convenient point on which to solder a lead. The 3,000-ohm smoothing resistance should be mounted "in space," so that it does not overheat. Note that the red end of the rectifier must be connected to the smoothing circuit. When this unit is wired, complete it by attaching final leads to the tag board.

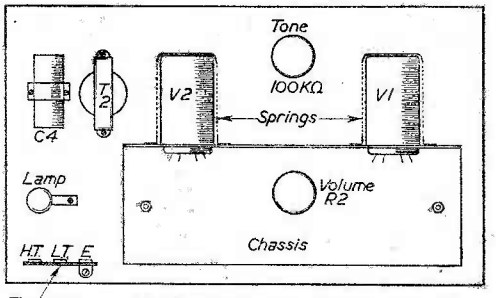


Fig. 5.—View of the underside of control panel.

Fig. 3 shows the top view of the motor panel.

Testing the H.T. and L.T. Supply Unit

Plug into mains, black wire to neutral and red wire to live, as shown in plan of three-point socket, then switch on. With an A.C. voltmeter test between the earth tag and the L.T. tag—it should read just over 6.3 volts. If no voltmeter is available, spark between the tags with a strip of wire held in a reliable insulated tool; small blue sparks should be produced. Do not hold the wire in actual constant contact with the tags. Now test the H.T. with a D.C. voltmeter—it should be well over 250 volts. If no meter is available, switch off the mains and immediately short between the H.T. tag and Earth tag with a well-insulated screwdriver. A large fat blue spark should jump the gap with considerable noise. Before leaving the motor and supply unit cut a ventilation hole in the case somewhere near the metal rectifier, as this must not on any account overheat. Cover the hole with gauze or perforated zinc.

The Amplifier

A simple chassis is cut from tinplate or aluminium (see Fig. 4). If aluminium is used, then solder tags will be necessary at all earth joints, but with tinplate

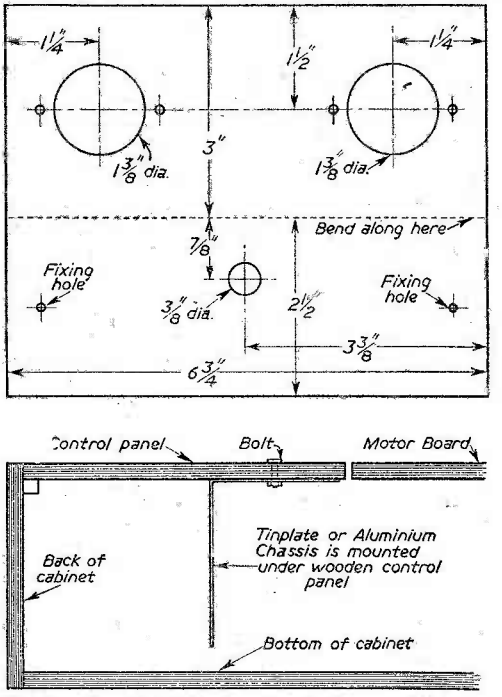


Fig. 4.—Details of the chassis—tinplate or aluminium.

the wires may be soldered direct. The writer mounted the valveholders as shown and cut the hole for the volume-control. This hole needs placing carefully. The control knob must not foul the pick-up or the turntable and the control must not be too near the output valve or transformer. The writer found he could fit it best between the valveholders, so that when not being used the pick-up arm was over the

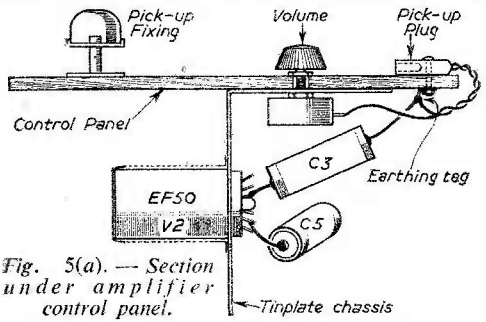


Fig. 5(a). — Section under amplifier control panel.

knob. Once set for a certain room it may be more or less left alone.

The speaker transformer and 8μF H.T. decoupling condenser were mounted directly under the control panel, which is cut to fill completely the space where the horn used to come out. Plywood is best for the panel, metal is least suitable, although the prototype used aluminium. The sketch (see Fig. 5) shows the approximate position of components. The tag board is mounted to tally with the one on the motor board. The pick-up is fixed to the control panel, bearing in mind the following :

1. The lid is able to close at all times except with 12in. records.
2. That it is as near as possible at a tangent to the record when playing.
3. That the record pulls and does not push the needle.
4. That when static the pick-up rest can be used.

The writer at first used a home-made moving coil pick-up, using an old meter movement as the basis, but later fitted a standard large moving-iron pick-up as it looked neater. Any ordinary crystal or magnetic one will do. When positioned, remove it from the panel until later. Note that you should always remove needle and needle grub screw from pick-ups when fitting to avoid damage—especially with crystal types.

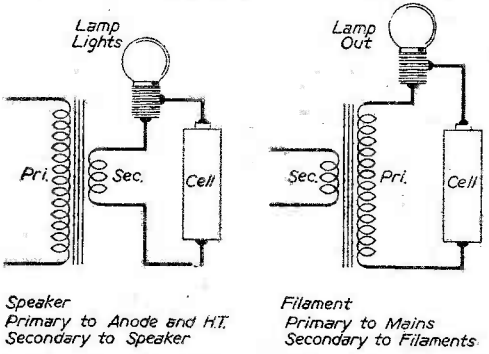


Fig. 6.—Identifying the tags on transformers with flash-lamp and torch battery.

The best way to carry out the wiring (see Fig. 7) is as follows :

1. Wire all earth connections to chassis and earth tag, i.e., Pins 1, 5, 8 and 4 on valveholders, minus of 8 μF condenser, one side of pilot light and one side of volume control.
2. Wire in the resistors and condensers directly on valve tags and earthing tags (or solder to tin plate). Remember to put the minus side of the two bias electrolytics to earth and the plus sides to pin 6 (valves are numbered clockwise looking from under them).

Make sure you have connected the anode of V2 and the H.T. line to the *primary* of the speaker transformer. The primary can be tested as shown (see Fig. 6) with a torch battery and bulb, the bulb will not light. The lamp will light when connected to the secondary as shown.

The coupling condenser C8 must be a good one and is best purchased new, 500 volt working preferably. If this is not good, not only will the output be distorted but the life of V2 will be short.

All the components have large tolerances and may come from the spares box. When buying ex-Government EF50s at, say, 2s. 6d. each, reject any with cracks in the glass round the pins. New ones are available surplus for 5s. each, but the writer used 2s. 6d. ones. Be careful to place the valves very carefully when putting them in or you will crack the glass ! If old valveholders are used be careful, as oxidisation causes bad contacts ; clean them with a small sharp penknife and do not remove valves unnecessarily.

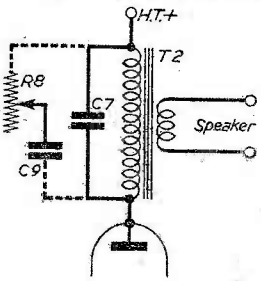


Fig. 8.—Fitting a tone control.

Make sure the tag strip has three connections : Earth ; L.T. to pins 9 ; H.T. to speaker transformer, etc.

Take a short lead out from the speaker transformer secondary, long enough to go to the speaker which is mounted on a hole cut in the lid.

Testing the Amplifier

Plug into the mains and connect mating tag strips with 6in. lengths of wire (or longer) for testing. The valves should warm up—if they do not, inspect filament transformer and circuit on pins 1 and 9 of valves (you cannot see the filaments, but the valves will get warm after 10 mins. or so). Touch pin 7 of V2, use an insulated screwdriver. Clicks should be heard in the speaker when this is done. If not, inspect all wiring, etc. concerned with that valve. Now touch pin 7 on V1. A loud hum should come from the speaker, if not, inspect all wiring concerned with this valve.

Now mount the pick-up and fix everything in position including the speaker. This should be 5in., carefully mounted in the lid so that it does not foul the pick-up or knobs when closed. Switch on and make sure the pick-up is plugged in. Put on a record and adjust the volume control.

Performance

The writer found that ample volume is available for a large room and more than was comfortable in a

small one. When advanced too far V2 overloads and some distortion is present but even this is not intolerable. A 6V6 or similar output valve could be fitted but ventilation would be necessary. The writer actually fitted a small air grille near the valves but it was hardly necessary with the EF50s. If a small microphone or earphone is plugged into the pick-up socket, a really useful baby alarm is available and the unit may be left switched on continually and no harm will result.

Further Information

When fitting the speaker put strong fabric between it and the top of the cabinet to prevent damage to the cone. Chromium slats would improve the appearance.

Reproduction is somewhat better with the lid open if the records are not too worn.

A tone control may be fitted as shown (see Fig. 8), and will prove useful in cutting out needle scratch if carefully adjusted.

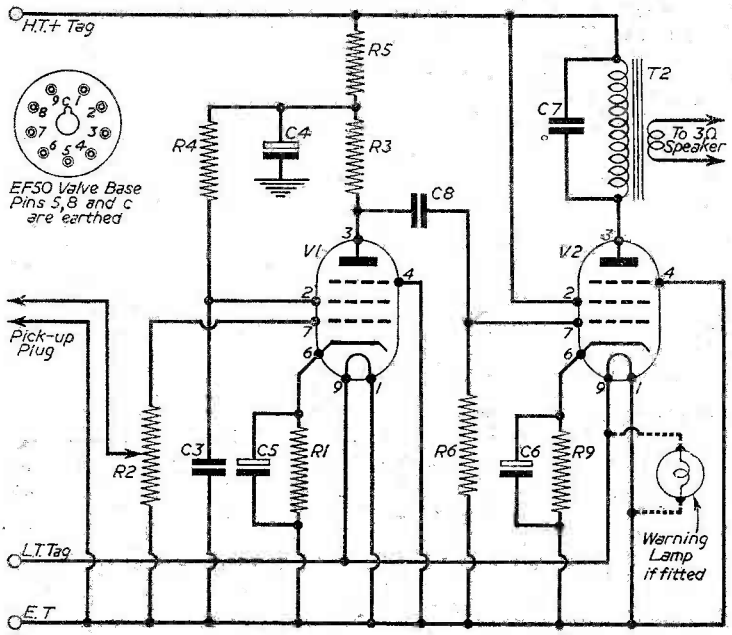


Fig. 7.—Amplifier circuit.

Since the earth line is direct to mains it is wise to use a wooden control panel and to varnish it afterwards covering any screws which come through. If the spring motor is used do not connect it to anything, leave it isolated. In any case, in common with all electric gear, do not use it in wet locations, i.e., a bathroom.

If the unit is to be moved about make sure the valves, pick-up and turntable are fixed firmly. Spring clips are best over the valves (see Fig. 9); a shoe-string may be used round the pick-up, and the turntable, being tapered, should hold firmly. A warning light may be fitted to the amplifier circuit to remind you when it is on. A 6 v. .18 amp. or similar lamp would do. The writer used a small flash lamp from a torch and about 30in. of 32 s.w.g. resistance wire wound round a resistor as a dropper.

The original model has given hours of enjoyment to the writer and his friends.

LIST OF COMPONENTS

Resistors
(All ½ watt unless otherwise stated.)
R1—150 ohm.
R2—1 M. Pot. Volume.
R3—50 K.
R4—250 K.
R5—2.2 K ½ watt.
R6—1 M.
R7—3,000 2 watt.
R8—100 K Pot. Tone (Optional).

Condensers
C1, C2—16 + 16 μF 350 v. or double 32 μF.
C3—1 μF.
C4—8 or 16 μF 350 v.
C5, C6—25 μF 25 v.
C7—.001 μF.
C8—.01 μF 500 v. Sprague.
C9—.02 μF 350 v.
Two three-way tag strips or multi-pin plugs.
T2—Standard Speaker Transformer.
T1—Filament Transformer, 6 v. and 200-240 v. or use large speaker transformer.
S1, S2—Toggle switches 240 v. 1 amp.
MR1—Metal Rectifier 30 mA 250 v.
Speaker 3 ohms 5in. dia.
Pick-up, any make magnetic or crystal.
Two-pin socket and plug for pick-up.

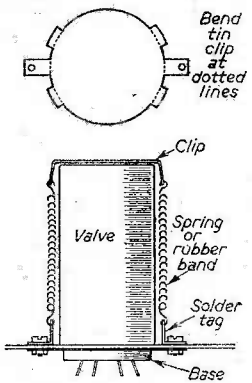


Fig. 9.—Valveholder clips.

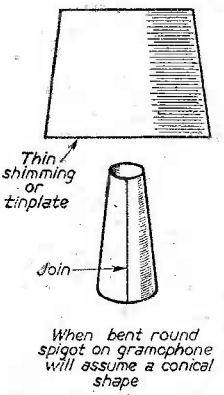


Fig. 10.—Gramophone spindle cone (if required).

The Blattnerphone

I HAVE received the following query of a technical nature, the answer to which I feel will be of interest to other readers. One asks: "What was the Blattnerphone?" It was the precursor of our present system of wire- and tape-recording. The apparatus consisted, in essentials, of a powerful electro-magnet with the two poles arranged opposite each other and with only a small gap separating them. At each end of the machine were two spools, one of which contained a length of thin steel tape. This was taken across through the gap of the magnets and so to the other reel or spool. The tape then fed from one spool to the other when the mechanism was set in motion, in the same manner as a typewriter ribbon. The sounds to be recorded are fed into the electro-magnet in the same manner as the wireless signals are applied to a loudspeaker.

New President of I.P.R.E.

CONGRATULATIONS to my old friend Colin Gardner on his election as President of the Institute of Practical Radio Engineers. This is a well-merited honour, and a specially appropriate recognition of his long services to the cause of amateur radio.

Some 25,000 service engineers and other technicians have listened to technical talks given by Colin Gardner on the occasions of Mullard film meetings held during the last year or two. Many of these film meetings were organised in co-operation with the Incorporated Institute of Practical Radio Engineers and centres of the Radio and Television Retailers' Association.

Mr. Gardner, a Fellow of the Institute, and who has been associated with it since its inception, was elected president for the years 1950 and 1951, following which he was elected a vice-president and operated as liaison officer for the Institute.

The Advance of V.H.F.

THE BBC's V.H.F. sound broadcasting service was brought within the reach of a further 14,000,000 people when the Holme Moss V.H.F. F.M. transmitting station came into regular programme operation on December 10th.

Holme Moss is the first of the new high-power V.H.F. stations to be opened in its permanent form with a full three-programme service. It is built on the same 150-acre site as the BBC's Holme Moss television station, and is situated 1,750ft. above sea level adjoining the Holmfirth-Woodhead road (B.6024) some eight miles south of Huddersfield.

The V.H.F. transmitters are housed in an extension to the television station building. The new building is of similar construction and appearance to the original one, being stone faced and having double windows throughout in order to conserve heat during cold weather.

In general, the new station is expected to provide satisfactory reception in Yorkshire, with the exception of the northern and extreme eastern parts of the North Riding; Lancashire as far north as Morecambe Bay; Lincolnshire with the exception of the extreme eastern and southern parts; Cheshire; Derbyshire; Nottinghamshire; north Leicestershire; north Shropshire; most of Staffordshire; the north-eastern part of Anglesey; Flintshire and most of Denbighshire. There will, of course, be some locations within this area, particularly in valleys and behind hills, where reception is difficult or even unsatisfactory, as with television reception.

The transmissions will be horizontally polarised and will be on the following frequencies: North of English Home Service, 93.7 Mc/s; Light Programme, 89.3 Mc/s; Third Programme, 91.5 Mc/s. The effective radiated power on each programme service will be 120 kW.

Very Short Waves!

IT is interesting to note that research workers are now delving into the mysteries of Ultra High Frequencies and Micro-Waves. The G.E.C. in their review of activities over the past year refer to frequencies of 10,000 Mc/s. Their experiments in micro-wave techniques include the development of a magnetron for low-power pulsed operation at 10,000 Mc/s. A new and more robust form of higher-power magnetron for operation at 10,000 Mc/s has also been produced. Other work has been concerned with travelling wave tubes, of which the large frequency bandwidth is becoming increasingly important in multi-channel micro-wave communication. A research programme has been carried out on the design parameters of high-power travelling wave tubes operating in the 500/1,000 Mc/s frequency band. Peak powers in excess of 10 kW and an efficiency of 30 per cent. have been obtained.

International Scout Jamboree

I HAVE been most interested in the way that radio amateur activities have been slowly increasing in various types of exhibitions run by local authorities and other public events.

At the International Scout Jamboree, to be held in Sutton Coldfield in August, amateur radio will play its part by having its own special radio station operating from the camp and using a special call sign. Members of some well-known clubs are organising this interesting event, and if any readers would like to assist in any way they should contact Mr. A. F. Dennis (G3CNV) at 47, Hemlingford Road, Walmley, Sutton Coldfield. This event is being held to celebrate the 50th anniversary of the foundation of the Boy Scout Movement and 100th anniversary of the birth of the founder, Lord Baden-Powell.

OHM-METER Design Problems

THE DETAILS AND PRINCIPLES OF A USEFUL CLASS OF TEST INSTRUMENTS

By W. Cleland

RESISTANCE measurement is usually included among the ranges of a multi-range testmeter. A Wheatstone bridge, which one would use for precision, is not rapid enough when tests become numerous, and a direct-reading instrument is indispensable. It enables checks to be made upon the following :

(1) The values of resistors,
(2) Faults in the wiring.
(3) Coil and switch connections.
(4) Open-circuits and short-circuits in valves and other components.
(5) Polarities and condition of rectifiers.
(6) The leakage resistance of electrolytic condensers.

Since the need for an ohmmeter arises continually, it is worth while to reserve a meter entirely for resistance measurements. It is then easy to assemble and calibrate without the extra complication of current and voltage ranges. A sensitive meter has the advantage that it does not take a heavy current from the battery, and the battery will therefore last for a long time. There is the further advantage that components such as miniature rectifiers will not be damaged by an excessive current when connected to the ohmmeter terminals. Low-priced microammeters have been obtainable at various times in the form of direction-finding indicators, thermometers, etc., but microammeters, scaled as such, are more expensive.

A true ohmmeter measures the voltage-current ratio by means of a pair of coils, but the ordinary type used in servicing responds to the current through

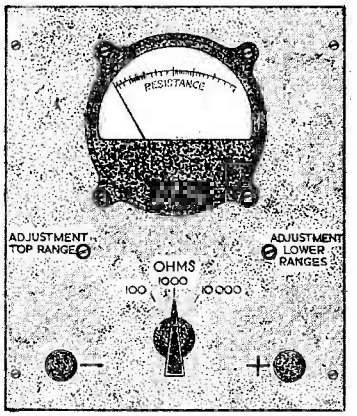


Fig. 1.—Top panel of the three-range ohmmeter which covers 100 ohms to 5 Megohms.

the resistance or else to the potential drop across it, but not to both simultaneously. The shunt form of ohmmeter, which measures a resistance in terms of its effect upon the potential drop, finds its most useful application in measuring low resistances, while the

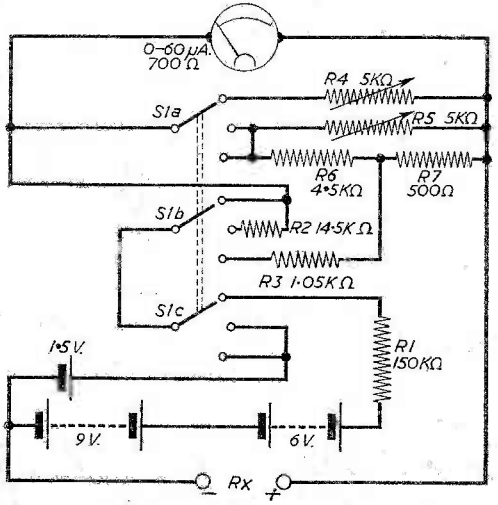


Fig. 3.—Circuit of an ohmmeter covering 100Ω to 5 MΩ in three ranges with a common scale.

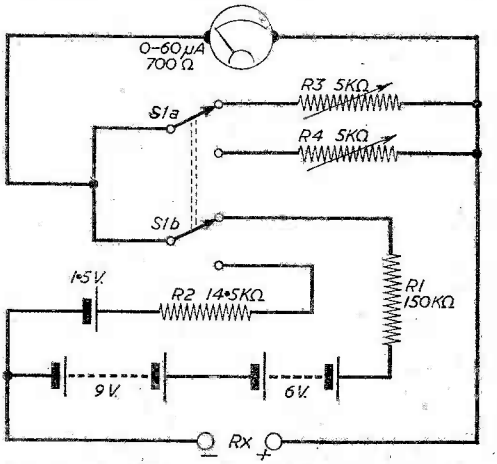


Fig. 2.—A simple circuit which measures from 1 KΩ to 5 MΩ in two ranges. Maximum current approximately 100μA. A single scale serves for both ranges.

series form, which measures the current through the resistance, is convenient for the higher ranges. As the formulæ of Fig. 5 show, both varieties have similar scale shapes except that the scale of the shunt ohmmeter increases from left to right, while the series form of scale increases in the opposite direction. It

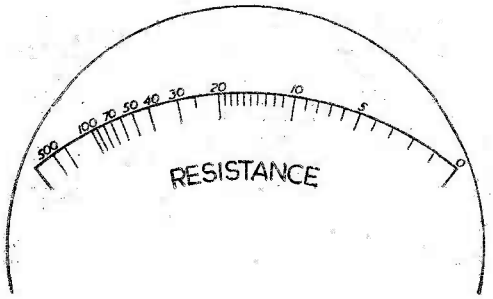


Fig. 4.—Scale of the ohmmeters of Figs. 2 and 3. Mid-scale value=15. On the different ranges the figures are to be multiplied by factors of 100, 1,000 and 10,000 respectively to give ohms values.

should be possible to devise circuits which will reverse either scale, so that a single scale could be made to serve both shunt and series forms, but it appears that the circuit arrangements would be rather awkward, and it is much simpler to use two scales—one for ranges of the series type and the other for the shunt type.

In setting zero and full-scale deflection the ends of the scale come into use, but the maximum value which it is worth marking will be short of the end of the scale, and the ratio of this maximum to the minimum division (just above zero) usefully expresses the range. The mid-scale reading, Ro, is important, since it is also the resistance of the ohmmeter itself on the particular range, and it can be related to the maximum and minimum division, these being, let us say, 25Ro and Ro/25 respectively (giving points equally spaced from the ends of the scale). A factor of 100 between adjacent ranges (and between their mid-scale values) would therefore be satisfactory, but quite often the factor is 10, as in the instruments to be described, and this means that a resistance can be measured on two or even three ranges at different parts of the scale. On adjacent ranges the ohmmeter resistance Ro is in the ratio 10 : 1, and the voltage must be in tenfold steps if the current is to be the same on all ranges. This is

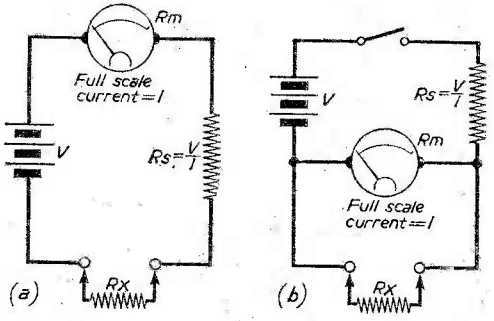


Fig. 5.—The formulæ for (a) series, and (b) shunt ohmmeters. Note that the scales obey similar laws except that one is reversed relative to the other, and Ro is likely to be lower in case (b).

more satisfactory than having tenfold increases in current, which it is desirable to minimise.

Obviously, a battery switch—preferably a push-button one—is required in the shunt form of ohmmeter, and also in some arrangements of the series type, but a series type of ohmmeter can be made in

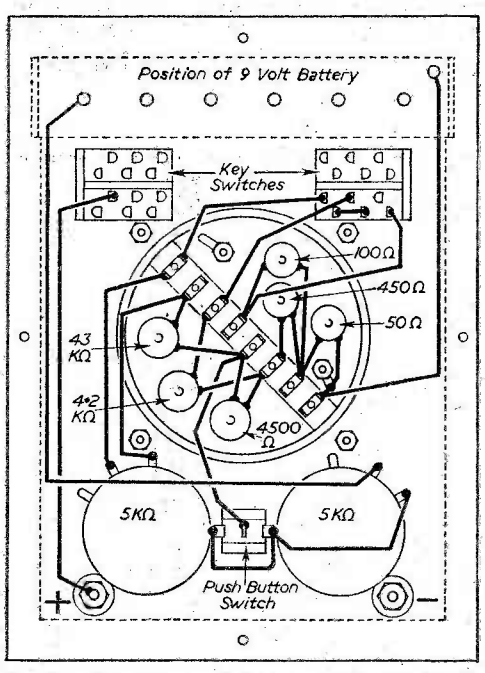


Fig. 7.—The reverse of the top panel, showing the components and some of the wiring.

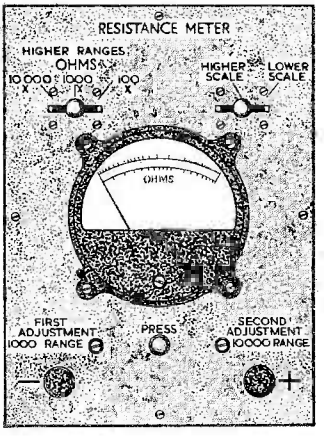


Fig. 6.—An ohmmeter in which a push-button switch has to be included. It measures from 1Ω to 2 MΩ in four ranges, the lowest of which has a separate scale.

which none is required, and this allows a more rapid succession of readings. However, the test leads should then be only a few inches long to make a prolonged accidental short-circuit of the terminals unlikely.

The Circuit

The circuit diagram, Fig. 2, is for an ohmmeter of this sort. The upper range uses 15 volts and the lower range 1.5 volts. Readjustment of the variable resistances R3 and R4 will be necessary from time to time to restore full-scale deflection with the ohmmeter terminals short-circuited. This compensates for the

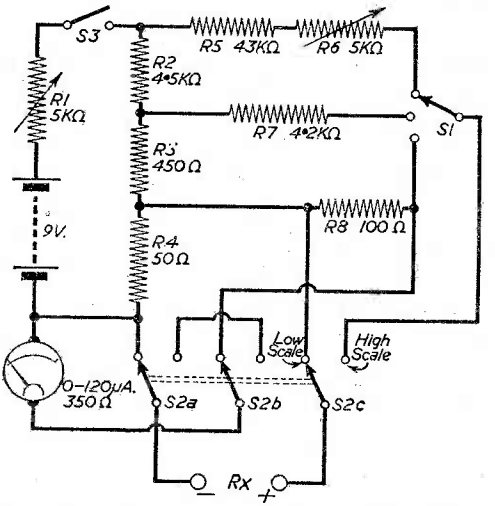


Fig. 10.—An ohmmeter circuit with four ranges which provides measurement between 1Ω and 2 MΩ. The lowest range has a separate scale.

fall in battery voltage with use, by increasing the sensitivity of the shunted microammeter. It is assumed that the ohmmeter resistance, Ro, remains constant, and the adjustments will in fact alter this resistance by less than 1 per cent. The increase which occurs in the resistance of the battery as it deteriorates should also have little effect. Both ranges use the same scale, but the values are multiplied by a factor of 10 on the upper range. The ranges have mid-scale values of 15 KΩ and 150 KΩ and cover 1 KΩ to 5 MΩ. A

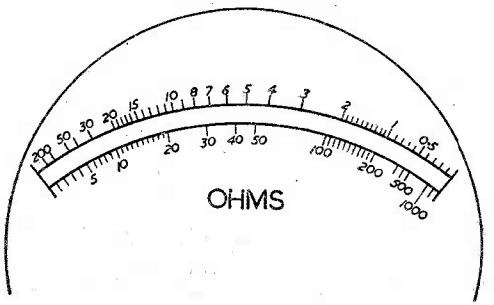


Fig. 12.—The two scales of the ohmmeter of Fig. 10. Mid-scale readings 5 (x 100, etc.) and 45Ω. The upper scale is for the three series ranges; the lower scale is for the lowest range, which uses the shunt method.

third range with 1.5 KΩ mid-scale can be added by including a universal shunt as in Fig. 3, but on this range the full-scale current becomes 1 mA. Other ranges could be added in the same way, but each lower range would demand a further tenfold increase

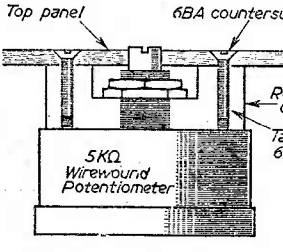


Fig. 8.—An unobtrusive method of mounting the pre-set potentiometers.

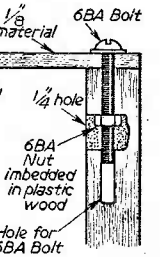


Fig. 9.—A method of using bolts instead of wood-screws to fasten the top.

of current, and so an extension to measurement below 100 ohms by this method is not very satisfactory.

Since, as the formulæ reveal, half-scale deflection in an ohmmeter is obtained when the external resistance equals the internal resistance of the ohmmeter, it follows that a high-resistance ohmmeter is suited to measuring high resistances and a low-resistance ohmmeter to low resistances. This decides the ratio of the battery voltage to the full-scale current of the meter, and a low voltage is clearly desirable for measuring low resistances, mainly in the interest of battery economy A reduced voltage is obtained in Fig. 10 by means of a potential divider which is connected across the battery when the push-button is depressed. The potential divider forms part of the series resistance on each range, in accordance with Thévenin's theorem. For the lowest range the shunt method is employed, with a separate scale. The mid-scale values are 45Ω, 500Ω, 5 KΩ and 50 KΩ, and measurement is between 1Ω and 2 MΩ.

Battery Deterioration

In this ohmmeter, adjustment for battery deterioration is made by reducing a resistance R1 in series with the potential divider, instead of by increasing a resistance across the microammeter. On the highest range this adjustment alters the effective series resistance, and an extra rheostat R6 is included to correct this. The resistance R1 is first adjusted on the second highest range, and then R6 is adjusted to ensure short-circuit f.s.d. on the highest range. On the two lower ranges the meter is damped by the low circuit resistance and the pointer moves a little less rapidly. The effect of temperature is also noticeable at f.s.d.,

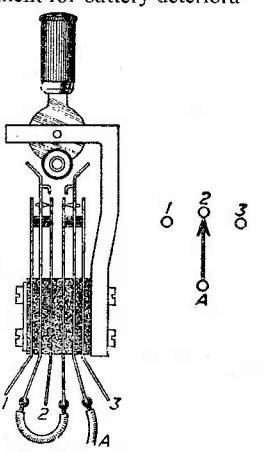


Fig. 11.—Connecting up a three-position key switch as one-pole, three-way.

since the meter is wound with copper wire and the other resistances are necessarily of low temperature coefficient. A change of 20 deg. F. may produce a discrepancy of nearly 5 per cent. at f.s.d. To overcome this it is necessary either to use the meter at a single temperature or to make R8 variable, but the error can usually be ignored.

A less sensitive meter has been used in this four-range ohmmeter—less sensitive, that is, to current, but it will be noticed that the potential sensitivity is the same, namely, 42 millivolts, f.s.d. This implies that the two meters would give similar results in the shunt method, although the 60 μA meter is superior for measuring high resistances by the series method, and will reach higher values. Microammeters are not actually wound to exact resistances as the diagrams suggest.

Construction

The microammeters shown in the illustrations were converted from direction-finding indicators. Two movements with crossover pointers were included in the bakelite case. One of these was removed and the case re-orientated relative to the remaining movement to bring it into a central position. A zero adjuster was also repositioned centrally and the holes in the case were filled in with black sealing wax. It is essential to exclude dust from moving coil instruments. A particle of steel lodging in the gap in which the coil moves, or a fine fibre rising from paper covering the scale plate, will cause "sticking" at some point in the swing of the pointer. The pointers, originally yellow, were painted black, and in the two-scale instrument a twist with a pair of tweezers produced a knife-edge pointer. As the ohmmeters are always used in a horizontal position, it was fortunately not necessary to worry very much about re-balancing the moving systems.

Paper was stuck to the scale plates with Durofix to take the scale markings, and it was therefore necessary to raise the pointer slightly either by bending it or by adjusting the screws of the jewelled bearings. The movement should be retained rather loosely between the jewels, care being taken not to blunt or detach the pivots, fold the pointer or distort the springs. One would hesitate to adopt such measures with an expensive microammeter, but if the scale plate is temporarily removed it may be possible to rub out the existing scale with an ink rubber, and it can then be replaced by an ohmmeter scale, or if preferred the microammeter can be left intact and used with a conversion table, which can be easily prepared.

The scale is first marked on with a sharp pencil and then replaced by Indian ink. In calibrating, it is best to work, if possible, on a single range, using a series of accurate resistances or a resistance box, the meter being screened from draughts which would move the pointer from its correct position. Alternatively the scale may be prepared largely from its formula (Fig. 5) with the aid of a slide rule and protractor, but discrepancies may appear.

Small bobbins found inside the direction-finding indicators and in other meters were modified or rewound to provide most of the resistances required in the ohmmeters. The others were high stability carbon ones. The bobbins could either be mounted inside the microammeter case or on a disc fixed to the outside as in Fig. 7. It will be appreciated that a large margin has been left for battery deterioration, and the values of the resistances are to some extent arbitrary, although the ratios must be correct if a single scale is to serve for a number of ranges. It is best to adjust the ratios of the universal shunt or the potential divider carefully by means of a bridge. This may be set up temporarily for the purpose, using the microammeter (protected by a potentiometer) as a null-detector. The series resistances can then be adjusted where necessary, under working conditions, for f.s.d. on short-circuit.

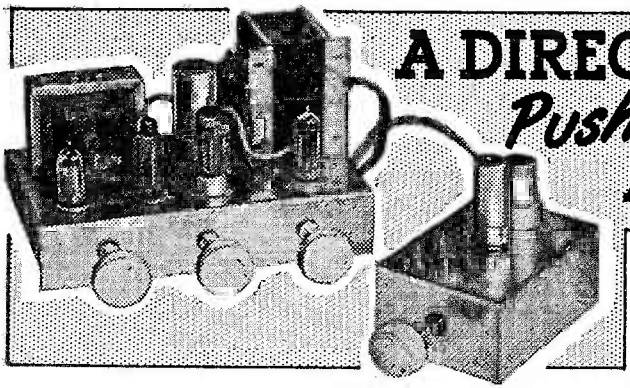
Various kinds of switches can be used, e.g., wafer switches, push-button and key switches. The last are very easily worked and are incorporated in one of the designs illustrated. The box is made of $\frac{3}{8}$in. wood with a $\frac{1}{8}$in. plywood bottom, and the $\frac{1}{4}$in. top panel may be of insulating material or even of plywood or hardboard. The screws which hold it will not often have to be unscrewed. If wood-screws are used and become loose they can be tightened by putting a little shellac in the hole, allowing it to dry, and then replacing the screw. An alternative which is very satisfactory is to sink 6 B.A. nuts in the wood as shown in Fig. 9. This is done with the aid of plastic wood, and enables 6 B.A. bolts to be used. The plastic wood is applied in several instalments and pressed in, the nut being held in place by the bolt until the plastic wood has set.

It is convenient to cover the top panel with paper, as the switch and other markings can then be made in Indian ink. The rest of the paper can then be filled in by a dark brown crayon, or by using stain. The paper is then glazed by rubbing Durofix over it with a strip of folded paper. Another method is to cover the markings with discs or rectangles of Perspex. Alternatively, an engraving tool could be used and the characters filled in with white paint. The terminals are marked + and — to facilitate the checking of electrolytic condensers and rectifiers.

On the higher ranges one soon recognises the possibility of shunting, the resistance being measured by holding the connections. This may place anything from 10 KΩ upwards in parallel with the resistance, depending upon the pressure with which the terminals or leads are held. In testing non-linear devices such as rectifiers, it has to be remembered that the resistance varies with voltage. From a knowledge of the ohmmeter circuit and the battery voltage, one can find the voltage across the rectifier at the particular resistance value indicated. The forward resistance observed will probably be a small fraction of the back resistance, but the voltage across the rectifier when measuring the back resistance will be much higher.

With electrolytic condensers, charging may occupy a large number of seconds, but a leakage resistance of something like a megohm should be observed when a full charge is approached. Paper capacitors will give a very small flick of the pointer, and in the case of the circuits of Figs. 2 and 3 the charge should be retained for a period during which reconnection to the ohmmeter will give no renewed indication.

An ohmmeter should not, of course, be connected to a "live" circuit or to a charged capacitor, and it is thus in no danger of receiving an overload such as can easily damage other meters in a momentary lapse of caution. The calibration should therefore remain reliable, and is easily checked at any time.



A DIRECT-COUPLED Push-Pull AMPLIFIER

THE 20-WATT VERSION OF A USEFUL AMPLIFIER, WITH TONE CONTROL AND PRE-AMPLIFIER

By J. S. Kendall

(*Continued from page* 811 *February issue*)

OFTEN the amplifier has a 7 ohm output so that two 15 ohm speakers can be used in parallel, or two 4 ohm in series.

A case can often arise, however, where a number of 4 ohm speakers, usually four, have to be joined to a 4 ohm output; this can be done as in Fig. 11. Some people with this type of circuit put in a wire as shown dotted and marked " A"; this, whilst assisting to keep the amplifier load balanced better in event of a speaker going open circuit, will allow an excessive power to pass through one speaker and seriously overload it. The overload can prove fatal to this second speaker.

Earlier the use of the " tweeter " or high note speaker was suggested. There is now on the market the German " Lorenz"; this is a very neat job with a plastic cone. It can also be used in systems up to 25 watt but must not itself handle more than five watts peak output. The speaker is known as the Lorenz LPH65 and has a rather differing characteristic from the normal tweeter ; it will handle from 1,600 cycles to 20,000 cycles that is a flat response to within 2 db. An amount of experimental work has been done with these speakers in the laboratory of Kendall and Mousley Ltd. Suitable crossover networks are given with the speakers, three in all, the simplest is shown in Fig. 12. The circuit is very simple and of course allows the speaker to be added to the normal radio receiver or 'gram with very little trouble.

The mounting of the tweeters can be a little trouble, some due to the nature of the sound waves radiated from them. These waves prefer to travel straight, but if reflected an amount of cancellation can occur. For example, in a hall it would be as well for the tweeters to be mounted fairly high in the room so directed that the sound beams from them would cross in the centre of the hall and fall in the far corners. With the radiogram simple mounting can be employed.

The observing of the phase relationship of the connections of the tweeters is also important.

The impedance of the LPH65 is given as 5.5 ohms, but it can be used with a crossover network in conjunction with a normal 4 ohm speaker. The speakers can also be used in series, and such a series combination would be preferred, if, say, a 15 ohm output was being used on the amplifier. The effect of using a crossover network with two 15 ohms speakers in parallel and fed from a 7.5 ohm output with only one LPH65 can be thoroughly recommended, even when fed with 25 watt, that is, to the network and not to the LPH65.

The 20-watt Model

This version is quite a high powered amplifier and it is rated at 20 watts for high fidelity reproduction. The valves chosen are the EL34 for the output with an EF86 driving. The EL34 is a rather high slope output pentode and quite well suited for the job. With this type of push-pull circuit the overall efficiency depends on the actual value of the cathode coupling resistor used. In this case it is only 1,000 ohms. In theory, for perfect coupling between the two valves, it should be 10 or more times the normal cathode bias resistance required for the valves in push-pull, but as the valves take between 160 to 180 mA the voltage drop has to be watched very closely. Even with 1,000 ohms the cathodes are running at 110 volts to chassis, and thus the H.T. voltage on the

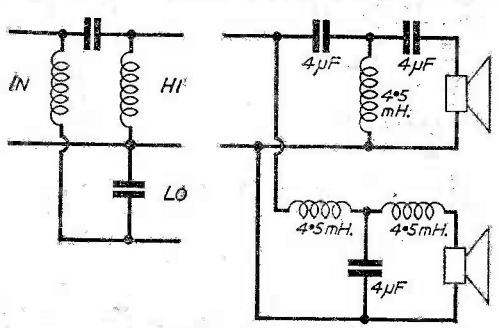


Fig. 13.—*Further speaker arrangements.*

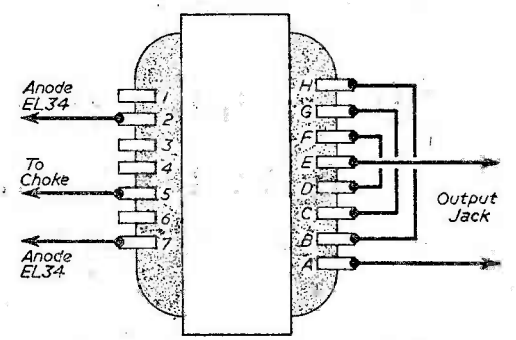


Fig. 14.—*Output transformer details.*

valves is reduced to just under 350 volts. Another limiting factor in the other direction is the anode voltage of the EF86. This must only be the normal bias voltage of the EL34s less their cathode voltage. Design balance has therefore to be maintained at the cost of overall electrical efficiency. The circuit is highly efficient from the point of view of fidelity. A similar static balance circuit is used as with the 10-watt version already described.

The tone control circuit for both amplifiers has been described earlier. Smoothing is not quite as simple as with the 10-watt model, and a large choke has had to be used. The mains transformer chosen is the Elstone MT/7 which will give 450 volts at 250 mA, thus an electrolytic capacitor must be chosen for reservoir that will stand both the voltage and the current. However, Hunts type KB554 is the ideal capacitor for this service as it will handle 300 mA as well as a surge voltage of 525 volts. Care should be taken to see that the slightly lower-priced capacitor, the KB554A, is *not* used, as it is only designed for a maximum current of 175 mA. It is not good policy to use just any capacitor in these heavy current circuits, as many capacitors, whilst being of the correct capacity and having the correct working voltage, just will not stand up to the ripple current—they can, in fact, make a very loud bang when they explode through overload.

The smoothing choke is a 250 mA 20H model, with a further 16 μF smoothing capacitor. This is all that is required for first-class smoothing. The feed to the octal holder at the rear for the feeder is fed with a 2.7 K 10 watt decoupled with the aid of an 8 μF. This latter is in the same can as the 16 μF and is a

LIST OF COMPONENTS

R1—3.9 K. 10 per cent. Lab. type "T."
R2—33 10 per cent. Lab type "T."
R3—1 M. 10 per cent. Lab. type "T."
R4—1 K. 10 per cent. Lab type "T."
R5—470 K. 10 per cent. Lab. type "T."
R6—100 10 per cent. Lab. type "T."
R7—100 10 per cent. Lab. type "T."
R8—1 K. 10 per cent. Lab. type "T."
R9—330 K. 2 per cent. Lab. high stability.
R10—10 K. 10 per cent. Lab. type "T."
R11—150 K. 2 per cent. 1 W. high stability.
R12—2.7 K. 10 W. Lab.

VR1—25 K. pre-set Lab.
Elstone MT/7 mains transformer, MT/30 output transformer.
SC/250 smoothing choke.
C1 Hunts 50 μF 12-volt JD27D.
C2—Hunts 0.1 μF 150 volt.
C4 and C3—Type KN564A, 32-32 450 v.
C5—Type KB554 16 μF 450 v.

Two EL34 or two KT66.
One GZ32 Mullard. **One EF86 or Z709.**
Four McMurdo valve holders I.0.
One McMurdo B8A valveholder.
Bulgin, three K107 knobs, two each J6 jacks and P38 plugs.
Chassis and case by Kendall & Mousley, Ltd.
Octal plug, nuts, bolts and wire, etc. Kendall & Mousley, Ltd.

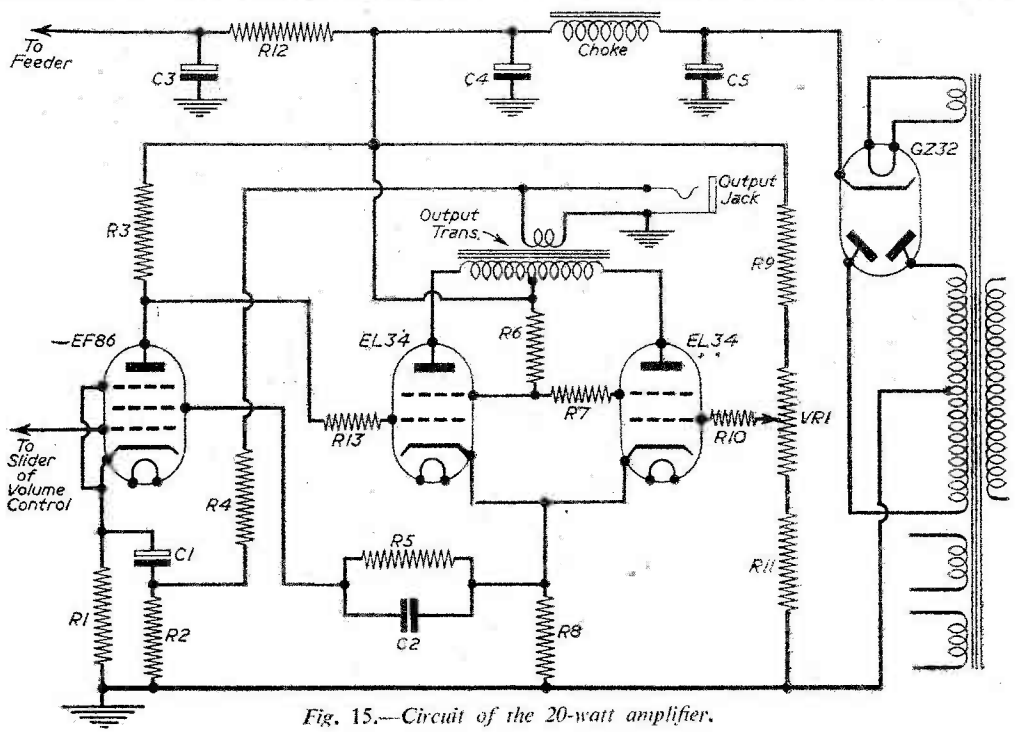


Fig. 15.—Circuit of the 20-watt amplifier.

Hunts KN561. The output transformer is of high power, with a rating of 30 watt maximum. This again was chosen as an Elstone job, the MR/30 being chosen.

The output transformer ratio chosen, or rather recommended, is to match the output valves to 7.5 ohms. This load can then be in the form of two 15-ohm speakers in parallel or two 4-ohm in series —either works equally well.

The Circuit

The basic circuit is shown in Fig. 15. The anode of the EF86 is taken direct to the grid of the EL34, whilst the screen of the EF86 is fed direct from the cathode of the two EL34s via a 1 M resistor (R5) and a 0.1 μF capacitor. This circuit, besides feeding the screen, introduces a quite large amount of N.F.B. via the screen of the EF86. A further feedback path is provided to the cathode of the EF86 from the output transformer secondary. It will thus be seen that there is a heavy overall feedback, resulting in a very low overall distortion.

The size of the chassis is 12in. x 8in. x 2½in., so that it will fit into a Kendall and Mousley type 9-14 instrument case. It is recommended, however, in view of the amount of heat generated by the amplifier, that the type "14" case be used as it is 10½in. high and 10½in. deep by 14in. long. The extra 1½in. clearance at the back and the front makes a large difference in the cooling of the amplifier.

Layout

The layout of the components is shown in Fig. 17. Separate heater windings are used for the rectifier and the feeder unit and the three valves of the amplifier are all fed from the same centre-tapped winding. The centre tap of this latter winding is taken to cathode of the output valve in order that the heater of the EF86 will be kept well positive and result in a very low overall hum level. It is a wise plan to mount

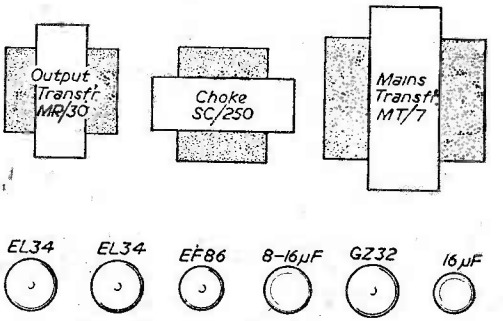


Fig. 17.—Diagram of the layout.

the 1,000-ohm cathode resistor directly under the hole in the chassis where the wires are taken through. This will assist in ventilation, as nearly 20 watts of heat has to be radiated away.

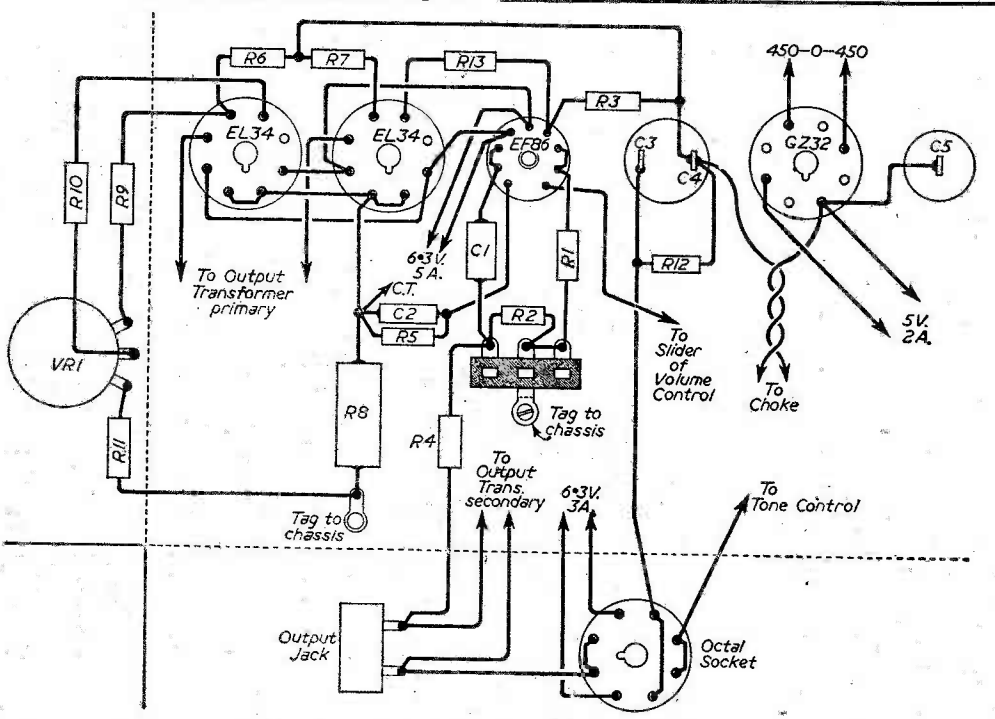


Fig. 16.—Wiring diagram of the 20-watt model.

Single Transistor Circuits

SOME ARRANGEMENTS EMPLOYING ONE TRANSISTOR ONLY

By F. G. Rayer

COMPLICATED circuits with several transistors are rather expensive to build and the testing and setting-up required, for correct operation, may also be considerable. Because of this, straightforward circuits employing a single transistor only should be found of interest and very worthwhile results can be achieved. The arrangements dealt with here can be built and used with a minimum of difficulty and employ a junction type PNP transistor.

A fair evaluation of results will help to avoid possible disappointment and a receiver using one transistor cannot have the range, sensitivity and volume obtainable from a one-valve receiver. On the other hand, no H.T. battery is necessary and the current drain from the small dry battery used is so small that it lasts several months. With proper operation really loud headphone results can be expected. Under less favourable conditions a transistor circuit will give satisfactory volume where a crystal set would be virtually useless.

A single transistor is not adequate for proper loudspeaker reception. It was, however, found that the circuits described could give speaker results at low volume. This is just sufficient for listening under conditions where there is no background noise. Despite this, the circuits are really intended for headphone listening and are easily adequate for this.

Transistor Detector

Fig. 1 shows one of the simplest circuits possible and many present-day transistors will act as detectors as well, on both M.W. and L.W. frequencies. Here, rectification arises between emitter and base. The small currents thus created allow larger currents to pass through the 'phones.

Reasonable results are obtainable if the emitter is taken directly to the aerial end of the coil. But volume increases with a coupling winding or tapping. If this circuit is to be tried with the minimum of trouble a standard coil such as the Wearite PHF2 can be employed, with the reaction winding feeding the emitter. As maximum volume is required the aerial is taken directly to the tuning coil. If lack of selectivity is troublesome the usual means may be introduced—e.g., a condenser of about 100 pF to 300 pF in the aerial lead-in, or substituting a coil with aerial tapping or aerial coupling winding. Lack of selectivity is less troublesome than with a crystal set, due to signals being taken from the coupling (reaction) winding.

If a coil is to be wound tappings on the tuned section give comparable results and this is shown in Fig. 2. The point is not very critical, but can easily be found by trial. As the tapping is moved from the earthed end of the coil volume will increase until a point is reached when it begins to fall. If experiment is not desired a tapping one-quarter the distance from the earthed end of the coil will be satisfactory.

For the M.W. band 90 turns of 30 s.w.g. enamelled wire on a former about ⅝in. to 1¼in. in diameter will do. For L.W. about 300 turns will be necessary. These will have to be pile-wound so that they may be accommodated. A dual-range coil can have 90 turns for M.W., and 200 further turns for L.W.

Small coils of modern type and efficient design, dust-cored and Litz wound, will be found to give very excellent results. Some transistors do not operate well on very high frequencies and reception is likely to be best on the L.W. band and middle and upper part of the M.W. band.

Simple Amplifier

A single transistor can be added to a crystal set to boost volume, by wiring base to detector and emitter to earth. This circuit is shown in Fig. 3. It is not essential to take the detector to a tapping on the coil, though this increases volume, as already explained. It is, however, necessary to have the output in the correct polarity. With some crystal sets it may thus be necessary to reverse the leads to the detector.

If the crystal detector is not efficient it will be best to remove it and employ the circuit in Fig. 1 as better volume will then be obtained.

To conserve battery life the circuits dealt with may have an on/off switch fitted in one battery lead.

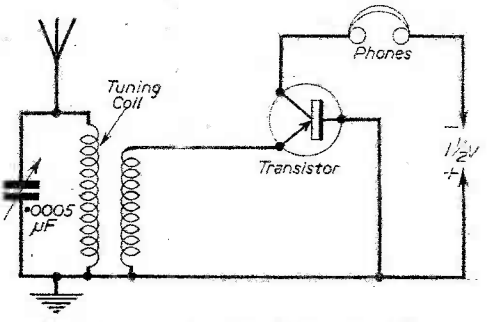


Fig. 1.—Transistor as detector-amplifier.

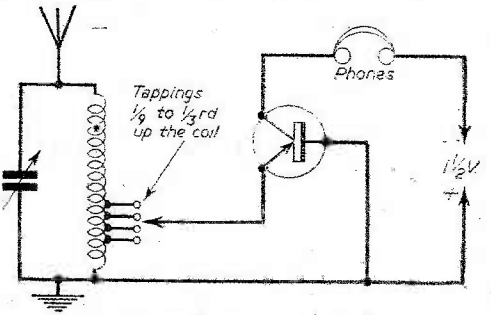


Fig. 2.—Using a tapped coil.

Alternatively, the 'phones may be removed to break the circuit.

Since maximum volume is in view the tuned circuit should be on reasonably efficient lines. An air-spaced tuning condenser is necessary and the coil should also be of good design.

Headphone Matching

Any type of headphones which have proved satisfactory with a crystal set will work well with the circuits given. 'Phones with a very high resistance

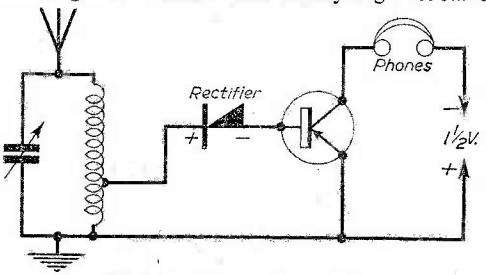


Fig. 3.—An A.F. amplifier.

are not so satisfactory as the types with windings of lower resistance and volume may then be reduced. If so, a multi-ratio speaker transformer will help to improve matching and it is connected as shown in Fig. 4.

A transformer with several tappings is necessary, the secondary being ignored. The transistor is connected so that relatively few turns are in series with its collector. The 'phones, on the other hand, are in parallel with a large part of the winding. It will be necessary to find both transistor and 'phone tapping points by trial.

Tests show that perfectly satisfactory results can be obtained with no transformer and 2,000 ohm 'phones. To some extent this arises from the small battery voltage, as current is very low. But if optimum results

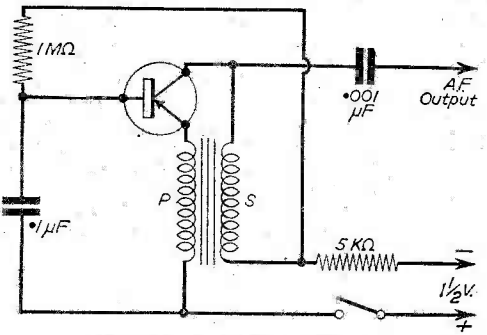


Fig. 5.—An audio oscillator.

are wanted it becomes necessary to ensure that the matching is reasonably correct. Whether or not a transformer improves volume will depend upon the 'phones. Many balanced-armature 'phones are of quite low resistance and these do not need a transformer.

An Audio Oscillator

It is not always realised that a single transistor can be made to oscillate with a suitable circuit. If components are chosen to produce an audible note, an A.F. signal generator is obtained. It will in no way be a miniature design, due to the transformer or choke, but it has useful applications as Morse oscillator, or for receiver testing.

Such an oscillator, requiring only one transistor, is shown in Fig. 5. A small ex-service coupling transformer was found ideal for this application, and if various transformers are to hand, each can be tried.

The transformer needs to have characteristics similar to those found in the inter-stage A.F. coupling components used in battery-type receivers. The older type of transformer, with fairly generous windings, is good, but it must not have too high a D.C. resistance. If no oscillation is obtained, connections to one winding need to be reversed.

Initially, the note may be heard by wiring phones

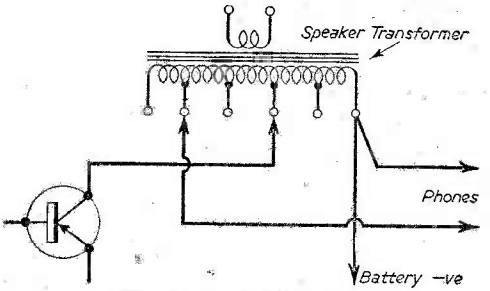


Fig. 4.—Output matching.

in one battery lead, or to the .001 μF condenser. If the note is not satisfactory, it can be increased in frequency by removing some of the transformer stampings from the core. It is also possible to change the note somewhat by modification of component values.

Other things unchanged, the audio tone produced will depend upon the transformer, so it is worth while trying such components as are available. The expedient of wiring secondary to emitter and primary to collector may also be tried.

Employing Reaction

Many transistors are sufficiently active to make reaction possible, and a circuit which it was found could be operated in this way is shown in Fig. 6. The coil-winding details given are for long waves, as the circuit could not be made to oscillate on the

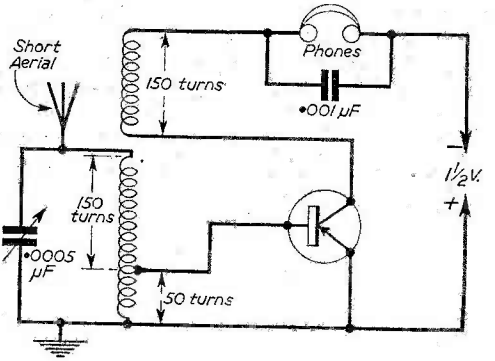


Fig. 6—Adding reaction.

M.W. band with the average transistor. Nor was the usual type of reaction, with variable condenser, sufficient.

Variable coupling is required between the coils, which are of the old basket type, about 2in. in diameter. If volume falls when the coils are brought together, connections to the reaction winding need reversing.

Reaction is much less satisfactory than with a valve detector. As volume increases, so does the efficiency of the transistor. As a result, the circuit tends to go abruptly into oscillation, and it is then necessary to separate the coils considerably to stop oscillation. But the circuit has the advantage of increased sensitivity despite these limitations.

The effect of reversing connections to base and emitter is worth trying. A long aerial must not be used, or no oscillation will be obtained. The by-pass condenser across the phones is necessary. Adjusted for best results, the circuit permits the use of a very short aerial. When the point at which oscillation commences has been found, the coil coupling can be adjusted to a trifle under this value.

Transistor Mounting

In order that the theoretical circuits may be followed correctly, the electrodes are shown in Fig. 7. It is particularly necessary when wiring, to see that the collector is not taken to any circuit at positive potential.

As damage to the transistor can quite easily arise, due to breaking the leads or from heat travelling from soldered joints, it is worth while mounting the transistor as illustrated. A small paxolin or ebonite piece is required, with three small terminals. The transistor leads are clamped under these terminals. When wiring, other leads can readily be connected

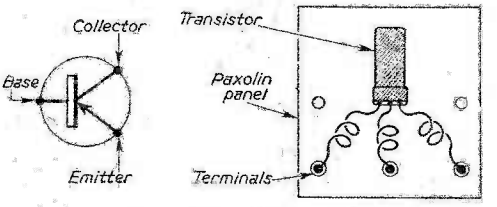


Fig. 7.—Transistor mounting.

up or removed. The paxolin square can be mounted by two small screws.

All the circuits described only require a 1½ v. supply, and this can be obtained from any single dry cell. With such batteries the zinc case is negative, and the inner carbon rod (with brass cap) is positive. A battery clip can be made by bolting two shaped brackets to a strip of insulating material, or leads may be soldered directly to the battery. The correct polarity must always be observed.

News from the Clubs

TORBAY AMATEUR RADIO SOCIETY

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

AT the meeting held on Saturday, December 15th, 1956, at the Y.M.C.A., Torquay, there was a poor attendance, caused by the bad weather conditions.

All members are asked to keep this date vacant: Torbay Radio Society Annual Social and Dinner will be held at Oswalds Hotel, Babbacombe, Torquay. Assemble 7.30 p.m., on Saturday, February 23rd, 1957. Tickets from G2GM, at 36, Shiphay Lane Torquay (Tel. No. Torquay 63365).

It is hoped that members will make this event a success—which it always has been in the past.

BURY RADIO SOCIETY

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

THE next meeting is:

February 12th—"A Broadcast Transistor Receiver," by G6QT.

The meetings are held at the George Hotel, Kay Gardens, Bury, at 8 p.m.

In addition, the clubroom at the A.T.C. headquarters, Hill Street, Bury, is open most Wednesday evenings.

CLIFTON AMATEUR RADIO SOCIETY

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

THE annual Christmas party was held on December 14th and was attended by many members and their friends. The Constructional Contest was won this year by the club chairman, J. Lambert, G3FNZ, with his 813 H.F. transmitter. In second place was W. Martin, G3FVG, who entered a 2-metre transmitter and receiver. The judges for the contest were S. Coursey, G3JJC, and P. Horwood, G3FRB, both members of the Cray Valley club.

At the last meeting in 1956, S. Horne, ex-G3IXL, ex-VE2AEE, and now VE3EGO, visited the clubrooms to renew old friendships and to show numerous colour-slides of photographs taken in Canada and the U.S.A.

Programme for February:

8th—To be arranged.

15th—Constructional Evening and Ragchew.

22nd—"Tape Recorders," by Messrs. Grundig (Great Britain) Ltd.

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

THE SLADE RADIO SOCIETY

Hon. Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23.

THE Club Station (G3JBN) at the Church House is available every day of the week for the use of members. Instructional and constructional classes are held on every Tuesday and Wednesday evening. The "Slade Net" will be on the air on the following Friday evenings—February 22nd and March 22nd.

February 15th—"A Demonstration of High Quality Sound Reproduction," by Messrs. Whiteley Electrical Radio Co. Ltd.

March 1st—"Circuit Applications of Transistors" by Mr. J. Chandler and Mr. A.W.Yates, of the British Thomson-Houston Co. Ltd., Rugby.

March 15th—"Brains Trust," followed by a description of the aims and purposes of the Radio Amateur Emergency Network (Raen) by Mr. A. E. Matthews, G3FZW.

March 29th—"Radio Direction Finding." The technicalities of D.F. by Mr. N. B. Simmonds and other members.

CRAY VALLEY RADIO CLUB

Hon. Sec.: S. W. Coursey, G3JJC, 49, Dulverton Road, New Eltham, London, S.E.9.

THE Annual General Meeting of the Club will be held at the Station Hotel, Sidcup, Kent, on Tuesday, March 26th, 1957, at 8 p.m. The Club is holding a "Brains Trust" and Quiz Session entitled "Your Questions Answered" at the Station Hotel, Sidcup, Kent, on February 26th, 1957, at 8 p.m.

THE SCARBOROUGH AMATEUR RADIO SOCIETY

Hon. Sec.: P. Briscombe, G8KU, "Roseacre," Irton, Nr. Scarborough, Yorks.

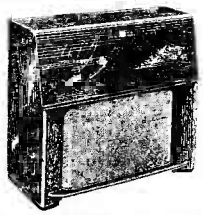
AT the Annual General Meeting held on Thursday, January 10th, 1957, P. Briscombe, G8KU, was once again elected Hon. Secretary. He has held this office each year since the war and his hard work and smiling service have earned the admiration of all those associated with him. Mr. Watson, G3JME, is now Chairman, and Fred. Powell is Hon. Treasurer.

The Society's Station, G4BP, will now be more active on 160 and 80 metres, phone and C.W. A 10-watt rig, made by G2YS, is now available and G3KJY has provided a very nice receiver.

Visitors and new members are invited to take part in a very comprehensive programme now being prepared. Meetings take place each Thursday evening at 7.30 p.m.

Built to the highest standard!

CABINETS



CAT. NO. CAB/02. A well-designed Bureau-type cabinet in a medium size. Veneered in a highly figured Walnut. Outside dimensions, length 29½in., depth 16in., height 32in. Sloping control panel on right-hand side approx. 13in. x 10½in. Removable baseboard on right-hand side, approx. 13½in. x 13in. Large record compartment inside the cabinet, located at the top on left-hand side.
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CASH
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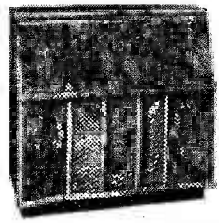
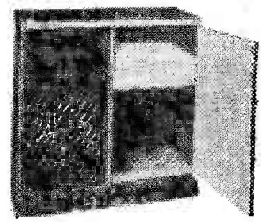
Packing and Carriage 25/-.





CAT. NO. CAB/04. Walnut veneered de luxe cabinet of the very highest quality with sycamore-lined interior and pull-out base on the right-hand side running on high quality ball bearings. Large silk-covered baffle board with speaker cut-out on right-hand side below chassis control panel. Overall size 32in. long x 32in. high x 16in. deep.
CASH
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Packing and Carriage 20/-.

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CAT. NO. CR/AFM49PP. Complete radio Chassis of latest Design and Technique. 9 valves. 4 wavebands including FM/VHF Band. Push Pull output stage, including special **10in. high-flux speaker.** A.C. 200/250 volts 50 cycles only. Suitably lit multi-coloured glass dial of the horizontal type. Slow motion tuning drive. Full provision of Automatic Volume Control. Negative feedback from output transformer secondary. Sockets provided for Aerial, Earth, Gram. Pick-up and Extension Speaker. Connections provided to Gram. Motor controlled by Chassis On/Off switch. All inductances have an exceptionally high Q value. The Audio Section is designed for first rate reproduction on Radio and Gramophone. The tone controls have been given an extra wide range to embrace all types of recordings. Size 15in. long x 8¾in. high x 7½in. deep

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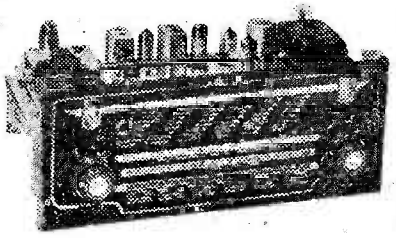
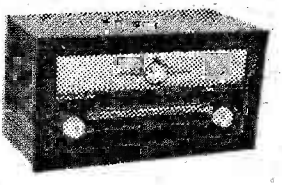


AM/FM (FOUR WAVEBANDS) TUNER CHASSIS. F.M. Short, Medium and Long. Six valves. Superhet with permeability tuned FM/VHF band. Magic Eye Tuning. FM band sensitivity of 0.9 microvolts. Minimum oscillator radiation. Less than 20 kilocycles drift. Signal to noise ratio better than 28db. Size 15in. long x 6¼in. high x 7½in. deep.

CASH **22 Gns.**

Or on Credit Terms.
Packing and carriage 15/-.



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Self powered. Six valves with grounded grid RF stage followed by additive mixer using a FCC85 twin triode in sealed permeability tuned unit. Two I.F. stages ensure maximum gain with 6AL5 double diode as ratio detector. Frequency coverage of 85-101 megacycles allows adequate overlap. Very finest quality throughout.

CAT. NO. FMT/A. Complete Unit in Cabinet with Magic Eye tuning. Boxed, 13in. long x 6¼in. overall depth x 7¼in. high (approx.).
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CAT. NO. FMT/B. Chassis only excluding magic-eye. Unboxed, 11½in. long x 5¾in. overall depth x 4in. high.
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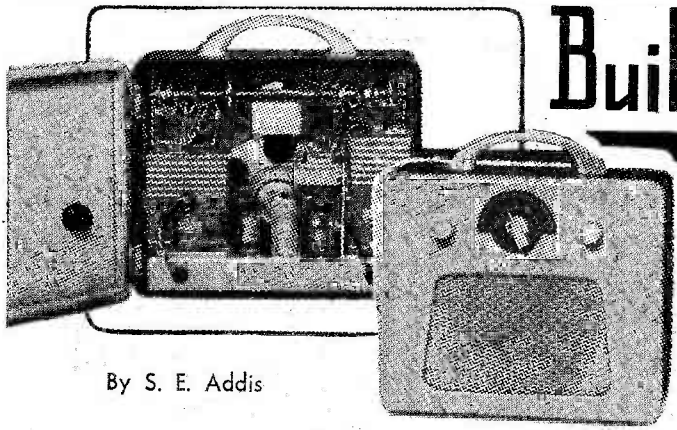


Building the MINI-SET

A MINIATURE BATTERY-OPERATED RECEIVER USING THE NEW LOW-CONSUMPTION VALVES AND A FERRITE ROD AERIAL

By S. E. Addis

(*Continued from page* 830 *February issue*)

FOLLOWING the successful building of the mains version of this set it was decided that a battery model would be welcomed by some constructors and so the design was put in hand.

It was found that a receiver could be constructed on the same lines as the mains version and the set was made to the same measurements and will fit the same cabinet.

In order to accommodate the batteries in the cabinet, some rearrangement of the components had to be made on the chassis but the front panel remains the same. In addition two brackets are required, one to support the output transformer and to form a partition for the H.T. battery, and one to form a partition for the L.T. battery. These small brackets, apart from supporting the output transformer, are really to stop the batteries from pressing against valves and I.F. transformer.

As will be seen from the circuit diagram the new Mullard 125 mA valves are used and for those readers not familiar with these types of valve it should be said that they are similar to existing types such as 1R5, 1T4, etc., or DK91, DF91, etc. except that the filament rating has been halved. This is a very useful improvement as it has the effect of making the L.T. battery last twice as long.

Circuit Description

The Ferrite Rod Aerial is tuned by one section of the midget twin-gang tuning condenser (C3) with trimmer (C1) connected across L1 for medium-wave operation and trimmer (C2) connected across L2 for long-wave operation.

Valve 1 (Mullard DK96) is a Heptode operating as frequency changer. Osmor Q08 and Q09 are medium and long waveband oscillator coils tuned by C7 second section of the 500 pF midget twin-gang tuning condenser with medium-wave trimming by C6.

Valve 2 (Mullard DF96) is a R.F. pentode operating as I.F. amplifier in conjunction with the Wearite I.F. transformers type M800.

Valve 3 (Mullard DAF96) is a diode pentode operating as signal and A.V.C. diode and A.F. pentode.

Valve 4 (Mullard DL96) is an output pentode, and together with the other valves in the circuit gives a

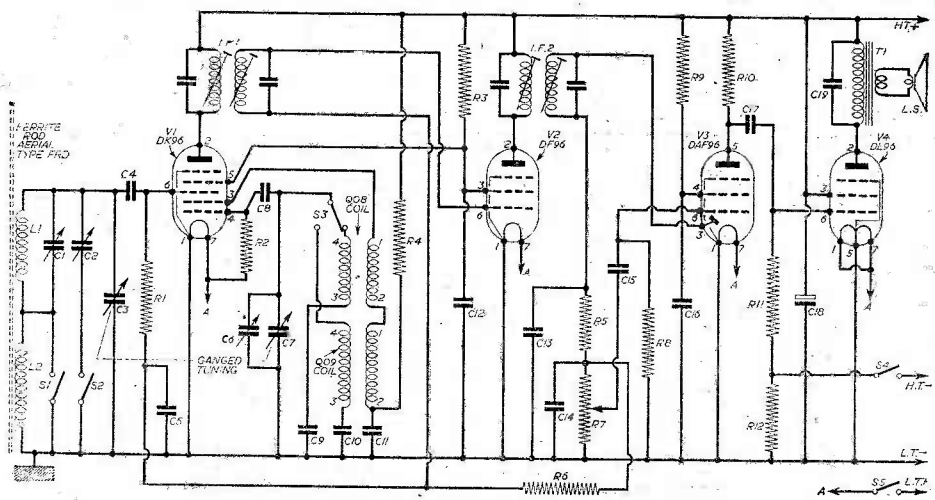


Fig. 1.—Theoretical circuit of the Battery Mini-Set.

total L.T. consumption of 125 mA. Total H.T. consumption is about 9.5 mA..

Construction

The receiver is constructed on a small chassis and panel as with the mains version, the chassis being 8in. x 2¾in. x 1in. and the panel 8in. x 6¾in. In addition two brackets size 2½in. x 3in. with ½in. right-angle bend will be required to support the batteries as mentioned earlier.

After all holes have been drilled, and the cut-out made for the loudspeaker, the tuning condenser, volume control and wavechange switch should be mounted on the panel together with the trimmers and oscillator coils.

Alignment

The alignment is as for the mains version, but final alignment should be carried out with the batteries in position and slight readjustment of the trimmers can be made when the set is fixed in the cabinet.

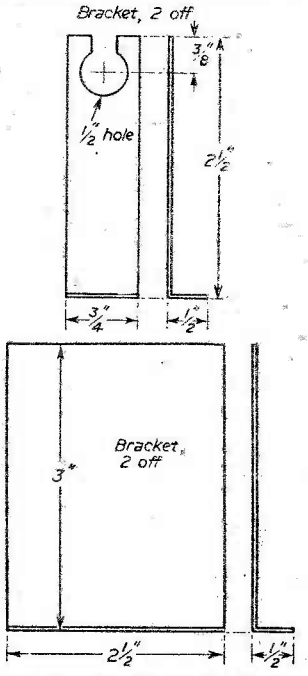


Fig. 2.—Details of the Ferrite Rod mount and bracket for output transformer.

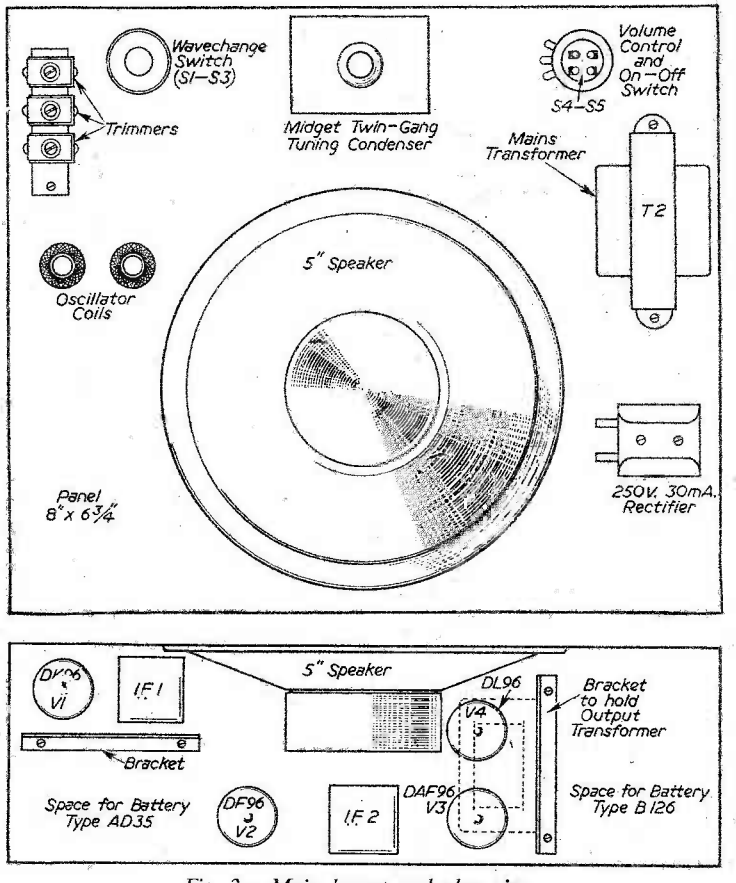


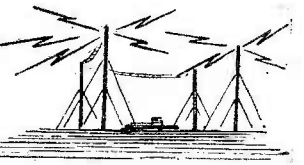
Fig. 3.—Main layout and plan view.

LIST OF COMPONENTS

Resistors
R1—1 MΩ ¼ watt.
R2—27 K ¼ watt.
R3—33 K ¼ watt.
R4—22 K ¼ watt.
R5—47 K ¼ watt.
R6—4.7 MΩ ¼ watt.
R7—1 MΩ volume control.
R8—6.8 MΩ ¼ watt.
R9—10 MΩ ¼ watt.
R10—2.7 MΩ ¼ watt.
R11—4.7 MΩ ¼ watt.
R12—470 ohms.

Condensers
C1—50 pF Trimmer .
C2—100 pF Trimmer.
C3—500 pF Tuner.
C4—150 pF Silver Mica.
C5—.01 μF 150 vw Tubular.
C6—50 pF Trimmer.
C7—500 pF Tuner.
C8—150 pF Silver Mica.
C9—470 pF Silver Mica.
C10—150 pF Silver Mica.
C11—.01 μF 150 vw Tubular.
C12—.01 μF 150 vw Tubular.
C13—100 pF Silver Mica.
C14—100 pF Silver Mica.
C15—.002 μF 150 vw Tubular.
C16—.1 μF 150 vw Tubular.
C17—.01 μF 150 vw Tubular.
C18—8 μF 150 vw Electrolytic.
C19—.005 μF 150 vw Tubular.
C3 & C7—Midget 500 pF Twin Gang Tuner.
T1—Midget Output Transformer 80-1.
Teletron Ferrite Rod Aerial type FRD.
Osmor Osc. Coils type Q08 & Q09.
Wearite 465 kc's I.F. Transformers type M800.
Stern Radio Portable type Tuning Scale.
4 B7G Valveholders.
2 Round Knobs.
1 Pointer Knob.
Battery Plugs.
3-pole 2-way wavechange switch.
R7—Midget 1 meg. volume control with switch.
Elac 5in. Loudspeaker type 5/56.
Valves
DK96 Mullard. DF96 Mullard.
DAF96 Mullard. DL96 Mullard.

Converting a HEARING AID



A MEDIUM- AND LONG-WAVE BROADCAST SET MADE FROM A STANDARD MEDRESCO AID

By M. J. Dunn

THE conception of the conversion to be described is extremely simple, although its execution is somewhat tricky in detail. During the actual building, every step was carefully tried out before the final construction in miniature was carried out, so that no awkward alterations had to be made in embarrassingly small spaces. A word of advice, not out of place here, to all those attempting miniature work, is to use a pair of dissecting forceps instead of fingers and to wear a pair of magnifying spectacles. The latter measure will obviate a great deal of eyestrain, especially when working for comparatively long stretches. It is essential, of course, to use a small soldering bit, the other requirements being a steady hand and the patience of Job!

When considering miniature receivers in general, the author contends that certain desiderata should be fulfilled, namely:

1. It should be really small and easy to carry about.

2. That there should be a minimum of accessory paraphernalia.

3. That it should function, in favourable conditions, with little or no aerial.

4. It should be capable of receiving all the principle services of the BBC; the Home Service, the Light and Third Programmes.

5. Its acoustical quality should be good.

These points will be dealt with as they arise during the course of the description to follow.

There are several different types of hearing aid available on the surplus market consisting basically of a high-gain audio amplifier of sub-miniature dimensions, and almost any of them can be usefully employed for constructing pocket-sized radio receivers. The conversion consists fundamentally of feeding the audio output from a tuned detector stage into the hearing aid amplifier. The writer has tried out various schemes to this end and found that excellent results can be obtained from the most simple circuits, all of which consist essentially of a tuned circuit and crystal diode detector. The arrangement to be discussed uses a home-wound Ferrite rod, tuned by a 250 pF trimmer feeding into a surplus germanium diode of no particular specification. The set is designed to receive the London Home Service (330 metres), the Light Programme (1,500 metres) and the Third Programme (464 metres). The author's house is some 70 miles from London, 50 from Daventry and 100 from Droitwich: it stands about 30ft. above sea level and the top storey is 40ft. from the ground. On the top storey good audible signals are obtainable from London and Daventry without an aerial or earth, but the addition of two metres of wire as an aerial gives first-class results from all three stations. In districts, therefore, fairly remote from the services required, it might be just as well to use a high-Q coil with a short aerial (and earth if required). I have found that in most situations earthing the top end of the coil works very well and is usually quite easy to achieve, but the optimum arrangement when distant from a station is a short aerial and a good earth. The locality will decide what is best and naturally one is going to meet tremendous differences in signal strength with any kind of portable receiver.

LIST OF COMPONENTS

Medresco Hearing Aid, Type OL 10.
L.T. and H.T. batteries for same.
Germanium diode (surplus).
Bare Ferrite rod (about 10 cms. long).
250 pF Trimmer (postage stamp type, e.g., Hunts').
Litz wire (6 strand).
For other minor requirements, see text.

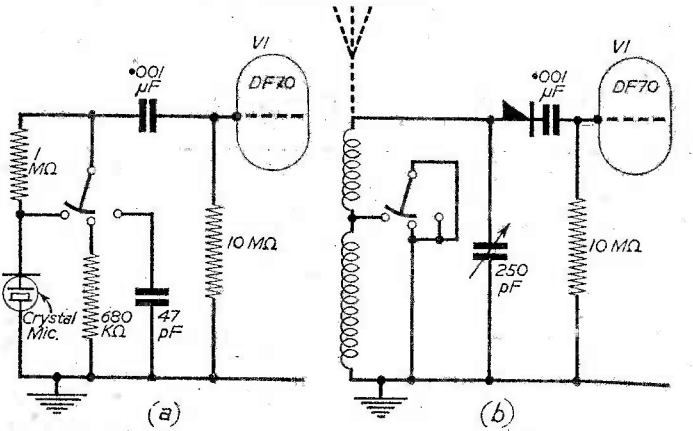


Fig. 1.—(a) The original input circuit; and (b) after conversion.

The hearing aid used was the Medresco " Crystal " OL 10 and it consists of a black bakelite case housing the amplifier and crystal microphone. Separate leads issue from the bottom of the case for the single earpiece and battery connections. The amplifier itself is of fairly straightforward design and employs valves DF70, DF70, DL71. The circuit is identical with that recommended in the Medical Research Council's Report No. 261, p. 47.

Removing the Chassis from the Case

Care must be exercised throughout all the operations to avoid damage to wiring and miniature

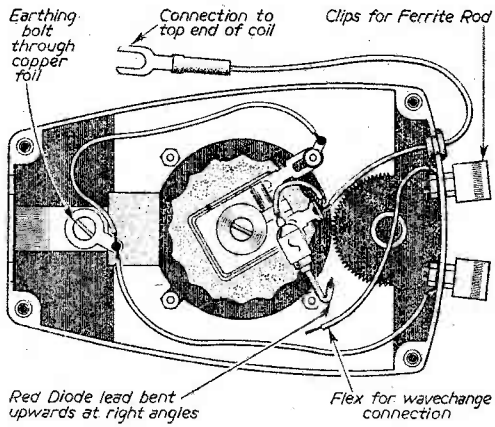


Fig. 2.—Inside front of case after construction of diode receiver.

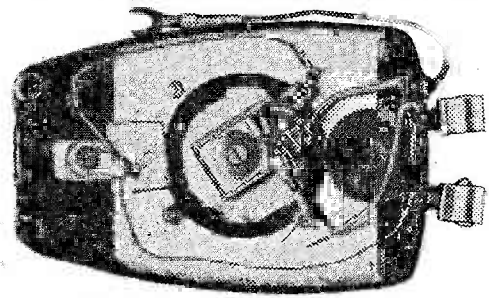
components. First lay the aid face downwards, preferably on a large sheet of white paper in a good light, and unscrew the four countersunk bolts, one at each corner. Then, holding the two halves of the case firmly together turn the instrument over on its back and only then remove the front of the case. This will reveal the chassis on the microphone side and the whole may then be gently raised off the four corner pillars and taken right out. Four springs will be found, one on each pillar. Once the chassis has been removed the conversion is undertaken in three parts : (1) alterations to the chassis, (2) alterations made to the front half of the case and (3) the winding of the Ferrite rod. The rear half of the case may, therefore, be put on one side until the work is completed. There are also some refinements which are desirable if the finished receiver is to be used for listening to music. These three stages will now be considered in order.

Alterations to the Chassis

These are few.

1. Gently but firmly prise up the microphone until free and unsolder the two connections. (The mike is not required further and may be placed in the spares box.)

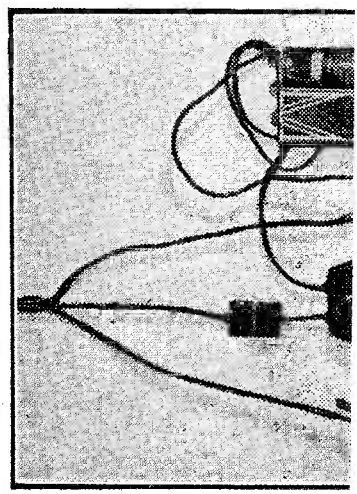
2. Remove the two resistors and one capacitor which constitute the tone correction network and which are situated to the left of the volume control, together with all the leads to the tone control switch (which is destined to be used as a wave-change switch). We are now left with two free wires passing to the rear of the chassis. One of these is an earth connection and is left alone at this point, the other



Actual photograph of the view in Fig. 2.

passing through a hole will be found to be the free lead of the grid capacitor of the first valve.

3. Draw this free wire back through the hole and cut it short to a critical length so that with a small loop at its free end this loop will lie exactly over the hole through which the lead was drawn (this loop, or simply the end bent over, will ultimately take the end of the diode which will pass up through the same hole). Before making the loop it is as well to tin the end of the wire (Fig. 6).



The complete receiver v

4. The wave-change switch may now be dealt with. Its connections will be found on the front side of the chassis and it will be seen to consist of a central wiper and three selector positions. Choose any one of the outer two connections for the coil, and the remainder may then be wired together and

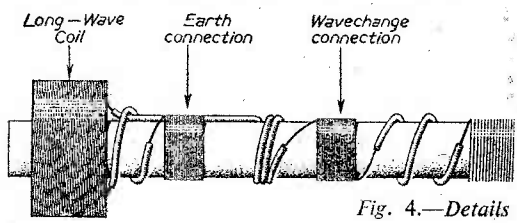
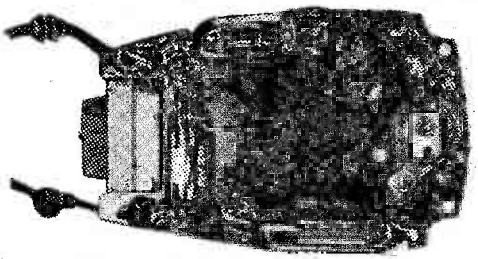


Fig. 4.—Details

earthed. First bend the free earth connection (mentioned in secion 2) so that it can be soldered to one of these switch connections. A bare tinned wire may then be run to all the earthed points, not forget-

ting to re-earth the casing of the volume control which was disconnected when removing the tone filter (Fig. 3).

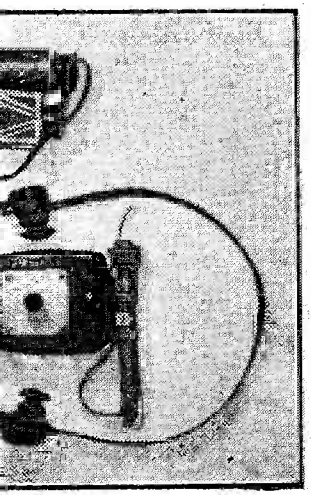
5. Next a small hole is drilled through the chassis just below the switch, and an insulated wire, soldered to the coil switch connection, is passed through this



Photograph of the view at Fig. 3.

hole and extends on the front side sufficiently to allow connection to a flexible wire coming from the coil. (See Figs. 6 and 3.)

These operations completed, the chassis is now ready, and at this juncture it is as well to feed an audio signal (ideally from a crystal set) into the amplifier to see that all is correct.

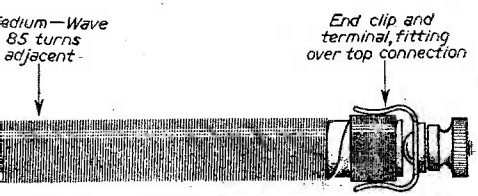


'i a double head-set.

Preparation of Front of the Case (Fig. 2)

It is upon this that the diode tuner unit is built. The Ferrite rod fits on to two clips on top of the case, and the diode and 250 pF trimmer are housed inside.

1. Working from the inside, first snip round the protecting gauze which covers the microphone grille. This done the grille itself is carefully cut out to leave a circular hole. (Proceed with care because the bakelite is very brittle.)



the Ferrite rod aerial.

2. From some suitable sheet aluminium cut out a small square, the size about 4 cms. File the corners off round, and in each drill a hole for 6 or 8 B.A. bolts (to correspond to similar holes to be drilled on the front of the case) and also a central hole to accommodate the bush thread of the trimmer. This metal panel fits centrally over the circular hole in the case and is bolted to it through the four coinciding holes. Inside the case a solder-tag should be put under one of the four nuts for earthing purposes.

3. Remove the adjusting screw from the trimmer and replace it with one of the same thread but about twice as long. This will then project externally and can be fitted with the bakelite knob from an old S.G. valve (1930 vintage) held firm by a lock-nut.

4. Three slots are now cut in the upper free edge of the case. Two of these are placed 1 cm. equidistant from the midline on either side of the volume control knob, their width and depth being such that they

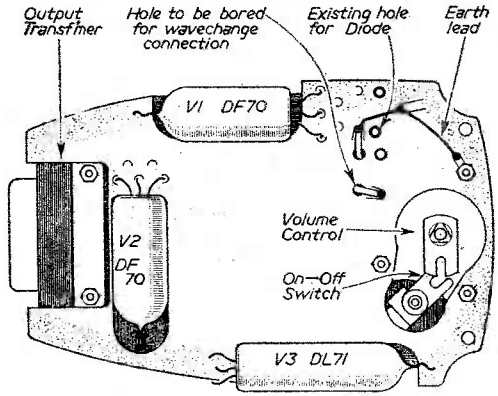


Fig. 3.—Rear of chassis after conversion.

will accommodate a 6 B.A. bolt snugly. The third hole is placed close to the right-hand of these two latter (viewed from the front) and this will house a very small grommet through which will pass the connection to the top of the coil.

5. Two suitable clips (e.g., from a fuse-holder) are bolted to the top of the case through the two slots mentioned above, and these will hold and make connection with the Ferrite rod.

6. A hole is drilled to take a 4 or 6 B.A. bolt through the front of the case at the lower end in the midline. A bolt is passed through this and the head on the inside should make contact with the copper screening inside the case and should have a solder-tag placed under it. Outside there is a terminal nut to take an earth connection where necessary.

7. With everything fixed in position this part may now be wired.

(*a*) A bare tinned wire is run round and soldered to all the points to be earthed, connecting these to the earthing tag mentioned under (6) above.

(*b*) Next solder the black end of the diode and a thin piece of flex to the non-earthed connection of the trimmer, the latter passing through the grommet should be left reasonably long ultimately to fit on to the top end of the coil. It can be cut to length later.

(*c*) Connect another short length of flex to the other clip and leave this free inside the case, eventually to make the wavechange connection.

(d) Ascertain the exact position of the hole in the chassis through which will pass the red diode wire

and then bend the latter (after putting on some sleeving) at right angles so that its free end points vertically upwards and will then pass precisely through the hole.

This finishes the alterations to the aid itself and the chassis may now be replaced. While doing this make sure that the volume control/on-off switch control engages with the peg on the knob, and also guide the sleeved wire from the diode through the appropriate hole in the chassis. This may then be soldered to the

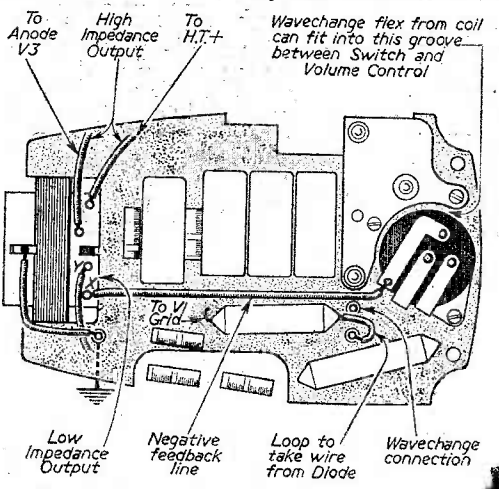


Fig. 6.—Rear of chassis after conversion.

loop in the capacitor lead and also the flex from the coil to the wire from the wave-change switch.

Preparation and Winding of the Ferrite Rod

The geographical situation of the writer's house (25 miles north of Cambridge) necessitated using a L.W. coil for the reception of the Light Programme, but this will not be necessary in areas where the signal strength of the medium-wave station is adequate. This would obviate the necessity of the wave-change switch and the third coil connection, so that the entire conversion would be very much simplified.

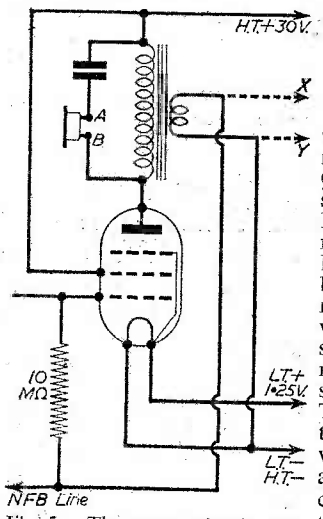
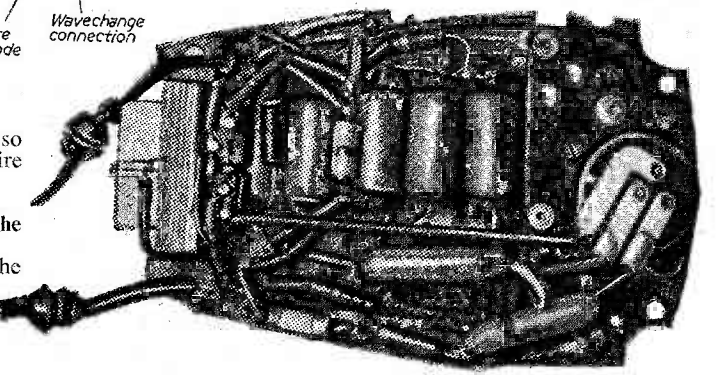


Fig. 5.—The output circuit. XY provides low impedance, and AB high-impedance outputs.

The details about to be given apply to the reception of London 330 metres, Daventry 464 metres and Droitwich 1,500 metres. Constructors wishing to receive other stations would do well to try out their coils first with ordinary wire to avoid having to make subsequent alterations to Litz windings.

The Ferrite rod used was 10 cms. long and the exact dimensions are best obtained from the accompanying diagram. First the rod is covered by a layer of insulating material, which may be kept in place by cellulose tape. For the long-wave section the writer had a suitable surplus Litz-wound coil which exactly fitted the diameter of the rod. The medium-wave section consists of 85 adjacent turns of six-stranded Litz wire. With this arrangement it was found that 330 metres was tunable just above the minimum position of the tuning trimmer and that 464 metres could be tuned just short of maximum position. Soldering the ends of the Litz wire was achieved by firmly but gently teasing the strands with very fine steel wool soaked in acetone. These were examined under a powerful magnification before tinning.

The three connections along the rod are made by tinning a length of bare copper wire, winding it tightly around the rod at the appropriate position and while still tightly held the hot solder bit is stroked over the surface to weld the turns together. The coil connections are made to these contacts, two of which fit into the clips on the top of the case, the third to the free flex (Fig. 4).



Photograph of the view shown in Fig. 6.

We now have a pocket radio with two-range tuning, the audio output of which feeds into a single high-impedance earpiece. The wave-change switch is adjustable by a small screwdriver or any similar device that is handy. As it stands it is excellent for listening to speech, but leaves much to be desired if one wishes to listen to music seriously. To this latter end some useful refinements may be effected.

In its existing form the output of the receiver is fed through a step-down transformer, the primary of which acts as an A.F. choke, which is shunted by the high-impedance phone and a 0.1 μF capacitor in series. The secondary of the transformer is utilised solely for the provision of negative feedback to the grid of V2 (via the bottom end of the volume control). For musical fidelity certain conditions are essential with headphone reception:

1. Optimum matching.

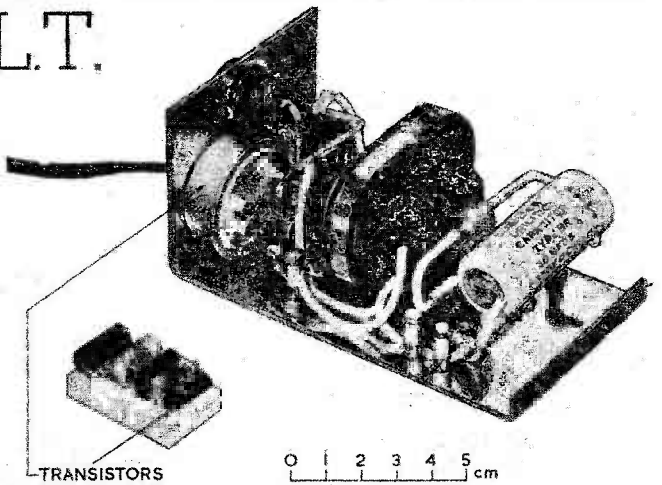
(*Concluded on page* 58)

H.T. from L.T.

SOME INTERESTING METHODS OF GENERATING LOW TENSION SUPPLIES

THE following details have been reprinted, with permission, from the *Mullard Outlook*, and will undoubtedly answer many of the questions which readers continually raise on problems connected with the supply of H.T.

The problem of obtaining the anode and screen-grid voltage supplies in receivers and other apparatus, when only a low voltage supply is available, is conventionally met by the use of a vibrator. There are, however, at least two other possibilities. One, which involves a new conception of "H.T.," consists in running valves at very low anode and screen-grid voltages. Thus in a car radio the anodes and screen-grids in the earlier stages would be run at about 12 volts, and the output stage would be transistorised. This arrangement (which, incidentally, is possible only with specially developed valve types) dispenses with the vibrator and its disadvantages, and effects a considerable reduction of battery drain. The redesign of one particular receiver along these lines was found to provide a battery drain reduction from 3 or 4 amps to about 1 amp without any serious loss of performance.



Converters with 2mW and 4 to 6W output.

The Transistor D.C. Converter

A second new method of providing H.T. (this time in its conventional sense) from an accumulator or a dry battery, is the transistor D.C. converter. This device performs the same sequence of operations as the conventional vibrator unit. The battery input is interrupted, the resulting waveform is stepped up to the required level, and the output is rectified, smoothed, and delivered to the load.

The last of these three closely linked processes follows normal practice; and it may be elaborated by means of multiplier arrangements to give output voltages in the kilovolt range. The step-up stage can be either a transformer (with, for high powers, push-pull operation) or a ringing choke system.

The interruptor stage, which is analogous to the electromechanical vibrator, makes use of the fact that a transistor can be made to switch rapidly between two extreme states. The first state is "bottoming," in which the working point is somewhere below the knee of the collector voltage/collector current characteristic. In this condition the collector current is high (limited, of course, by the rating of the transistor) the voltage is very low (perhaps only a fifth of a volt) and the dissipation is also low. In the opposite condition the transistor is cut off, the collector voltage is high, the current is very small and the dissipation is again low. Hence the losses in the interruptor stage are virtually only those which occur in the transistor while it is changing from one state to the other. Good circuit design, correct choice of transistor, and the use of the optimum operating frequency, allow performance at quite low loss levels.

Efficiency

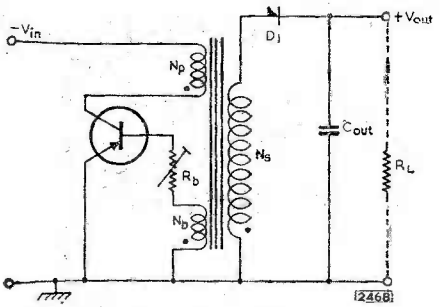
The smallness of the losses in the interruptor stage gives the transistor converter its chief advantage over the conventional vibrator and other devices, for these devices all need a certain irreducible power drain to maintain operation. Thus a vibrator system, even when new, has an efficiency of only about 55 per cent. at 5W output, with a considerable reduction below 1W (at which level the power required to operate the device exceeds the power delivered). The transistor converter on the other hand will maintain an efficiency of 65 to 85 per cent. from its upper power limit of tens of watts down to about 5 mW.

The Ringing Choke Converter

A full description of the action and design of the ringing choke version of the transistor converter can be found in the *Proceedings* of the I.E.E. (November, 1955, part B). The following is an outline of the action of the basic circuit.

During the input stroke the transistor is "on" (that is, bottomed) and the supply voltage produces a linearly rising current in the primary inductance of the transformer. The linear flux change induces a steady voltage in the base winding, and thus an almost constant negative bias to the transistor. The working point rises to the knee of the collector voltage/current characteristic and starts to move round it. The resistance of the transistor now incresses from its very low "on" state value, therefore the current supplied to the primary inductance falls. The induced voltage in the base winding also falls as the flux decreases, and the changing bias voltage reduces the current through the transistor still further. When this rapid cumulative cut-off is complete, the flux in the transformer collapses and the secondary voltage reverses. As soon as this voltage reaches the voltage level already existing across the output capacitor it discharges through the diode (which hitherto has been non-conducting) and into the output circuit. When the

secondary voltage falls below the output capacitor voltage, conduction through the diode ceases. The transistor (which has remained cut off during the output stroke) then returns rapidly to its starting point and the next input stroke immediately follows.



Basic circuit of ringing choke converter.

The first cycle of operation is usually started by surge currents when the battery voltage is connected. These surges produce the necessary negative base voltage swing. It is often convenient, however, to arrange a push-button starter which momentarily applies part of the battery voltage negatively to the base. In subsequent cycles a negative base voltage swing is provided by stray ringing voltages in the transformer. When the cycle of operation is established it can be inhibited by the application of a long positive pulse to the base.

The Transformer-coupled Converter

In one version of this alternative circuit the feedback can be applied to the emitter rather than to the base, with the advantage that switch-off is determined by core saturation rather than by the characteristics of the transistor.

In the push-pull version of the transformer-coupled circuit the two transistors act as switches which "make" alternatively, so that the input is applied to each half-primary in turn. The transistors are switched on into the bottomed condition by feedback applied to the emitters. Part of the input current flows into the load and part is stored in the transformer inductance. When the core saturates, the transistor comes out of bottoming and cumulative switch-off occurs. The consequent reversal of the transformer voltages then switches the second transistor on and the half-cycle is repeated.

The output is taken from the two half-secondaries in turn, with the appropriate diode conducting. The energy stored in the transformer inductance is largely fed to the output during the first half of the conduction period. In one of the single-ended forms of the transformer-coupled circuit it is, instead, restored to the input battery, but this arrangement necessitates the use of an additional diode.

Comparisons

The ringing choke circuit is simple and efficient, but it has a rather high output impedance, and it cannot readily be adapted for push-pull operation. The transformer-coupled circuit has a low output impedance, and it lends itself to adaptation, but the maintenance of operation under heavy loading conditions tends to be difficult. Push-pull circuits, such as the one already illustrated, allow a relatively small transformer to be used for a given output. The expense of the unit is, however, increased.

The chief advantages of the device are its long life, its compactness, its simple smoothing arrangements (which follow from its relatively high operating frequency), its efficiency (which is particularly marked at lower power levels), its modest power requirements (allowing dry battery operation of apparatus hitherto dependent on accumulators) and its innocence of spark-generated interference.

Refinements

The basic circuits which have been described are usually elaborated to give, first, improved regulation, and, secondly, a considerable measure of protection from overload or no-load conditions.

It is possible to use a separate transistor oscillator in place of the self-oscillating arrangements described. Faster switching is obtained in this way, and transient losses are therefore reduced. A practical converter of this kind has provided an output of more than 20W from an output stage using two 2W power transistors in push-pull.

Applications

The versatility of the transistor D.C. converter is indicated by the accompanying table of H.T. supply

(*Continued on page 66*)

Input	*Output*	*Operating frequency*	*Efficiency*	*Possible applications*
1.3 or 2.6 v.	30 v., 100 μA: or 40 v., 75 μA	10 kc/s	60%	2-valve hearing aid.
6 v.	45 to 50 v., 3 mA	3 kc/s	80%	Frequency changer and I.F. amplifier stages of a battery receiver.
6 v.	90 v., 12 mA	1 kc/s	70%	Typical battery receiver.
6 v.	135 v., 17 mA,	1 kc/s	70%	Large A.M. or F.M. receiver.
12 v.	10 kV, 100 μA	1.5 kc/s	55%	E.H.T. unit.
12 v.	2 kV, 750 μA; and 150 v., 3 mA	1 kc/s	70%	Oscilloscope supply.
4.5 v.	400 to 700 v. 60 to 35 μA	2 kc/s	70%	Radiation counter.
12 v.	100 to 150 v. 4 to 5W	700 c/s	75%	Portable transmitter and receiver.

Use has been made in this article of some of the information and diagrams in the Paper entitled "Transistor D.C. Converters" by Light and Hooker, which was first published by the Institution of Electrical Engineers as Paper No. 1862R in April, 1955, and republished in Part B of the *Proceedings* of that Institution in November, 1955.

Some of the circuits discussed are the subjects of patents or of patent applications. The push-pull circuit illustrated was developed by Uchrin and Taylor (see *Proc. I.R.E.*, Jan., 1955).

An A.C. All-wave Superhet

A GENERAL PURPOSE RECEIVER FOR THE MORE ADVANCED EXPERIMENTER

THIS receiver uses a ready-made coil pack, which greatly simplifies assembling and connecting-up and enables a compact layout to be obtained without difficulty. The coil pack tunes Long, Medium and one Short Wave band, and the inductances are dust cored. On the S.W. band primary windings are used for both aerial and oscillator coupling, but bottom-end coupling is used on both Long and Medium waves. All the associated components, including the six trimmers, are already present and wired in the coil pack, which is mounted on the front runner of the chassis by means of the bush of the integral wavechange switch. This provides the earth-return for the various condensers and coils, and only five leads require to be connected. These issue from the back of the coil pack.

This pack has separate coils for each band and was found to give excellent results on each range. Short Wave results are particularly good, when correct alignment is secured, especially bearing in mind that many "all-wave" receivers fall off in efficiency to some extent upon these wavelengths. Alignment at the high-wavelength end of each waveband is secured by adjusting the cores; ceramic trimmers are used for adjustment at the low-wavelength ends of the wavebands. If the instructions, which will be given are followed, no difficulty should arise in arriving at satisfactory settings, and the intermediate-frequency transformers can also be aligned effectively without an oscillator.

The circuit employs four valves, plus rectifier. Some mains superhets have a double-diode-pentode in the output stage, thus enabling a full superhet circuit, including rectifier, to be made up with only four valves. This type of circuit has not been used in the present instance, however, and the additional stage of L.F. amplification obtained from the triode section of the 6Q7 greatly increases volume. It also enables a pick-up to be used with success, whereas volume for this purpose would be rather low, when only one stage of L.F. amplification (provided by the output valve) is available. A good measure of A.V.C. is obtained, the A.V.C. voltage with a powerful signal, as measured with a 10,000 ohms per volt meter, being about 15 volts. (It should be noted that practically no reading will be obtained here if a meter with a low internal resistance is used.)

A tone control of simple type is provided and this can be left at any desired setting since the on/off switch is combined with the volume control potentiometer. The latter, being of the L.F. type, enables volume to be reduced to absolutely zero, and operates on both radio and gram. The measure of mains smoothing employed was found to be ample, background hum being scarcely audible. A fairly compact layout is used, but no attempt has been made to arrive at a "midget" type of receiver, where space is cramped and wiring difficult, as a result, in many cases.

The tonal quality of reproduction should be considered amply good for all normal purposes with plenty of volume. Accordingly the receiver has a wide field of general utility.

Chassis Details

The chassis is approximately 13½in. × 5½in. × 2½in. deep, and can be made by bending two runners 2½in. deep along a piece of aluminium 13½in. × 10½in. The material should be of stout gauge, 16 S.W.G. being suitable. Alternatively, a ready-made chassis which is suitable for the receiver may be obtained from the supplier listed and this greatly facilitates constructional work. If the chassis is being made up all drilling should be accomplished before mounting any of the components to avoid damaging the latter. A suitable cut-out for the transformer can be made by drilling a series of small holes, or drilling corner holes and completing the work with a small metal saw. The valveholders may be mounted either above or below the chassis; the latter gives a slightly neater appearance. In the diagrams they are shown above the chassis to clarify sub-chassis wiring.

The 8 plus 16μF condenser is mounted by means of a clip, this providing the negative connection to the chassis. The tags project through a hole, and that marked as being for the 8μF section should be taken to the rectifier cathode, as illustrated. The 16μF section is wired to the H.T. positive line of the receiver.

All connections are clearly shown and no difficulty should arise in wiring up, though one or two points need mention. In the sub-chassis plan one .1μF condenser, and the 25μF bias condenser with associated 3,000 ohm resistor, are shown *outside* the rear runner. This is to clarify wiring adjacent to the runner, and these components lie against the edge of the runner, inside.

Insulated wire is necessary throughout, and joints and the bare ends of resistors or other components should not touch each other or the chassis. Points marked "M.C." are taken to tags bolted to the chassis.

When wiring in the coil pack take the white lead to the .0005μF aerial condenser. The black lead goes to the .15 megohm A.V.C. line resistor. The blue lead is taken to the .0001μF oscillator grid condenser, and a lead also passes from this point up through the chassis to the fixed plates tag of the rear section of the gang condenser. The green lead is also taken up in this way, through a second hole, to the fixed plates tag of the front section of the gang condenser. The red lead is taken to the .0002 μF oscillator anode condenser. The band-switch nut should be tightened securely to provide a sound earth-return between pack and chassis.

If the resistors are colour coded, care should be taken to make quite sure that the values are correctly read, and, in particular, that the correct number of noughts has been ascertained. An incorrect value may cause distortion, poor results, or complete absence of signals, according to the circuit position and degree of error, and this has been found to arise occasionally. If ex-government or similar potentiometers are pressed into service, see that the bushes are "dead." No signals will be heard if the volume control centre tag is common to the bush; a tone

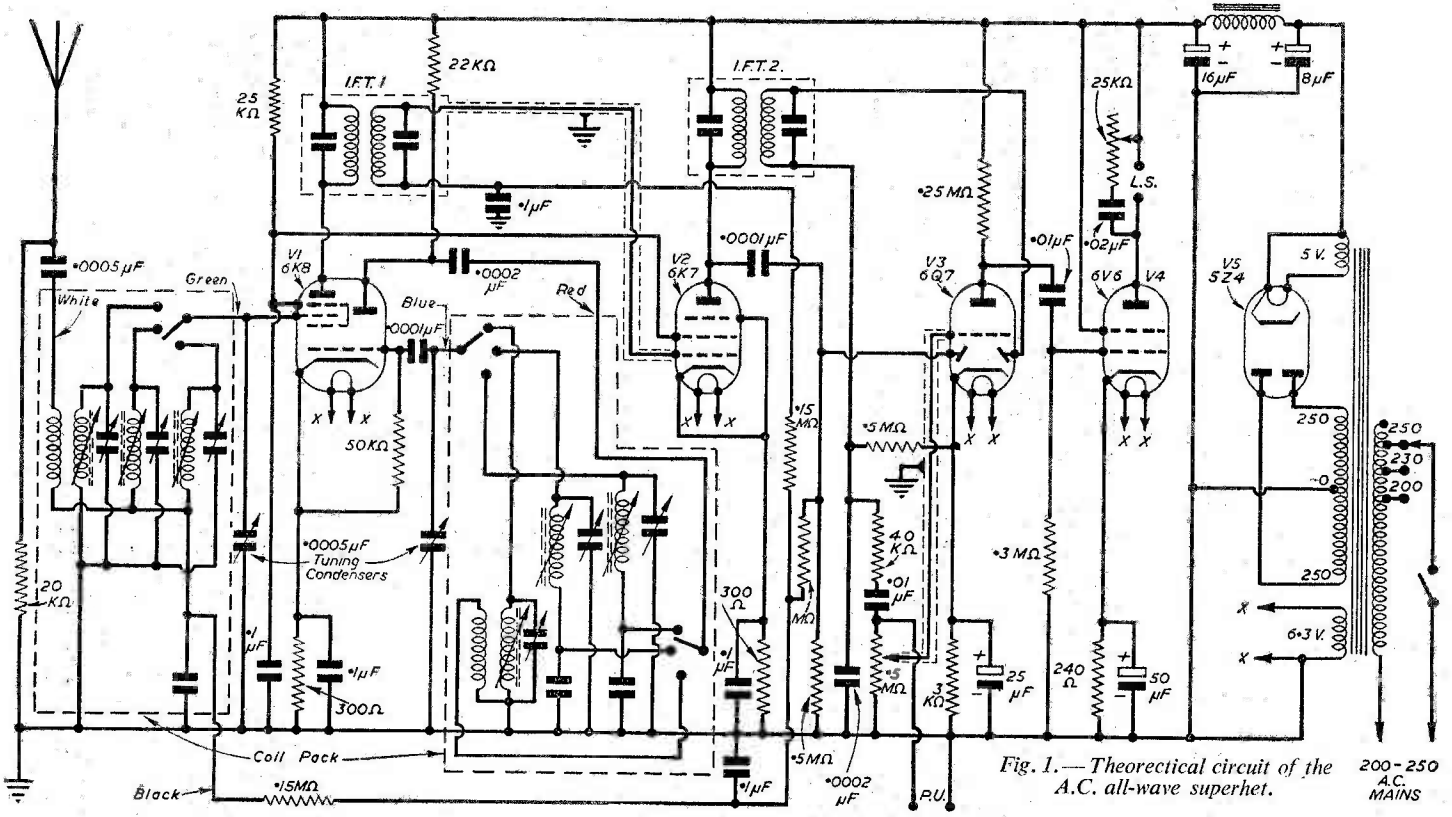


Fig. 1.—Theorectical circuit of the A.C. all-wave superhet.

COMPONENT LIST

"Astral" 3 Band S.Het. Coil Pack (Astral Radio Products).

2-gang .0005 μF J.B. condenser with drive.

2 465 kc/s I.F. transformers.

8 plus 16 μF smoothing condenser with clip.

20 Henry. 60 mA 250 ohm smoothing choke.

.0005 μF fixed condenser
Two .0002 ditto.
Two .0001 ditto
Two .01 ditto
Five .1 ditto
25 μF 25 v. bias condenser
50 μF 50 v. ditto
½ Watt resistors :—
20,000 ohm
Two 300 ohm
22,000 ohm

50,000 ohm
Two .15 Megohm
1 Megohm
1 .5 Megohm
1 .3 Megohm
40,000 ohm
.25 Megohm
3,000 ohm
25,000 ohm, 1 watt
240 ohm, 1 watt

25,000 ohm potentiometer (Morganite, etc.).
.5 Megohm ditto with switch (Morganite, etc.).
5 McMurdo octal holders, metal for chassis, and A.E., PU socket, *OR*
5-valve superhet chassis with holders, etc. (Osmor).
250-0-250, 6.3 v. 5 v. Elstone drop-through transformer (Osmor).
6K8, 6K7, 6Q7, 6V6 and 5Z4G valves.
Screened lead, bolts and nuts, etc.

control potentiometer of this type would cause damage to the smoothing choke and rectifier unless insulated from the chassis, in which case the spindle would still be alive to H.T. positive.

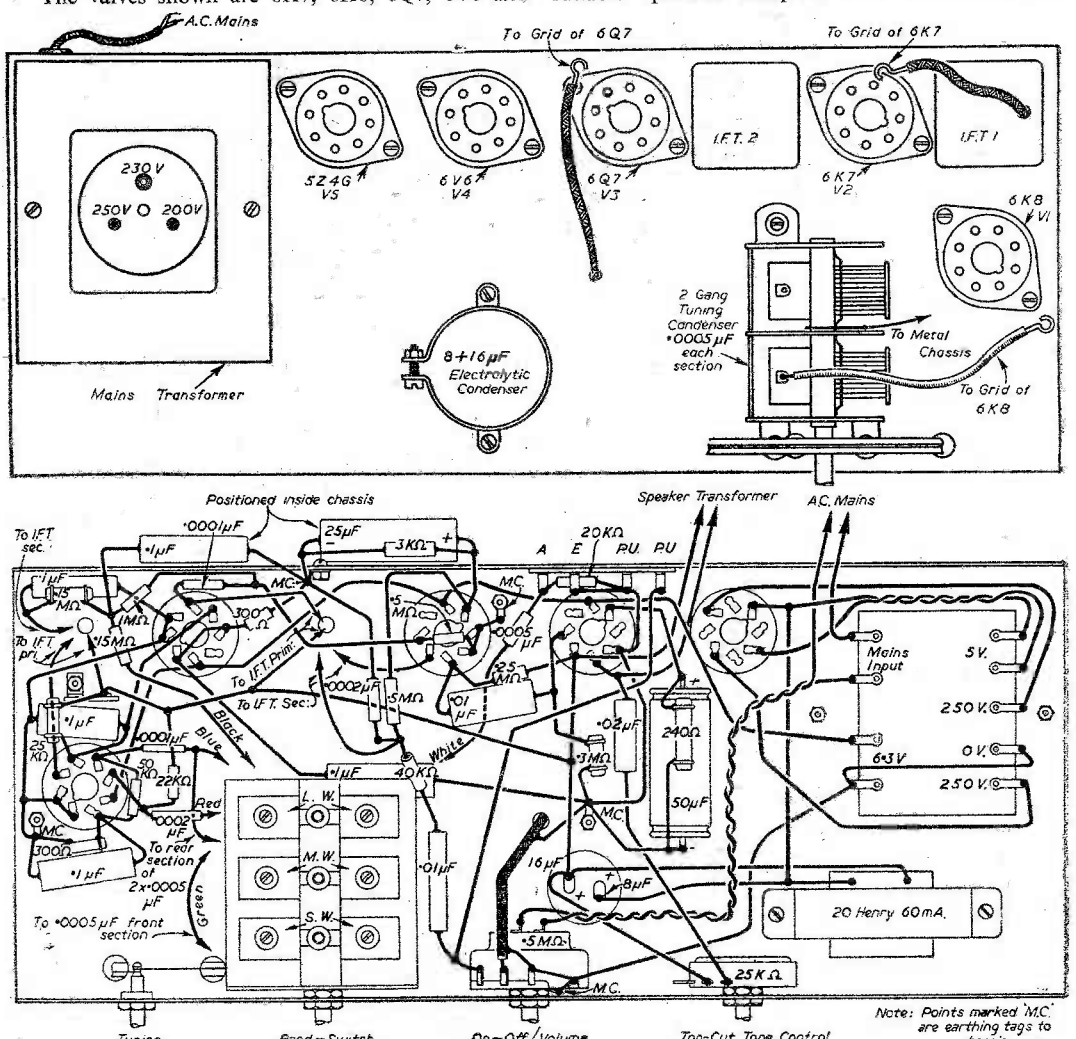
The driving cord is taken once round the drum, round the tuning control spindle, then back to the drum. There, it is passed through the slot provided and looped round the tension spring, the ends being tied.

Heater leads should be kept adjacent to the chassis and away from other wiring. The one .1 μF condenser lies partly under the coil pack ; it is wired to chassis and 6K7 cathode. Wire all the electrolytic condensers in correct polarity, and if the .1 μF condensers have one end marked "O.F." (outside foil), or have a ring, employ that end for the chassis connection.

Valves and Speaker

The valves shown are 6K7, 6K8, 6Q7, 6V6 and 5Z4G, but valves with the "G" or "GT" suffix are equally suitable, here. This merely indicates the type of envelope employed. If equivalents are to hand, these can be used. The Marconi/Osram X65 is an equivalent of the 6K8G. The W63 is comparable to the 6K7G. The DH63 may be used instead of 6Q7, while the Mullard GZ30 is suitable for the 5Z4G position. However, if new valves are being obtained, those listed are in general most readily obtainable.

The loudspeaker should have an optimum load, with its transformer, of approximately 5,000 ohms. With the usual 2-3 ohm speaker a transformer of a ratio of approximately 45 : 1 is necessary, reduced to 18 : 1 for a 15 ohm speaker. The transformer primary should be able to handle an average current of 50 mA, and the speaker should, of course, be of the permanent-magnet type, since no provision for mains energising is made. The supplier listed can provide suitable speakers complete with transformer for



Figs. 2 and 3.—Top and underchassis details.

6V6 output valve, but other speakers could be used. An 8in. model is suggested and it *must* be enclosed in a cabinet, or secured to a baffle, for proper results.

Gram Reproduction

The usual type of medium impedance moving-iron pick-up will give good results, though other types may be employed. To assure stability and freedom from hum the pick-up leads may be screened. The outer, screening brading should be taken to the pick-up socket which is wired to the earth socket at the rear of the chassis. If a microphone is used this must be coupled in the correct manner. With ribbon and moving-coil microphones a transformer is necessary. With carbon microphones a transformer of suitable type and a dry-battery (about 3 to 6 volts) to energise the primary. As two stages of amplification are available, good results can be obtained, except in the case of ribbon microphones of small output. Sound waves from the speaker should not reach the microphone or howling will arise.

Aligning Procedure

The six trimmers on the coil-pack should be adjusted to roughly a mid-way position, as should the I.F. transformers. The A.V.C. should be rendered inoperative by shorting the junction of the two .15 megohm resistors and 1 megohm resistor to chassis. It should then be possible to tune in the local station. Having received a signal adjust the I.F. transformers for maximum response, reducing volume by means of the volume control to compensate for this. It should now be possible to pick up a number of stations round each waveband. Select one of as high a wavelength as possible on the M.W. band and adjust the M.W. oscillator coil core, simultaneously operating the tuning knob until the pointer indicates the wavelength correctly on the tuning dial. Then leave tuning knob and oscillator coil and adjust the M.W. aerial coil core for maximum volume, reducing volume if necessary by means of the volume control. The receiver should then be tuned to a station of low wavelength in the M.W. band and the M.W. oscillator trimmer adjusted until the pointer gives a correct indication. The M.W. aerial trimmer is then adjusted for maximum volume.

The band switch can now be turned to the L.W. position and the same adjustments made to the L.W. cores and trimmers. The S.W. band is then treated in the same manner. The whole procedure may now be repeated, remembering to treat each band individually and leave the trimmers and coils associated with other bands untouched. After having done this many more stations will have become audible throughout all wavebands, and it will be possible to select weak transmissions and repeat the procedure, including alignment of I.F.T. circuits, to see if any further improvement in sensitivity is possible. When no further adjustment of any core or trimmer improves volume of a station correctly tuned in the shorting wire may be removed and the A.V.C. permitted to function.

A special note is necessary on aligning the set on the S.W. band. If the cores are severely out of position there may be an almost total absence of signals. But by tuning slowly round the band some signal should be heard; the S.W. coils can then be roughly adjusted to obtain some measure of ganging, whereupon other stations throughout the band will become audible and correct alignment can be undertaken as already explained.

Final Notes

It was not found necessary to employ additional screening in the receiver, since wiring was positioned with the possibility of stray pick-up in mind. However, the lead from the one pick-up socket to the volume control may be screened, and also the lead from control centre tag to 6Q7 cap. The screened brading should be bonded to chassis.

Though individual components have in some cases been specified there is, in general, no reason why other components of similar characteristics should not be employed with success. It should be assured, however, that such components *are* of an equivalent type and that they can be accommodated in the space available.

Information Sought

Design of a 'scope built around the ZC8932 required by **J. Martin of Stirling.**

Circuit of the R.1093 required by **A. R. Tinkler of Leicester,** who also wishes to contact another enthusiast of his own age (15).

Details of an ex-American Air Force receiver which covers 190 to 550 kc/s and has six valves. It was intended to work from a dynamotor—input 28 volts, output 250 volts. It came from a Liberator bomber. **K. Bailey of Norwich** requires this information.

F. J. L. Griffiths of Hereford requires details of a pre-war set which consisted of a 6A6 transmitter—one half oscillating and the other modulating. The oscillator was crystal controlled. It appeared in a magazine.

R. L. Tetley of Edgware asks for details of an ex-government receiver which appears to be R.1074. It is totally enclosed and incorporates nine valves.

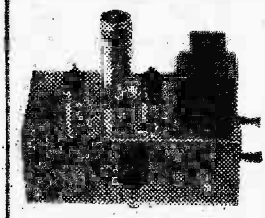
Details are needed of a pre-war Goodson (?) five-valver. It had two type 60 valves in push-pull in the output stage. **R. Fairley of Barrow** asks.

G. K. Young of Southend-on-Sea seeks information on a radar set type 43. A circuit alone would do.

A negative earth EHT and deflector circuit for use with the 12in. VCR131 tube by **J. H. Wickham of Wembley.**

J. Martin of Bannockburn requires details of an oscilloscope built around ZC8932.

D. Sadeke of Ilford requires details for fitting a pick-up socket and an "S" meter to the R107 receiver.



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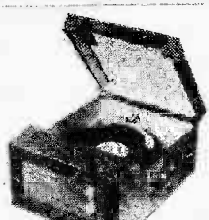

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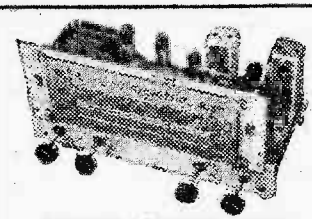

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6K7	6/6	EBC41	10/6	EL84	11/6
6K8	8/6	EBC33	8/6	EY51	10/6
6Q7	8/6	ECC84	12/6	EZ40	8/6
6SN7	8/6	ECF80	12/6	EZ80	8/6
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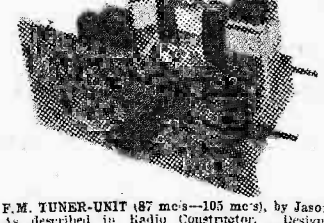

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TRANSMITTING TOPICS

...TERS ON THE V.F.O.

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

SEVERAL misconceptions appear regularly concerning V.F.O. problems. Generally speaking, V.F.O. problems boil down to a consideration of either frequency stability or of arranging for a definite frequency coverage so as to cover a given band comfortably. As far as frequency stability goes, there are many aspects that determine the final performance of the V.F.O. These are worth considering carefully, as they are often glossed over or otherwise neglected, sometimes with disastrous results.

From time to time new "magic" circuits are announced for which exaggerated claims are made with respect to frequency stability. Generally, these circuits turn out to be thinly disguised versions of old and familiar circuits. The recently heralded TESLA circuit, for example, is our old friend the familiar Colpits. Let it be stated once and for all that "other things being equal" there is not the slightest difference in stability between any of these circuits. Thus, with correct design one oscillator circuit may be made as stable as another. This will immediately create dissension among the proponents of the so-called Clapp circuit, whose originator would now appear to be Harries. However, the saving clause is ". . . other things being equal." Briefly, the equality is that the oscillatory circuits of the oscillators should be of the same Q value.

Why then is the Clapp circuit so popular? The great popularity of the Clapp circuit is not based on superstition, but upon experience. It just so happens that the Clapp combines two requirements for a stable V.F.O. very happily. Thus, with the usual circuit constants the coil inductance is relatively high, and this gives a good coil Q. It is not generally realised that the Q of a coil increases with both its length and its diameter. Furthermore, the Clapp circuit ensures that the valve is effectively well tapped down the tuned circuit, so that valve capacities and variations are of little importance. However, other oscillator circuits will give effectively the same performance as a Clapp circuit, provided that a high-Q tuned circuit is used, and that the valve is loosely coupled to the tuned circuit by tapping it well down the coil. In fact, before the Clapp appeared, E.C.O. and similar oscillators of stability equal to crystal control were built by amateurs by paying attention to the importance of high-Q tuned circuits and of loosely coupling the tuned circuit to the valve. Thus, Figs. 1, 2 and 3 show the relationship between the Clapp circuit (Fig. 1) and redrawn as in Fig. 2 to show how it is a "capacity tapdown" equivalent of a conventional E.C.O. (Fig. 3), with the valve well tapped down the tuned circuit. The virtue of the Clapp is that it provides loose coupling automatically with the usual range of component values, whereas with an E.C.O. the adjustment of taps on the tank coil for optimum performance is a fiddling operation. Despite this some amateurs were able to obtain stability of the same order as a crystal oscillator with "tap down" methods applied to the E.C.O. Indeed, the Franklin circuit achieved its stability also because of the very loose coupling between the valves and the tuned circuit.

The Layout

The point has thus been made, that it is not so much the circuit that matters but the arrangement of the circuit. With the Clapp as virtually the "standard" V.F.O. circuit, one should consider what arrangement of the Clapp will give optimum stability. First, the higher the mutual conductance of the oscillator valve, the less coupling need be to the tuned circuit, so that a valve of the highest mutual conductance would seem suitable. Especially suitable valves are the 6AC7, 6AG7, 6CL6 and 12BY7, in particular the 6AC7 which has an effective mutual conductance of around 14. However, the beneficial effects of high mutual conductance are not obtained by plugging one of the above valves into an existing Clapp oscillator. In fact, it is conceivable that this might even deteriorate stability, as high mutual conductance is generally achieved by very close internal electrode spacings in the valve. Hence, slight variations as electrodes expand during "warm-up" become proportionately greater with very close electrode spacings. The actual coupling of the valve to the tuned circuit must be reduced to obtain any benefit from increased mutual conductance. Fortunately, in the Clapp circuit one has merely to increase the value of the cathode and grid-bridging condensers—Cg and Ck in Fig. 1—to reduce valve coupling to the tuned circuit.

As is well known, if the grid and cathode bridging condensers are made too large, the circuit will not

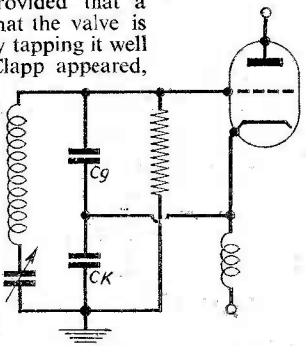

Fig. 1.—The Clapp oscillator.

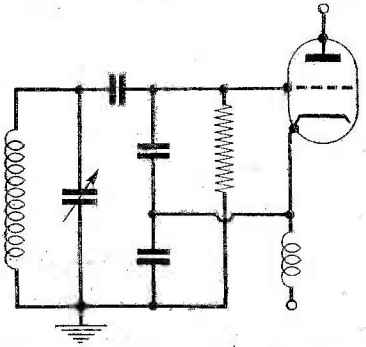

Fig. 2.—The "capacity tap" E.C.O.

oscillate. Therefore, for optimum stability the condensers should be made just large enough to ensure comfortable oscillation with a given oscillator set-up whatever valve is used. Of course, if a valve of different mutual conductance is substituted, smaller or larger grid-cathode condensers may be required. Moreover, if a coil of higher Q is substituted, larger condensers may be substituted, with an attendant improvement in stability. In fact, "oscillation ability" with given sizes of grid-cathode capacitors is a good test of oscillator coil Q. Thus, those who employed the high-Q coils wound with silver-plated thick wire on large ceramic formers to be found in surplus Service equipments are potentially able to build a Clapp oscillator of high stability. Provided that they exploit the possibilities of looser coupling offered by the higher Q coils by increasing the grid and cathode condensers, then the full value of the large coils is achieved. However, unless the loosest coupling is used, they may be no better off than those using much smaller coils. In fact, by not choosing large values of grid-cathode condensers the drift of their V.F.O. may be worse than one designed round a smaller coil!

Drift

Drift problems are, of course, one very important facet of the stability problem. With the modern trend to pint sized "table-top" rigs, the V.F.O. coil may be made small so as to crowd it in to a jam-packed chassis of heat producing components. This inevitably encourages drift troubles due to heating effects, and is not really recommended in view of a very simple and elegant solution of the problem. The "remotely tuned" Clapp takes advantage of the proportion of the Clapp oscillator to separate the tuned circuit completely from the valve. In fact as we have already shunted 1,000 pF condensers or even larger ones in the interest of stability across both grid and cathode, there is no reason to quibble

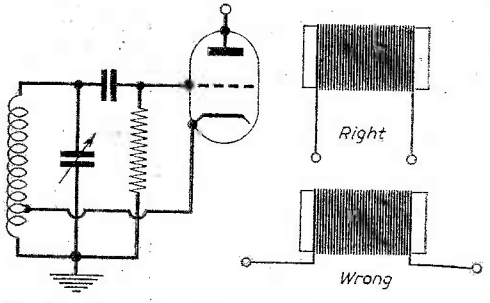

Fig. 3.—A conventional E.C.O.

Fig. 5.—Bringing leads from a high-Q coil.

at the extra 50 pF or so added by taking the tuned circuit outside the transmitter chassis, and connecting it through some yards or so of coaxial cable to the oscillator valve still inside the transmitter (Fig. 4). This effectively removes the tuned circuit from the heat producing components in the transmitter, which is often tightly enclosed anyway, as a TVI precaution, and thus acts as a heat trap and enables the V.F.O. to be comfortably tuned from the operating position. For the C.W. man, at any rate, appreciable amounts of QSY may be effected without retuning the main transmitter, and with a typical wideband coupled driver rig, only the P.A. tank need be retouched even when hopping from one end of the band to the other.

When trying the "remotely tuned" V.F.O., it will of course be necessary to make a solid rigid job of the tuned circuit, so that mechanical vibration will not cause frequency changes. In any case, the mechanical construction of a V.F.O. tuned circuit is of the greatest importance with regard to frequency stability. Moreover, despite the manifold virtues of the Clapp, it is like all "low-C" oscillator circuits—particularly vulnerable to mechanical movement of conductors near it. Such mechanical movements affect any oscillator tuned circuit by the slight variation of the stray capacities to the oscillator circuit. When the oscillator circuit is of the "low-C" type, the effect of slight stray capacity variations is more noticeable than with "high-C" circuits for obvious reasons. Moreover, mechanical stability also applies to the coil itself. Unless the wire is tightly stretched on the ceramic coil former, slight variations of irregular nature may occur in inductance, under mechanical vibrations leading to irregular frequency jumps and calibration variations. Moreover, if the wire is tightly stressed against the coil former, the effective expansion under heating is only that of the ceramic former, and may be very low. One cannot approach the "tight winding" standard found on Service equipment coils by plain hand winding. However, one method of obtaining a tightly stressed winding is to "hot wind." This involves passing a few amps. through the wire, sufficient to heat it appreciably, when winding as tightly as possible by hand. Having soldered the ends of the coil firmly, the wire on cooling when the heating current is removed, will shrink slightly and produce the required stressed winding. Incidentally, bring the coil leads if at all possible directly away at right angles to the former, and not away parallel with the coil axis (Fig. 5), as this has an appreciable effect upon coil Q. For the

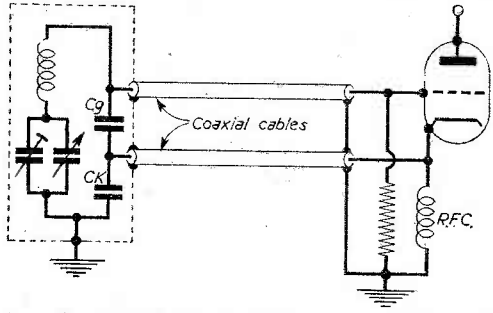

Fig. 4.—The "remotely tuned" Clapp V.F.O. The tuned circuit may be separated from the transmitter by using several feet of coaxial cable as shown. The tuned circuit is preferably enclosed in a screening metal case, thus giving "table top" control of frequency.

same reason keep metal shields, chassis sides and so on at *least* one coil diameter away from the coil if the coil Q is not to be appreciably deteriorated. Moreover, do not wind turns closely spaced, but space by approximately one wire diameter. Remember also that coil Q increases with both the length and the diameter of the coil. For very short coils, the Q increases rapidly as the length increases. However, the increase in Q is very small for long coils.

(Continued on page 57)

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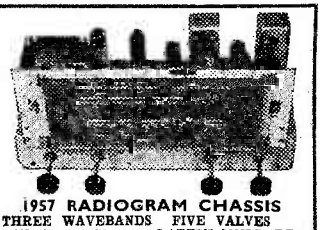
6J7				EF80
6K8	7/6	7/6	7/6	EL41
6SL7	6BE6	6V6G	12BE6	EL84
6SN7	6BW6	6X4	EL52	1Z40
6V6GT	9D6	6X5	HVR2A	KT33C
EBC33	6F6	807	PEN25	MU14
EF50	6K7GT	EF39	VP23	PY81
Sylv. Red				12K7
EF91		11/6		35Z4
EZ80	EY51	U25	PL81	6Q7



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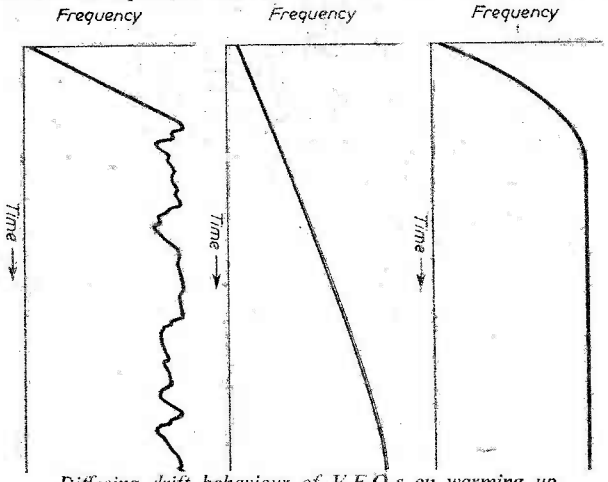
Perhaps a reasonable optimum is when the length is about 1½ times the coil diameter. Thus the proportions of the coil and the thickness of wire must be considered for high Q coils. Those who complain that a large ceramic former wound with thick wire cannot be squeezed into a "miniaturised" table-topper, are recommended to try the "remote tuning" idea, and comfortably accommodate a really efficient high-Q Clapp tuned circuit conveniently to hand at the operating position rather than squeezing a small coil of lower Q in the transmitter chassis!



Differing drift behaviour of V.F.O.s on warming up.

Fig. 6.—Rapid settling to steady frequency.

Fig. 7.—Appreciable drift over long periods.

Fig. 8.—Adverse frequency steady, but bad fluctuations about the average value.

Monitoring

Naturally the above considerations are not always stressed in V.F.O. designs. However, attention to these details will enable superior performance to be obtained. Many amateurs operating during the sunspot minimum on the L.F. bands, are now awakening to the deficiencies of their V.F.O.s when moving to the more H.F. bands. There seems to be only a two-to-one difference between the frequency stability of a V.F.O. that gives a stable note and one that gives a definitely wobbly note. This may be proved by monitoring successively the fundamental and the harmonics of a V.F.O. An 80 metre fundamental may sound ringing and rock steady under keying on 3.5 Mc/s, while on 7 Mc/s the second harmonic may betray a slight chirp and the 14 Mc/s fourth harmonic a really noticeable chirp that is barely tolerable, while on 15 and especially 10 metres, the keying may be almost unreadable. This does mean that a bad note may be cleaned up by a quite slight improvement to the V.F.O.

It is, of course, standard practice to monitor a V.F.O. for imperfections by listening to a high harmonic, as slight changes at the fundamental are hardly noticeable, but are multiplied up with the order of the harmonic. The percentage change is, of course, the same in all cases, but .01 per cent. at 1.8 Mc/s is only 180 cycles, while at 28 Mc/s .01 per cent. change becomes sixteen times as great, that is to say some 2,280 cycles! Despite the fact that one can hear steady V.F.O.s operating on 28 Mc/s, one still hears chirpy notes on top band and 80 metres! Incidentally, it is hardly necessary to mention nowadays that neon stabilised H.T. lines are used for the V.F.O. Stabilised H.T. dramatically cures many instabilities and ensures that the V.F.O. can be keyed without insuperable difficulties for H.F. band operation. However, one point of concern is residual V.F.O. drifting due to heating effects. Provided the coil has a low thermal coefficient, the change of frequency after the initial warm-up period should not be excessive.

Drift can take several forms. Thus there may be an initial "warm-up" drift in the first few minutes of operation due to valve heating, when the frequency rapidly settles down to a stable value for the remainder of the time (Fig. 6). In other cases the frequency may continue to steadily drift throughout the operating

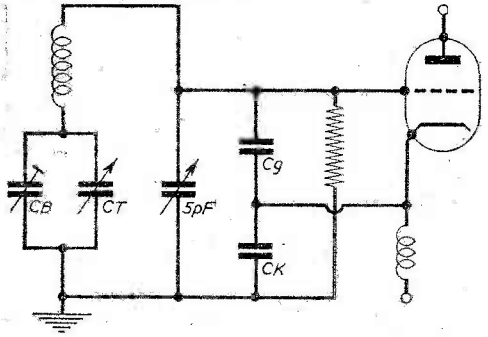


Fig. 9.—A 5 pF condenser connected as shown gives a "velvet vernier" control of a few Kc/s frequency shift in the Clapp V.F.O. circuit. CB is the "band-setter." CT is the usual tuning control.

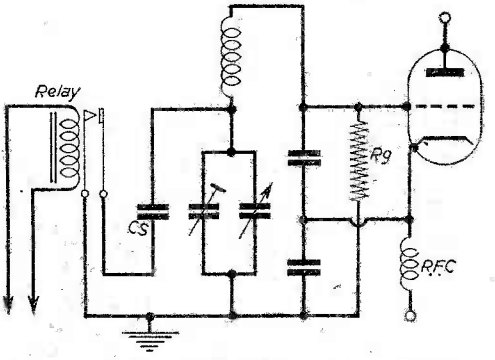


Fig. 10.—Between transmissions V.F.O. drift may be minimised by using a relay to switch in a detuning capacitor (CS). This shifts the V.F.O. frequency outside the band, but the V.F.O. valve still oscillates and therefore does not cool off during stand-by periods. After initial warming up the V.F.O. frequency during transmission becomes stable.

period (Fig. 7). A steady drift is, of course, very annoying, and indicates that thermal effects need reducing by shielding the tuned circuit from radiated valve heat, reducing the power input to the V.F.O. and so forth. Yet another annoying effect, found when heat insulation is often reasonably good, is that after an hour or so of running, heat eventually percolates to the tuned circuit and causes a steady drift. The cure is usually recommended in the form of temperature correction by negative coefficient temperature compensating capacitors. However, several difficulties can arise in applying negative coefficient ceramic capacitors. First, the small size capacitors can heat and cool rapidly, while the V.F.O. coil (the usual source of frequency drift through temperature) takes a considerable time to heat or cool under varying ambient temperatures. This leads to an annoying phenomenon if the negative coefficient capacitor is not shielded from draughts or air currents caused by hot components ; it may heat and cool rapidly causing random frequency fluctuations, as the coil itself may take a considerable time to heat. Unless the negative coefficient capacitor is in actual thermal contact with the coil former, and shielded from air currents, the addition of the negative coefficient capacitor may introduce annoying "thermal" fluctuations of frequency, while maintaining the long term stability (Fig. 8). Also, the calculation and selection of the correct fixed capacitor is often difficult, and the solution previously recommended by the author has been the use of a special condenser with a variable temperature coefficient. This has provoked enquiry as to where such condensers may be obtained. Readers may, therefore, be interested to learn that fixed condensers whose temperature coefficient is continuously variable from plus to minus values are made by Oxley Developments, Ltd. These capacitors are low loss air dielectric types, and at first sight appear to be a form of split stator variable. Actually the moving vanes can be adjusted between plates which give positive and negative temperature coefficients. Thus adjustment gives a fixed capacity but a variable temperature coefficient. Such a capacitor if fitted to a V.F.O. tuned circuit as a padder can be empirically adjusted for minimum frequency change with temperature. A 25-watt wire-wound resistor makes a good "heater element" to warm up the V.F.O. tank circuit when adjusting temperature coefficients. A domestic hair dryer delivering a blast of warm air is another means of rapidly warming the tuned circuit. With temperature compensation, particularly when applied to the remotely tuned Clapp circuit, frequency calibration may be maintained very accurately over long periods. The "remotely-tuned" Clapp is, of course, almost immune to thermal variations during an operating session, but unless temperature compensated, will "shift" during the course of the change winter to summer. This may seem a "fiddling" point, but unless care has been taken over coil design, drift can be several kilocycles per degree centigrade on the H.F. bands. Temperature compensation can largely remove this drift, which in a shack "warming up" in the winter from freezing point at the start of a session to a warm fug at the end of it may be 20 kc/s to 30 kc/s or even more. In fact, short of mechanical instabilities it is feasible to calibrate a V.F.O. and retain the calibration closely over long periods. With Clapp type circuits, moreover, the calibration is virtually independent of oscillator tube changes, so that almost "wavemeter" stability over long periods is feasible. Moreover, a "vernier" corrector may be used to keep calibration "spot-on" with a standard wavemeter or crystal calibration point. With the "low-C" Clapp oscillator, very smooth vernier QSY may be effected by shunting a 5 pF or 10 pF variable across from grid to ground, as shown in Fig. 9, a circuit the writer has described elsewhere.

CONVERTING A HEARING AID

(*Continued from page 38*)

2. Both ears must be used.

3. There must be an airtight connection between the earphone and the ear so that the two constitute an enclosed chamber with the phone diaphragm at one end and the eardrum at the other. All other conditions being optimum there should exist a very fair reproduction of the audible range of frequencies at least from a subjective point of view.

This latter consideration is all-important and can give a very much better degree of musical fidelity than is in any way possible with miniature speakers of any kind (so far experienced by the writer). One can get an excellent bass response and transients in the upper register are very well reproduced.

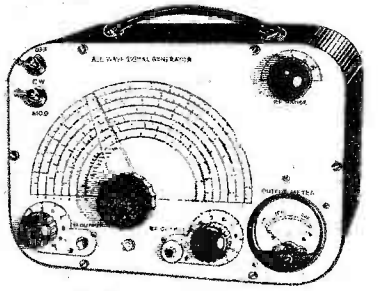
One possible solution is to obtain a second earpiece and lead, and wire these in series. Ear connection can be obtained by short lengths of suitable rubber tubing to fit tightly into the ear. Alternatively, the high-impedance connections can be removed and leads taken from the transformer secondary. In the latter case the output impedance will be about 30 ohms, and this may be connected to any suitable pair of headphones. There are available on the surplus market some excellent walkie-talkie headsets (the writer paid 2s. 6d. per pair for his !) which are illustrated on the front cover of the September, 1955, issue of PRACTICAL WIRELESS ; these give an excellent match and very good musical reproduction. This also applies to the moving-coil headphones of the Tank Corps, which also give excellent reproduction, but are, of course, much more bulky.

It is, therefore, quite a good idea to bring out a short length of flex from the output transformer secondary to which is attached a small two-point socket ; into this may be plugged either the double headphones or a single low impedance earpiece at will (Figs. 5 and 6).

One further refinement consists of sweating a thread of suitable length to the spindle of the wave-change switch so that it can carry a knob and thus obviate the necessity of having to have handy, and use, a screwdriver for this purpose.

The receiver being completed, all that is required is a suitable container for it, together with the batteries, Ferrite rod and two short lengths of single flex (each about 2 metres) for aerial and earth when needed. The writer had used successfully the old leather case from a pre-war electric shaver which has one large and two small compartments.

The batteries required are H.T. 30 volts and L.T. 1½ volts. The H.T. current is about 500μA, the L.T. 50 mA. The H.T. battery should provide about 200 hours of intermittent listening and the cost of running should be about ½d. per hour. This state of affairs should give little cause for complaint on financial grounds !



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Coverage 120 Kc/s-230 Kc/s. 300 Kc/s-900 Kc/s. 900 Kc/s-2.75 Mc/s. 2.75 Mc/s-8.5 Mc/s. 8 Mc/s-28 Mc/s. 16 Mc/s-56 Mc/s. 24 Mc/s-84 Mc/s. Metal case 10in. x 6¼in. x 4¼in. Size of scale. 6¼in. x 3¼in. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F. output continuously variable 100 milli-volts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel. Accuracy plus or minus 2%. **£4/19/6** or **34/-** deposit and 3 monthly payments 25/-. P. & P. 4/6 extra.

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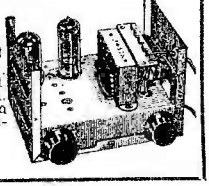

Complete with built-in power supply 230-250 v. A.C. mains. Crackle finish case 5¼in. long, 3¼in. wide, 4¼in. high. Incorporating gain control and band switch. Illustrated with cover removed.

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Heater Transformer. Pri 230-250 v. 6 v. 1½ amp.. **6/-.**
Extension Speaker cabinet in polished walnut, complete with 8in. P.M. P. & P. 3/-. **24/6.**
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Volume Controls. Long spindled and switch, ¼, ½, 1 and 2 meg., 4/- each. 10 K. and 50 K., 3/6 each. ¼ and 1 meg., long spindle, double pole switch, miniature, 5/-.
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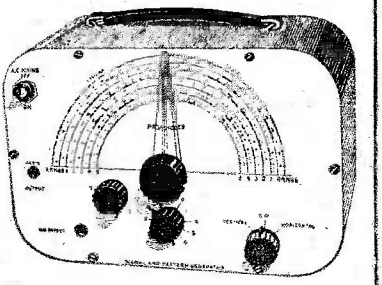

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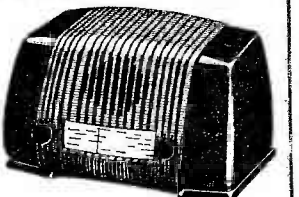

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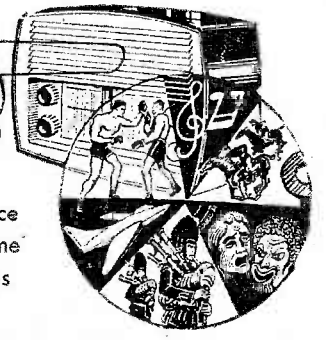

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

"THE GOLDEN AGE OF POPULAR SONG," No. 4 of which has been broadcast at the time of writing, was an excellent and well produced series. Written and produced by Charles Chilton and narrated by Alan Keith and Guy Kingsley Poynter, it was fascinating to get some "low down" on many of the most popular and widely sung hits as well as on the men who compose them. The dialogue was short and snappy and the numbers well rendered by Benny Lee and Marie Benson with the George Mitchell Choir, BBC Revue Orchestra under Harry Rabinowitz and pianist Malcolm Lockyer.

Plays

Joseph Conrad wrote little that wasn't memorable. His "Heart of Darkness," adapted by Helena Wood, was bound to make a good play, and so it did. Mostly in narrative form, it tells of the ruthless search for ivory in the Congo at the end of the last century. Captain Marlow, the chief protagonist and speaking autobiographically for Conrad, was forcefully played by Anthony Jacobs.

"The Lanchester Tradition," by G. F. Bradby, a school story adapted by Val Gielgud, made a good play. Telling of the unexpected appointment as head master of the Rev. C. E. Flaggon in the face of the strongest opposition from the Rev. Henry Chowdler, and of Mr. Flaggon's attempts to break with the Lanchester tradition—Lanchester having been a former head master—it contained interesting characters and views on youth and education. Hamilton Dyce was particularly good as Mr. Flaggon, as was William Fox as Mr. Chowdler.

"Trio for Two," with Griselda Hervey and James McKechnie, adapted by Marius Goring from the French of Louis Vernenil, contained a goodly ration of sex and passion. It might be called the Gallic version of "she loves me, she loves me not." Poor Maurice had it terribly badly. Good fun.

Chekhov's "The Seagull" is, of course, a classic. And with Paul Schofield as Trigorin and Gwen Ffrangcon-Davies as Mme. Arcadina, something of a treat for the connoisseur was foreshadowed. The result was not disappointing. All the great Russian playwrights, and novelists, impart a sadness into their plots and characters which possesses a sweetness and nostalgic element unmatched in any other nation. It is very difficult for English actors to capture it, but the company in the present production went some way towards doing so.

"In Town Tonight"

This has long since lost its flavour of spontaneity: the screaming jet and the rattling express no longer kid us that "interesting" people have just arrived and are being interviewed at airport and dockside. In fact, to speak the real truth, not half the people who come under John Ellison's and Pauline Tooth's aegis every Saturday evening are even "interesting." It is well known that those appearing in it are "booked" up as for any other programme. It is reading these sidelights on it that has, I suppose, cost it its savour. It would be a gain if it could recover its former unconstrainedness. But then it would also be welcome if many other of the older features could do likewise.

Panels

"Is There a Doctor in the House?" with Percy Cudlipp in the Chair, is yet another panel answering listeners' questions. The last time I heard it, Puritanism, Epilepsy, mirror writing (writing backwards) and pre-examination jitters were the subjects under review. An interesting series. But why a doctor? Why not a lawyer or schoolmaster? Obviously a highbrow class of listener writes in to it for enlightenment: a class that takes its entertainment seriously (none the worse for that!).

Disc Jockeys

"Record Week," 1956, contained much disc material, and many well-known jockeys appeared. One of the more interesting half hours was that in which Sir Compton Mackenzie—a pioneer of what may be described as the "modern" record—introduced Desmond Shawe-Taylor, Steve Race and John Watt to "Speaking of Records." We could have done with more of Sir Compton, his is such an outstanding radio voice.

The upshot was that many of the earlier discs and cylinders of some of the greatest stars who have ever lived are now more or less useless owing to their scratchiness and generally poor quality. The problem facing us—which was not discussed—is: how long will the recordings of the last 30 or so years last?

One of the falsest prophecies made when the radio first burst upon us was that it would "kill" the gramophone. That records have always formed one of the most popular of wireless items may be the gentle nudge and reminder that the wish is not always father to the thought!

An Experiment

"Town and Country" is an experiment which one hopes will prove successful and permanent. Usually of half an hour and following hard on the six o'clock news, it is divided into three unequal portions of local news, the day's sport and reports and comments. The local part is far the most interesting and contains much important material which, however, is not quite nationally important enough to find its way "up top." Sometimes the sports section gathers in some items which by no stretch of imagination can be styled "regional," but by and

large it should develop into a well worth while feature.

A hearing of No. 7 in the series " The Golden Age of Popular Song " convinces me that the compilers have succeeded to a far greater degree than has yet been reached in any comparable programmes of more serious music. Of course, the task was undoubtedly easier, but they did do the job very well.

Glyns House Club, Dramatic Section, in " Reluctant Heroes," by Colin Morris .

Glyns House Club, Dramatic Section, gave a successful presentation of Colin Morris's farcical comedy, " Reluctant Heroes," at Holy Trinity Hall recently. It is a good and very diverting piece. Whilst the longest serving soldier can comfortably raise his eyebrows at the things confronting him on the stage, he can none the less sniff the measure of truth and actuality that form their basis. This is the sign manual of all good farce. And certainly, if laughter be an equal partner in justification, Mr. Morris's play wins hands down.

Two performances seemed rather to stand out from a very capable cast : those of David Bonnor as Sergeant Bell and Gerald Leovold as Captain Percy. Each burlesqued the idiosyncracies and foibles of many of these worthies, as they are so well known to those of us who have served with them, with delightful freshness, zest and vigour. Mr. Bonnor and Mr. Leovold are very capable comedy actors.

John Strange, Geoffrey O. Clayton and Keith Armstrong made an excellent trio of national servicemen, each, apparently, seeming bent on seeing not only who could suffer the most but who could inflict the most on those in authority over them.

Donald McKenzie was a fierce and awe-inspiring P.T. sergeant instructor. Jack Chambers was a grotesque medical orderly. And A. W. S. Bramwell, the producer, filled a small part of a Scots soldier.

Three A.T.S. charmers found their way into the scheme of things (what Montgomery would have had to say about it I hesitate to put in print). These were captivatingly played by Cecile Elswood, Elaine Howard and Brenda Gray.

Mr. Bramwell's production went with a good swing and tempo, and the cast, for the most part, were quick on their cues and sure of their scripts. The scenery, by Capes of Chiswick, rather baffled. The " wooden army hut," to quote the programme, seemed, after all allowances for stage exigencies had been made, of a type quite unknown to old soldiers. But the farmhouse outbuilding of the last act was very good.

A large audience laughed continuously and thoroughly enjoyed themselves.

Ultrasonic Soldering of Aluminium

AS is well known, there are many difficulties associated with the soft soldering of aluminium. An interesting application of aluminium wire is its use as a speech coil in high quality loudspeakers. The main advantage is its lightness, which reduces the mass of the vibrating system thus permitting a high frequency response. Some loudspeaker manufacturers provide such coils in their high grade loudspeakers, and Mullard Equipment Division have pioneered a method of soldering aluminium which has made this practicable.

Ultrasonic energy is fed to a bath of molten solder, which causes cavitation to occur. When the aluminium wire is dipped in the solder the cavitation effect removes the oxide film normally present on the aluminium and tinning takes place. On removal the layer of solder thus fixed to the aluminium enables it to be soldered in the ordinary way. The principal advantages of this method are :

(1.) The short tinning time of about two to three seconds.

(2.) The low temperature at which the bath can be maintained (about 230 deg. C. in practice).

It is usual to use a 90 per cent./10 per cent. tin-zinc solder in the bath with no flux, and the only restriction on the soldering afterwards is that no chemically active flux should be used. It is recommended that 60 per cent./40 per cent. tin-lead resin core solder is used.

The perfection of this method has come about by very close co-operation between Wharfedale Wireless Works and Mullard, Ltd. Wharfedale Wireless Works have for some time employed the Mullard method of soldering their aluminium speech coils.

Two More V.H.F. Stations

TWO more BBC V.H.F. stations started test transmissions at the end of December. They are the permanent station at Wenvoe, near Cardiff (replacing the temporary low power transmitter which has been broadcasting the Welsh Home Service only), and the new station at Norwich. Both transmissions are liable to interruption for engineering purposes but will otherwise cover the whole of the normal periods of transmission.

When in regular service, the Wenvoe station will transmit the Welsh Home Service on 94.3 Mc/s (replacing the lower powered transmissions on this frequency), the West of England Home Service on 92.1 Mc/s and the Light Programme on 89.9 Mc/s. The transmission of the West of England Home Service instead of the Third Programme is intended as a temporary measure to enable listeners in the West of England to hear this programme on V.H.F. sooner than would otherwise have been possible ; the permanent arrangements for the transmission of the West of England Home Service have not yet been decided upon. The test transmissions may initially carry the Welsh and West of England Home Services only.

The area in which satisfactory reception is expected, under normal service conditions, has a population of nearly three and a half million people. It includes the whole of the counties of Monmouth, Glamorgan and Somerset ; most of Gloucestershire ; and parts of the counties of Pembroke, Carmarthen, Brecknock, Hereford, Wiltshire, Dorset and Devon.

The Norwich station, which in regular service will broadcast the Midland Home Service on 94.1 Mc/s, the Light Programme on 89.7 Mc/s and the Third Programme on 91.9 Mc/s, but during the initial test transmissions the Light Programme will not be transmitted.

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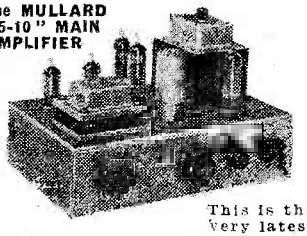

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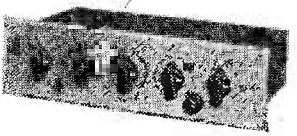

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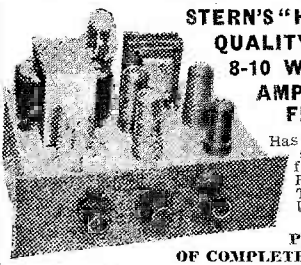

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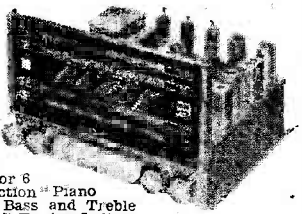

"A chassis for those who want the highest quality." ● A 9 valve line up employing the latest MULLARD preferred-type valves. ● Provides complete coverage of the V.H.F./F.M. Transmissions plus the Short, Medium and Long Wavebands. ● Has Push-Pull Output with Negative Feedback, for 6 watts peak Output. ● Quick Action "Piano Key" Selectors and separate Bass and Treble Controls. ● Has "Magic Eye" Tuning Indicator. ● Dimensions 13in. x 9¼in. x 8in. high. Dial size 11¼in. x 5¼in.

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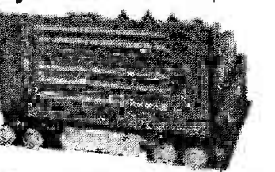

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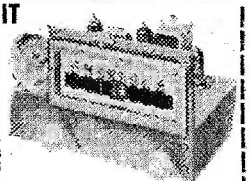

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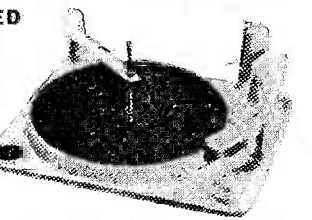

● Complete with High Fidelity Crystal "Turnover" Head which incorporates separate stylus for L.P. and 78 r.p.m. records. ● A "MIXER" Unit that will autochange on 7in., 10in. and 12in. records of same speed. ● Incorporates the Manual Control position.

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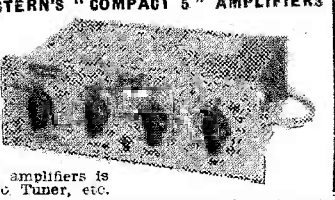

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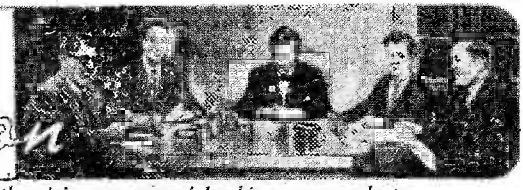


The Editor does not necessarily agree with opinions expressed by his correspondents

Wattage Rating

SIR,—May I point out that R. L. Wynne (Wallasey) in the January issue of PRACTICAL WIRELESS makes a false assumption when he calculates the "safe voltage" of a resistor merely on the basis of its stated permissible dissipation. This assumption is only true for low values of resistance. With high resistances there is the additional factor of voltage breakdown to be considered. In general the maximum rating is voltage between 250 volts and 500 volts for ½ to 1 watt ratings. However, there are some (½ watt and over) with maximum voltage ratings of 700 volts or more, and some (¾ watt and over) with ratings of 1,000 volts or more.

Having said that, I feel there is a strong case for advocating that manufacturers should be asked to indicate clearly, not only the wattage rating, but also the maximum voltage rating of their resistors.—DAVID ROWAN (Glasgow).

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.

New Loudspeaker Enclosure

SIR,—I would like to express my thanks for your publishing the article in the October issue on the new speaker enclosure. I have never had anything to do with carpentry in my life, but I found this child's play. It is highly efficient and very low cost to construct. The speaker which I am using is a Whiteley Electrical, Type HF 1012.—D. J. TAYLOR (Wickford).

An Electrostatic Speaker

SIR,—Reference my article on the above in the November issue. I have conducted further experiments and it may interest readers to know the latest about this type of reproducer.

I have found that it is possible to obtain aluminium foil from Messrs. Griffin and Tatlock, Nivic House, Ealing Rd., Alperton, Wembley.

This foil comes in books containing 25 sheets, 4in. x 4in., at 3s. 6d. Adequate for the purpose the foil is extremely thin and requires much care in handling but it enables one to make a much more sensitive speaker.

The method of construction is similar to the previous speaker, except that in place of model aircraft fabric dielectric it is possible to employ thin polythene, such as is used for sandwich bags, etc.; this ensures far more satisfactory insulation between electrodes, especially in damp weather. Great care must be taken when affixing the foil to the dielectric.

A successful method employed was first carefully to expose a sheet of the foil, by gently lifting off its protective cover of tissue paper, then spraying the foil with a *thin* film of cellulose dope. Quickly lay the polythene (which should have been already fixed to the perforated zinc plate at its edges) on top of the foil and hold in place with a book or something similar to ensure adhesion to the dielectric.

After about 10 minutes the foil should be adhering firmly to the polythene. Construction can proceed as before. It may be desired to use a large area of foil, in which case more sheets of foil can be affixed to the dielectric, providing they are connected to one another by thin strips of oil to ensure good contact. — N. A. BARGERY (Lostwithiel).

I.F. Strip "373"

SIR,—Regarding Mr. Hanway's letter on the conversion of the I.F. strip "373" to F.M., there seem to be a number of ways of converting it. By removing the third I.F. coil a discriminator transformer can be fitted.

In most F.M. sets the I.F. is usually 10.7 Mc/s. One can either add a few turns to the discriminator transformer in the ratio of 10.7/9.72 or alter the previous I.F. stages to resonate at 10.7 Mc/s. This can be done by removing turns from the I.F. coils or by removing the parallel capacitors; the latter seems to be the easiest as the capacitor across the coil can be calculated so that the I.F. coils resonate at 10.7 Mc/s. The discriminator transformer could be bought, or be wound on the existing former of the third I.F. To complete the conversion an R.F. stage frequency changer and output stage could be added, resulting in a neat and compact F.M. set.—R. H. LEATHER (Coventry).

Transmitting Topics

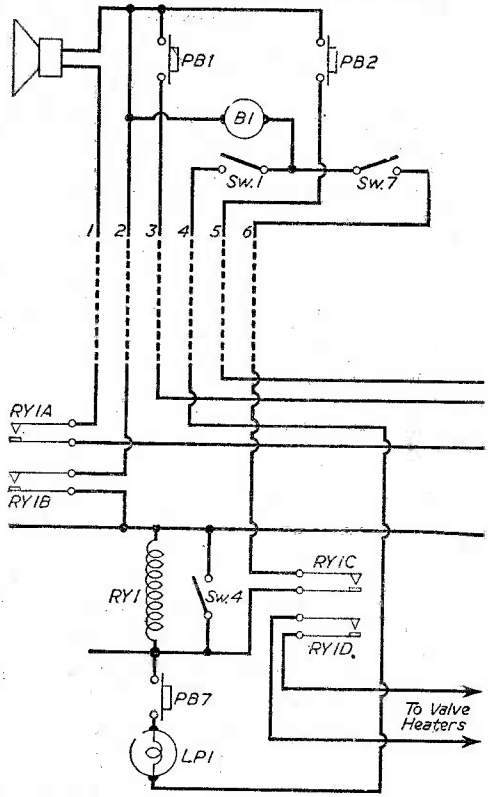
SIR,—For some time now I have felt that the articles under this heading have been rather beyond the majority of readers. Surely the purpose of your magazine is to help the amateur, and experts who are on the air have a society to help them, with its own magazine devoted entirely to the subject. Would not the space be better filled with simpler stuff to help those of us who are interested only in the receiving side, and interested in building test sets, etc.?—F. GOWING (Hythe).

[*We should be glad to receive the opinion of readers on this criticism.*—ED.]

A Front Door Inter-com. System

SIR,—I would like to draw attention to a rather serious disadvantage of Mr. Bowerman's system, i.e., that it provides no means of dealing with the unwanted caller or nuisance calls, e.g., if

a caller calls Flat 1 and the occupier does not wish to admit him, then to restore the system to normal he must proceed to the hall and operate SW4 momentarily to release relay RY1 or alternatively open the door by hand. Failure to do so would result in (1) the system being rendered useless so far as he is concerned, since he must leave SW1 open to silence his bell, and (2) his speaker SK1 being connected to lines (1) and (2) would degrade the speech to and from any other flat which may be called in the meantime.



Mr. Davies' modification to the Front Door Inter-com.

To overcome this difficulty I would suggest that wires from contacts RY1C, RY2C and RY3C should be disconnected from the common positive and taken individual on separate wires to their respective flats and there connected to line 4 through a normally made switch SW7 (see diagram). This additional switch SW7 could be incorporated with SW1 if a three-way key type switch of the type used on telephone switchboards is employed. With this modified circuit the operation of SW7 breaks the locking circuit of RY1C and system can be restored to normal without leaving the flat.

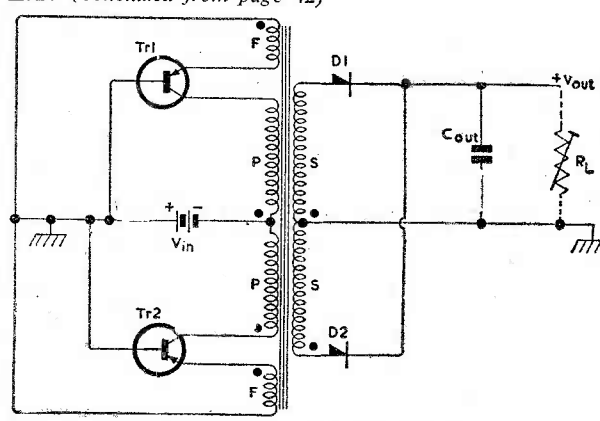
With regard to the amplifier it seems to me to be very wasteful to leave the valves running continuously and I would suggest that relays RY1, RY2 and RY3 each be provided with a fourth pair of "make" contacts (heavy duty) to switch in the valve heaters. This would prolong the life of the valves and effect a considerable economy in current consumption without causing any appreciable delay in the flat-dweller being able to speak to the caller.—A. DAVIES (Liverpool).

"Amateur Radio" Novice Licence

SIR,—I agree entirely with Mr. Walker's suggestions on a Novice Licence, but surely not in the 27 Mc/s band. This is a DX band and a novice should not commence his activities by working DX. This band lies dead, anyway, except during a sun spot cycle as at the time of writing. Phone would also be an advantage.—PAUL CRAPPER (Sheffield).

H.T. from L.T. (*Concluded from page* 42)

units which have been made up to illustrate the range of power outputs and applications which can be covered. (It is not intended to imply that all of these applications are recommended for practical adoption.) These units are all of the ringing choke variety, which was the earliest to be developed. Further developments in circuit design, and the extension of transistor power ratings, will increase this versatility. Transistor requirements in this application can be summed up as: low bottomed resistance, high maximum collector voltage rating, and a sufficiently high dissipation rating. Converters can be constructed, in general, to handle powers which are three to six times greater than the transistor dissipation rating. Under favourable conditions this may be increased to ten times.



Transformer-coupled converter.

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