LOW-DRIFT V.H.F. RECEIVER

PRACTICAL WIRELESS

SEPTMBER 1960

CONTENTS

SIX VALVE 9W AMPLIFIER
TRANSISTORIZED OHMMETER
COMBINED RECEIVER AND
SIGNAL GENERATOR
USING ABSORPTION
WAVEMETERS
BEGINNERS' dB METER
ETC. ETC. ETC.
SHORT WAVE RECEIVER
MODEL MARK 38

Frequency range 7.4 to 9 Mc/s. Here is your opportunity to own a real communication receiver and explore the world on the short wave bands. This receiver is compact and suitable for use on a short aerial as we hear over 65 short wave stations operating for entertainment. The Mark 38 operates from standard dry batteries 3 v L.T. 120 v H.T. Supplied complete with Headphones. Aerial. Junction Box and Battery connection details.

NEW! MORSE CODE SET

Here's a real bargain! The Morse key has adjustable spring tension and contact clearance. High frequency buzzer. Provision for Headphones. Complete with morse code alphabet and battery. Only 10/- P & P 2/-

TWO TRANSISTOR POCKET RADIO

with Microphone Speaker

Can anyone build it! This powerful pocket radio gives reception over the entire broadcast band. Complete with all parts, including 2 transistors,-exclusive service rod, microphone, tuning condenser, plastic case wiring diagram, and step by step instructions.

PORTABLE TRANS RECEIVER No. 18


NEW! STEREO BALANCER & AUDIO WATTMETER

The most versatile instrument ever offered to the Hi-Fi enthusiast! Solves all stereo balancing problems and ensures studio perfect stereo balance regardless of room acoustics. Instead of continuously running back and forth between listening position and amplifiers you can now balance the entire system in one step. It is very easy to use that the listener is in the exact centre of the area between the speakers therefore the Vu-49 controls compensate for differences in room acoustics.

The unique meter incorporates two independent high resistance movements. Each coil is connected to the speaker system of which channel! The dial continuously monitor both channel outputs without affecting speaker damping or response. Matched meter deflections denotes balanced output. Calibrated. 6-30 watts for both 3 ohm and 15 ohm loads.

Contemporary cabinet with gold stand and matching gold and black panel and controls.

开展包装 T.C.S.

PRACTICAL WIRELESS
September, 1960
HARVERSON SURPLUS CO. LTD.
83 HIGH STREET, MERTON, S.W.19. CHERRYWOOD 3985/6/7

THE WORLD FAMOUS E.M.I.
ANGEL TRANSCRIPTION
P.U. (Model 17A)

A Pick-up for the connoisseur originally priced at £17.10.0. The last remaining few offered at £4.10.0 Plus P. & P. 5/-

1/6 H.P. MOTOR

140 Watt (Approx. 1/6 H.P.). Series wound, 220/250 volt 50 cycle motor. Off load 14,000 rev/min. on load 6,500 rev/min. Ideal small saw, sewing machine, etc. 30/-

MONAURAL AMPLIFIER

This amplifier as illustrated, made by a leading manufacturer, Mullard valves—EC823, EL84 x 3, EZ80. Bass, Treble and Volume on remote panel. Elegant Knobs. OUR PRICE one month only £4.16.6 plus P. & P. 3/6.

WHY NOT VISIT US?

Our new retail premises at 83 High Street, Merton. London S.W.19 are London’s biggest walk around shop. 1,000’s of bargains, all enthusiasts welcome, no obligation to buy. 1 min. South Wimbledon Tube

TAPE RECORDER

★ CONTEMPORARY Red and White Tygan Cabinet. Size 12 1/2 x 14 1/2 x 9 3/4 inches.
★ B.S.R. DECK.
★ MAGIC EYE tuning.
★ INPUTS for RADIO and MIKE.
★ VOLUME and TONE Controls.
★ Complete with ACOS Xtal Mike. ONLY 18 gns.

AM/FM RADIOGRAM CHASSIS

★ By famous manufacturer. ★ 220/250 volts A.C. ★ Coverage 1000-1900 m, 200-500 m, 88-98 Mc/s. ★ Tuned by 5 "Piano Keys"—Off, LW, MW, FM and Gram. ★ Sockets for P.U., Ae, E. Extn. Spkr. and Dipole. ★ Tuning and tone controls fitted. ★ Valves, ECH81, EF89, EABCB0, EL84, ECC85 and EZ80.
★ 50 Only at ridiculous price of 12 gns. plus 8/6 P. & P.

STEREOPHONIC AMPLIFIER £5.10.0

Complete with 2 Loudspeakers

Plus 4/6 P. & P.

This is a compact amplifier embodying the latest features and giving a high standard of reproduction, with ample volume. Supplied complete with valves (ECL82, ECL82, EZ80), panel, knobs, etc., and two specially selected 31/2 matched loudspeakers. We only have a few, and we will never be able to repeat this offer at such a low price! Don’t risk disappointment! Order now!

THIS MONTH’S OFFER

Plessey 6 x 4in. 31/2 Loudspeaker, 14/- each. 7 x 4in. Goodmans, 16/-.
25 amp 21/2in. flush mounting meters, new, 7/-.
12 Assorted Pots. Wire wound and carbon. Switched and unswitched—all useful sizes at 15/- the dozen. Plus P. & P. 1/-. 60 Milliamp Chokes at per 2/6 each.


IF YOU DO NOT SEE WHAT YOU WANT ON THIS PAGE WE WILL GET IT FOR YOU

Write (enclosing S.A.E. please), for our list of small parts and accessories for the Constructor. Trade willingly supplied.
R.S.C. HI-FI TAPE RECORDER KIT

REALISM AT INCREDIBLY LOW COST. CAN BE ASSEMBLED IN HALF AN HOUR.
The Recorder incorporates the latest Collaroo Studio Tape Transformer, and 4 long quality Tape Amplifiers listed $1.25 each. High Fidelity Full P.M. Speaker listed 366, Empty Tape Spool. A Reel of Best Quality Tape listed 25c, and a handsome Portable carrying case for $1.25. Details for 2-tone cartridge 18 x 10 x 9 in., listed 34.10, and circuit. Total cost if purchased individually approximately $40. Performance equal to units in the $90-

25
G.N.S., H.P. TERMS, Deposit $5.64. and 12 monthly payments $8.76. Cash plus $2.14, 2-tone price if settled in 3 mths.

TELEVISION RECTIFIERS. 220v. 400va. small, size only 8 9/16x. 8 11/16. Full Transformer leads. On two-tone coverage. 2-ohm. $2.35 each. Paramek Hoke Type 10 watt. $18.3v. 4a. color matching. 58c, R.C.A. 20 watt, 15 ohms or 200 ohms, 6 9/16.

STAAAR GALAXY 4-SPEED MIXER AUTO-CHANGERS


THE SKYPUR T.R.F. RECEIVER

A design of a 5-Valve Long and Medium wave 250-250 v. A.C. Mains receiver with selenium rectifiers. High gain r.f. stage and low distortion stage. detector. Power output: 0.5 watt. Valve line-up 6EK7, 6FPE1, Type 15, Selectivity and quality excellent. Simple to construct. Point-to-point wiring diagrams. Instructions list, 1/9. maximum building costs 54.18. 9c. Pre-Fabricated cabinet. simple type. Well finished wood cabinet 12 x 6 x 3 1/2.

REPAiao TWINNETE TRANSISTOR PORTABLE CHARGERS


BUILD A BATTERY OPERATED RECORD PLAYER


R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER


R.S.C. BATTERY CHARGING EQUIPMENT

R.S.C. MAINS TRANSFORMERS

INTERESTED AND IMPRESSED. PRIMARIES 350-250, 250-200, 200-150, 150-100, 100-50, 50-25, 25-15, 15-10, 10-5, 5-2.5, 2.5-1.5, 1.5-0.75, 0.75-0.3, 0.3-0.25, 0.25-0.125, 0.125-0.063. FULLY SHROUDED UPRIGHT 250-200, 200-150, 150-100, 100-50, 50-25, 25-15, 15-10, 10-5, 5-2.5, 2.5-1.5, 1.5-0.75, 0.75-0.3, 0.3-0.25, 0.25-0.125, 0.125-0.063.

FULLY SHROUDED DROP THROUGH 250-200, 200-150, 150-100, 100-50, 50-25, 25-15, 15-10, 10-5, 5-2.5, 2.5-1.5, 1.5-0.75, 0.75-0.3, 0.3-0.25, 0.25-0.125, 0.125-0.063.

FILAMENT TRANSFORMERS

All with 300-200. 100-200, 200-150, 150-100, 100-50, 50-25, 25-15, 15-10, 10-5, 5-2.5, 2.5-1.5, 1.5-0.75, 0.75-0.3, 0.3-0.25, 0.25-0.125, 0.125-0.063.

OUTPUT TRANSFORMERS


CHARGER TRANSFORMERS

All with 300-200, 200-150, 150-100, 100-50, 50-25, 25-15, 15-10, 10-5, 5-2.5, 2.5-1.5, 1.5-0.75, 0.75-0.3, 0.3-0.25, 0.25-0.125, 0.125-0.063.

SMOOTHING CHOKES

150 mA. 7-10 H 250 ohms. 11 9/16. 100 mA. 10 H 250 ohms. 11 9/16. 50 mA. 30 H 200 ohms. 6 1/2. 30 mA. 50 H 250 ohms. 6 1/2. 15 mA. 75 H 250 ohms. 6 1/2. 10 mA. 100 H 250 ohms. 6 1/2. 30 mA. 50 H 250 ohms. 6 1/2. 15 mA. 75 H 250 ohms. 6 1/2. 10 mA. 100 H 250 ohms. 6 1/2. 30 mA. 50 H 250 ohms. 6 1/2. 15 mA. 75 H 250 ohms. 6 1/2. 10 mA. 100 H 250 ohms. 6 1/2.

CHARGER TRANSFORMERS

All with 300-200, 200-150, 150-100, 100-50, 50-25, 25-15, 15-10, 10-5, 5-2.5, 2.5-1.5, 1.5-0.75, 0.75-0.3, 0.3-0.25, 0.25-0.125, 0.125-0.063.

MICROPHONE TRANSFORMERS

All with 300-200, 200-150, 150-100, 100-50, 50-25, 25-15, 15-10, 10-5, 5-2.5, 2.5-1.5, 1.5-0.75, 0.75-0.3, 0.3-0.25, 0.25-0.125, 0.125-0.063.
R.S.C. 45 WATT AS HIGH-GAIN AMPLIFIER
A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Only 58 milliwatts input is required for full output, thus with the latest high fidelity pick-up heads, in addition to all other types of pick-ups and practically all instrument strings, separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided. These give fine long-playing record equalisation. Hum level is negligible, heavy feedback is provided. Separate Bass and Treble Controls are provided.
Output Transformer. Fixed ratio for
pedestals. normally 850. Sale price 10.50.
plus 4%. Transistors, old types FC1-DD24, etc. Sale price half current list price.

14b. TV Mask, grey plastic, normally 10.
Sale price 75c. Plus 1/8 post and ins.

15. TV, normally 1250. Sale price 90c, plus 1/16 post and ins.

5 amp. Car Battery Charger, variable charge rate. In steel enamelled case, with meter. normally 80c. Sale price 90c plus 1/16 post and ins.

250-2500 600 ohm. Mains Transformer, with 3v filament winding, half-shrouded throughbore, standard replacement in many receivers, made to sell at 15c. Sale price 25c, plus 5/8 post and ins.

Ditto, but with additional 8v. winding for use with rectifiers, made to sell at 45c. Sale price 50c, plus 2/8 post and ins.

Transistor A.F. Transformer or driver, made to sell at 9.50c. Sale price 1.00.

Sub-miniature electrolytic Condensers, for transistor sets: 1 mfd. 16v. 2.5 mfd. 6v. 5 mfd. 12v. 8 mfd. 6v. 10 mfd. 6v. 15 mfd. 6v. 20 mfd. 3v. All normally 1/2- each. Sale price 1.00.

Transistor Ferrite Rod Aerial, with 100 watts output with circuit, normally 120. Sale price 75c.

Oscillator Coil and set of 3 J.F. transformers for transistor set, with circuit, normally 30c. Sale price 35c.

TV Rectifier, RMS equivalent, normally 12c. Sale price 15c.

Transistor A.F. equivalent to red spot. Sale price 4/.

14 in. TV Cabinet, Sale price 9/6. Carriage 3/. Fordworth works more.

L.F. Cables, standard size by Weymouth 400k. dust cores. normally 126. Sale price 8/6 per pair.

Breakdown Unit. Over 20 lbs. of useful spares including metal rectifiers. transformers, condensers, switches, thermostats, chokes, etc. Normally 12c. Sale price 8c.

P.M. Speaker, 8ohm, with output transformer. Normally 90. Sale price 75c.


Pilot Built. 3-5 volt. 0.3 amp. 3/8 of a box of 25.

Transistor Set Case with chrome handle, knurled knob and scale. Sale price 7/6.

Transistor Set 2-gang, the Jackson 50.

Connecting Wire. 24 gauge, tuned copper, P.C. Insulated. For 110,000., coils different colours. Sale price 5/6.

135 watt Choke for fluorescent tube. 25v. Sherry Crop. 10watt. 15c. 30 watt. 3c.


Mains Lead, 5 ft, of unbreakable wire, as fitted to electric razors, makes fine lead for meters, etc. Sale price 1/8 for three.

6 x Assorted 1 watt Resistors, our assort ment is mixed, useful values. Sale price 2/4.

Ditto, but in watts. Sale price 4/5.

Pot Meters, standard types, 2 mfd. 150v. 1-1/2 mfd. 100v. 1-1/2 mfd. 200v. 1-1/2 mfd. 600v. 2-1/2 mfd. 600v. 3 mfd. 5-1/2 mfd. 1200v. 3-1/2 mfd. 6000v. 5 mfd. 6000v. 7 mfd. 6000v. 10 mfd. 6000v.

Mains Lead, 5 ft, of unbreakable wire, as fitted to electric razors, makes fine lead for meters, etc. Sale price 1/8 for three.

45 Assorted 1 watt Resistors, our assort ment is mixed, useful values. Sale price 2/4.

Ditto, but in watts. Sale price 4/5.

Crystal Microphone, miniature, suitable for all purposes, tape recorders, amplifiers, etc., normally 4/6. Sale price 5/6.


11th. TV Cabinet, modern design. Small, 74. Cost 4/. to make this list price 9/. carriage 3/.

12th. Microphone, Comroad (Incl. normally £3.00. Sale price 3/6.)

Set of Four TV Parts, scan coils. Line & Picture output and width control, normally 9/6. Sale price 8/6, plus 2/6.

200 Service Sheets, for modern TV sets. normally 40c. Sale price 30c.


Rectifier Unit, for working D.C. instruments, motorized equipment, etc. from A.C. mains. Input price 20/00-20/00. Sale price 20/00-20/00. 300 mamp. 35c., carriage 7/6.


12 in. Dust Aerial Rod. 8 x 5/6d. dia. 1/2 each.

Westinghouse Rectifiers, type H. 8/0 each.

**A REALLY MAGNIFICENT BARGAIN!**

BRITISH THROUGHOUT MUSCLE wherever you go for only 2d. a month

WONDERFUL TRANSISTOR RADIO SCOOP!

If you purchase an EMI transistor radio, you will be eligible for a free copy of our magazine. You will also receive a free copy of our latest catalog. Our magazines are full of exciting information and are sure to be of great interest to anyone who enjoys electronics. We guarantee that you will be 100% satisfied with our service. If not, we will refund your money within 7 days. This offer applies only to subscribers who purchase an EMI transistor radio during the current month.

- **1 TRANSISTOR**
- **2 TRANSISTORS**
- **3 TRANSISTORS**
- **DIODE**
- **Transistors last for ever.**
- **Wonderful Reproduction and wonderful value.**
- **British Manufactured—fully guaranteed.**
- **Contemporary style case.**

Price: £7.19-6 per Set & Batteries 5% extra.

**£7-19-6**

*With free Transistor Pocket Radio YOURS FOR ONLY 40% DEP*

**Cash Price Only**

- **Superb Quality Sound**
- **High Quality Parts**
- **Perfect Reception**

**BRITISH THROUGHOUT MUSCLE wherever you go for only 2d. a month.**

**Transistor Pocket Radio YOURS FOR ONLY 40% DEP. CASH PRICE ONLY.**

**£7-19-6**

With smart carrying case. New.

**BRITISH THROUGHOUT MUSCLE wherever you go for only 2d. a month.**

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**£7-19-6**

With smart carrying case. New.
PRACTICAL WIRELESS

September, 1960

until August 31st SUMMER SALE until August 31st
STOCK OFFERED AT SENSATIONAL REDUCTIONS

Overcurrent Relay, surface mounting. through panel type with a clear Pyrex glass cover. Type A for currents between 0.1 and 0.4 amps. Type B for currents between 0.5 and 2.0 amps. Unused and perfect. Sale price £2.17.6 each.

Metal Rectifiers, 250 v. 50-60 ma. ideal for emergency instrument, or replace that expensive valve. Sale price 3/-.

Rectifier Bargain, selenium rectifier 3600 ma., suit rebuilt into 6 full-wave charger rectifiers, suitable 6 or 12 v. battery at 3 amps. Sale price 15/-, plus 6/- post.

Rectifier Bargain, selenium rectifier 5500 ma., suit for full-wave or multiple type, Normal price 3d. Sale price 6/-, plus 1/- post.

Rogers Stat-Guard, metal pole, rated for 30 amps. D.C., suitable much higher current on A.C. Many applications, room, length, switching for motors, banks of lamps, etc. Probably cost 25 originally. Sale price 2/-6, plus 6/-.

Silicon Diodes, BTH. Sale price 2/- each or 18/- dozen.

Auto Starter, for 7-6 h.p. D.C. motor or other circuits which require starting resistance. Sale price £2.15./6., plus 6/- post OR carr. Larger models available at equally silly prices.

Thermal Delay Vacuum Relay, complete with booklot of interesting circuits. Sale price 3/-, plus 2/- post and ins.

Thermocouples mounted on base, useful for experiments and school. 8/-.

350 amp. Santon Switch, 20/-, or 26/- post.

5 1/2" x 12" full-wave Charger Rectifier, normal price £1.6., Sale price 15/-, plus 6/- post and ins.

Waterproof Motors, 0.500 ma., 0-250 ma., 0-150 ma., 0-100 ma., 0-50 ma., D.C., 0-15 v. A.C. All 15/- each, plus 2/- postage.

Moving Coil Meter, *A* model, 0-750 microAmp. Sale price 18/6-9/-, 30/-, plus 15/-.

Low Resistance Headphones, good British make. Sale price 6/-, plus 1/- post.

Chest Microphone, excellent American make, with adjustable mouthpiece. 6/-, plus 1/-.

Throat Microphone, excellent American make. 6/-, plus 1/-.

American Lightweigbthype, Type H830, Sale price 17/6, plus 1/- post.

Regulator Resistors, sliding wire, 15/-, 3 amp., 12/6. 6/-, plus 2/- post.

Variable Rheostats, heavy duty slider resistor rated at 25 amps., ideal for dimmer circuits, etc. Sale price 7/-6, plus 6/-.

Versatile Wire, single strand 18 gauge, with p.v.c. covering. New fumble on drum. Sale price 6/-, plus 3/- carriage.

Transformer Switch, standard metal body, round dollly, fixing ring and-off indicating plate. Sale price 1/- each, or 10/- doz.

Transmitter RH144, Unused but slightly scored. Post tested. Covers 200000 CChc. 3-54 Mcg. and 5-50 Mcs. Complete with valves. Sale price 19/-6, plus 15/- carriage.

Telephone Handset, sound powered, just join two together with a pair of wires and you have a 2 way electronic communication. Sale price 25/-, plus 3/- post and ins.

A.C./D.C. MULTIMETER KIT

Ranges: D.C. Volts 05, 0-900, 0-100, 0-500, 0-1000. A.C. volts 0-150, 0-600, 0-1500, D.C. milliamperes 0-5, 0-100, 0-5000, 0-10000, D.C. milliamperes 0-5, 0-100, 0-50000 with internal batteries. Measures A.C./D.C. volts, D.C. current and ohms. All the essential parts including metal case, 25 moving coil meter, selected resistors, wire for shunts, range selector switches, calibrated scale and full instructions. Price 18/6, plus 2/- post and insurance.

Pocket Transistor Loudspeaker 3

A 2-transistor plus plus plus plus for dimmer. Sale price 11/6. For medium and long waves. Easy to carry about, as size only approx. 5cm x 5cm. All parts including cream plastic case, miniature loudspeaker. Great for everything needed down to last nut and bolt. Only 22/6 plus 1/- each. 6 x 6 x 6. Batteries 10/-, extra. Full constructional data included in above price or separately. Money refunded if not fully up to your expectations.

TRANSPORTERISED

Trace signal right through—Radio, T.V., Tape amplifier, Hi-Fi, etc. By connecting to a fault find, carry it like a fountain pen, with direct torque feeding instead of the usual coil, transformer barreled crystal, miniature battery, 12/6 plus 1/- Battery and set, described, etc. Data included, or separately 1/-.

UNIQUE OPPORTUNITY TO BUILD FINE CINE PROJECTOR CONSTRUCTOR'S PARCEL consisting of cabinets, approx. size 4x 3 x 11/. With handles, switches and embellishments as described. Complete in a variety of transit cases. This is a complete, compact, transistorised unit which may be assembled at home. Price 22/6 plus 6/- post and insuran ce. You can build a pocket transistor set as currently being sold at 15/- each. We can supply all necessary parts at a highly competitive price. Alternatively build your own circuit. Diagrams and constructional data included. Price 11/- each.

F. M. Tuner (Radio Constructor Circuit), normally £12.10.0, Sale price £6.10.6. Note: This tuner, although described, may not be needed. Plus 3/- post and ins.

Arabian Hearing Aid, normally bargain at £17.10.6, plus 1/- post and ins. Needs attention. Price 6/- and 3/-.

Portable Receiver Cabinet, takes our Crippen Transistors, cost 22/- to make. Sale price 12/-6, plus 3/- post and ins.

Electrical Brake, disc type for stopping lathes, coil winders, etc., operates an unpowered D.C. motor. Sale price 15/-.

Connection strip, bakelite 16-way, Sale price 2/-.

Cine Camera, 16 mm, motorised (24 v. A.C.) for 15 frames per sec. Sale price £5.10.0, plus 3/- carriage.

Dinky Set, 4 model, tubular aluminum, extends from 15in. to 9ft. Sale price 4/-, plus 6/- ins.

Terminal Heads, always useful, bargain at our normal price of 2/- dozen. Sale price 1/-6, plus 1/- post.

Magnet Generator (hand), as used in telephones. Sale price 7/-6, plus 1/- postage.

Metrolots, Type APW 5/10., sensitive in the mains volts range. Sale price 1/-

Multi-speed Motor with gearbox, works on A.C./D.C. mains. Sale price 1/-, plus 3/- postage.

Navigation Compass, in carrying case but less fluid, may be slightly damaged. Sale price 5/-, plus 2/- postage.


Stud Switch, heavy duty, 30 amp, complete with shunt, chassis, regulator, etc. Sale price 7/-6.

6.005 Twin Gang tuning condensers 5/- . Sale price 1/-6, plus 1/- post.

Midget Coils (L.F.), dust cored, size 11 x 1in., 400 kcs. 5/- per doz.

Flower Blower, with motor, 24 v., 6, D.C. but can be operated off mains with rectifier, 15/- post and packings 2/- including transformer 20/-, or to 125 v. or vice versa. 15/- carriage 3/-6.

Cathode Ray Tube, V.C.R., 517 replaces V.C.R. 9/-6. 8/- carriage 6/-.

19-core Flexible Cable, 20/0. Insulation. Price 1/-6 per yard.

1-core Flexible Cable, 20/0. Insulation. Price 10/- per yard.

Bakelite 3 amp Electric Wall Switch, complete. 8/- and 8/- for 10/- per dozen.

As above, but two way. Price 11d. each, or 10/- per dozen.

Screw Parallel and off electric wall switch made by Crabtree. Price 1/-6 each, or 10/- per dozen.

3 amp. 3 pin, plus socket, "Hicraft", 1/- each or 10/- per dozen.

Screw Parallel and off Electric wall switch made by Crabtree. Price 1/-6 each, or 10/- per dozen.

Bi-Metal Contact Strip for making thermostat. 19/-.

250 v, 1 amp. Rectifier, 7/-6.

3-Phase Contactors, 17/6.

Filament Transformer, 6.3 v. 11amps, normally 9d. Sale price 6/-6, plus 1/-.

Filament Transformer, 6.3 v. 2 amps., normally 10/- Sale price 8/-6, plus 1/-.

90 ohm Coax, low loss, expanded,赞扬, normally 9d., usual price 4/-, plus 1/-.

Wire Jointer (weeder for 38 gauge or thinner), in bakelite case with stripper switch, works on small transistor. Sale price 2/-6, plus 1/-.

ELECTRONIC PRECISION EQUIPMENT LTD.

Orders received by post are despatched from our warehouse, Dept. 7, 46 Grove Road, Eastbourne and to save time, please post your order to this address. Care however, should use one of the following addresses:

* Electronics (Ruislip) Ltd., 202 Ruislip Green, Ruislip, Middx.
* Electronics (Croydon) Ltd., 366 London Road, Croydon.
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<td>CV1113 (1416)</td>
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### OBSOLETE INDUSTRIAL AND TRANSMITTING VALVES GUARANTEED FOR THREE MONTHS

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
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<tr>
<td>A1A</td>
<td>0.75</td>
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<td>A1B</td>
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<td>A1H</td>
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### ALL ITEMS LESS 5% & POST FREE IN DOZENS

No C.O.D. (Callers always welcome.)

List of 1000 plus items.

Post: 2 lbs. 1/4 and under 200; 1000 lbs. 3/6 each. 350-352 Fratton Road, PORTSMOUTH
**PRACTICAL WIRELESS**

**September, 1960**

**THE MOST COMPREHENSIVE RANGE AND OUTSTANDING VALUE IN TAPE EQUIPMENT.**

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### Stern's "fidelity" TAPE RECORDERS

Each recorder is supplied complete with microphone and spool of tape.

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
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<tbody>
<tr>
<td>H/F/G 2/D</td>
<td>Contains the Model HP/G2A-D Unit (described opposite). A small robust recorder with outstanding performance. Truly portable, weighs only 22 lbs. Twin track operates at 3in./sec. speed.</td>
<td>£225.00</td>
</tr>
</tbody>
</table>

**PRICE £29.15.0**

H.P. Terms, Deposit £8.00.0, and 12 months at £2.15.7.

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**HOME CONSTRUCTORS SPECIAL COMBINED ORDER PRICES**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Price</th>
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<tbody>
<tr>
<td>H/F/T3 Amplifier and Collaroy Mk. IV Deck</td>
<td>Together with the Collaroy &quot;Studio&quot; Deck, assembled and tested. Complete Kit</td>
<td>£29.00.0</td>
</tr>
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**THE TYPE "C" PRE-AMP. H/F/T3 AMPLIFIER AND THE HF/G2 UNITS ARE STERN'S - MULLARD DESIGNS.**

---

**FULL DESCRIPTIVE LEAFLETS ON ALL OF ABOVE ARE AVAILABLE - BUT PLEASE ENCLOSE S.A.E AND STATE WHICH LEAFLET IS REQUIRED.**
STERN'S presentation of MULLARD designs

MULLARD "5-10" MAIN AMPLIFIER
Designed to operate with the MULLARD Pre amplify. Input 10 watts and has additional power on 250 MULLARD VALVES. KIT OF PARTS £10.00 OR ASSEMBLED £11.10.

MULLARD 2-VALVE PREAMPLIFIER TONE CONTROL UNIT
Suitable for all amplifier requiring an input of up to 250 mvolts. Kits for Crystal and Magnetic Pick-ups, Microphone, Tape. Separate Bass and Treble. KIT OF PARTS £6.60 OR ASSEMBLED £8.00.

TWO UNITS PURCHASED TOGETHER ARE £15.15.0 OR ASSEMBLED £18.18.0.

MULLARD "3-3" AMPLIFIER
Ideal for small or medium quality installation, provides excellent reproduction up to 8 watts output. Input for Crystal Pick-ups and Radio Tuner. KIT OF PARTS £7.10.0 OR ASSEMBLED £8.18.6.

Mullard "5-10" Amplifier Model 510/RC
Comprises two MULLARD 3-3 Main Amplifiers on one chassis. Outputs with MULLARD STEREO PREAMPLIFIER. Output power 8 watts. Inputs for MG and Radio Tuner. KIT OF PARTS £11.10.0 OR ASSEMBLED £13.10.0.

STEREO "3-3" MAIN AMPLIFIER
Comprises two MULLARD 3-3 Main Amplifiers on one chassis. Outputs with MULLARD STEREO PREAMPLIFIER. Output power 8 watts. Inputs for Crystal Pick-ups and Radio Tuner. KIT OF PARTS £12.10.0 OR ASSEMBLED £15.00.0.

MULLARD STEREO PREAMPLIFIER
Suitable for Stereo or Monaural operation with any Power Amplifier requiring Input of up to 250 mvolts. Input for Crystal or Magnetic Pick-ups, Microphone. Tape. Separate Bass and Treble. Controls. KIT OF PARTS £9.10.0 OR ASSEMBLED £11.15.

STEREO PREAMPLIFIER
Suitable for Stereo or Monaural operation and has separate Bass and Treble Controls. KIT OF PARTS £12.10.0 OR ASSEMBLED £15.00.0.

MULLARD "3-3" POWER AMPLIFIER
Suitable for Stereo or Monaural operation and has separate Bass and Treble Controls. KIT OF PARTS £9.10.0 OR ASSEMBLED £11.15.

MULLARD "5-10" AMPLIFIER
Provides the same results as above, but for larger installations. KIT OF PARTS £12.10.0 OR ASSEMBLED £15.00.0.

"MONARDECK" and Matched Preamplifier
£17.17.0 Carriage and insurance inc. Deposit £3.12.0 and 12 months £6.12.0. Designed to operate through the Pick-up Sockets of the standard RADIO RECEIVER through which first-class results are obtained. It consists of two MULLARD Tape Deck, incorporating matched Pre-amplifier, and operates at 3m/sec. speed. Supplied with accessories, all fitted to an attractive woodplinth, and requires connections to mains supply and Pick-up Sockets, for which purpose "floating" leads are incorporated.

MULLARD "5-10" AMPLIFIER (plus Rectifier) £4.7.0. (plus Rectifier) £4.7.0.

MULLARD "5-10" MAIN AMPLIFIER £21.10.0 OR ASSEMBLED £25.00.0.

MULLARD "3-3" MAIN AMPLIFIER £21.10.0 OR ASSEMBLED £25.00.0.

STEREO "3-3" MAIN AMPLIFIER £21.10.0 OR ASSEMBLED £25.00.0.

COMPLETE STEREO AMPLIFIER
Meets the many requests for a low priced but good quality stereophonic Amplifier. Output power in 4 watts and suitable for Crystal Pick-ups. KIT OF PARTS £8.10.0 OR ASSEMBLED £10.10.0.

THE "ADD-A-DECK" incorporating the NEW B.S.R.
"MONARDECK" and Matched Preamplifier £17.17.0 Carriage and insurance inc. Deposit £3.12.0 and 12 months £6.12.0. Designed to operate through the Pick-up Sockets of the standard RADIO RECEIVER through which first-class results are obtained. It consists of two MULLARD Tape Deck, incorporating matched Pre-amplifier, and operates at 3m/sec. speed. Supplied with accessories, all fitted to an attractive woodplinth, and requires connections to mains supply and Pick-up Sockets, for which purpose "floating" leads are incorporated.

H.P. TERMS AVAILABLE ON EQUIPMENT OVER £9. DESCRIPTIVE LITERATURE AVAILABLE FOR ALL EQUIPMENT. PLEASE SEND S.A.E.

TAPE AMPLIFIERS and PREAMPLIFIERS PRESENTED FROM MULLARD DESIGNS

TAPE AMPLIFIERS and PREAMPLIFIERS

MODEL HF/TS3 TAPE AMPLIFIER
(Mullard Type "A" design) A very high quality Amplifier incorporating 3-speed treble equalisation, using the latest FEROXCUBE POT CORE PUSH FULL OSCILLATOR and 3-speed treble equalisation using the latest FEROXCUBE POT CORE PUSH FULL OSCILLATOR and 3-speed treble equalisation. In addition, separate Power Supply Unit. KIT OF PARTS £12.15.0 OR ASSEMBLED £16.10.0.

MULLARD TYPE "A" TAPE PREAMPLIFIER-ERASE UNIT
The "Hi-Fi" link to add full tape recording facilities to your Hi-Fi home installations. Incorporates FEROXCUBE POT CORE PUSH FULL OSCILLATOR and 3-speed treble equalisation using the latest FEROXCUBE POT CORE PUSH FULL OSCILLATOR and 3-speed treble equalisation. Includes separate power Supply Unit. KIT OF PARTS £14.00.0 OR ASSEMBLED £17.00.0.

(Model HF/2A Tape Preamplifier-Erase Unit
Identical to the HF/2A but excludes Loudspeaker and output transformer (see Model HF/2A-D). KIT OF PARTS £11.00.0 OR ASSEMBLED £13.00.0.

Mk.II "Fidelity" FM TUNING UNIT
An attractively presented Unit incorporating MULLARD PREAMP and TUNING HEART and corresponding Mullard valve line up. FOR THE CASH £10.10.0 ASSEMBLED £14.50.

A SPECIAL CASH ONLY OFFER!!
This very attractive PORTABLE AMPLIFIER CAN, together with a good quality "GRAM" AMPLIFIER and a MULLARD F.M. SPEAKER, all for only £8.7.6. (Plus 7/6 Carr. and Ins.) The Amplifier consists of a 2-stage design incorporating 4 modern H.Y.A. valves and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Mushroom Grey Resine. WE ALSO SUPPLY SEPARATELY:-
(a) The Portable (plus Rectifier) AMPLIFIER £4.7.6.
(b) The PORTABLE CARRYING CASE £3.17.6.
(c) 6-in. P.M. SPEAKER £18.9 Carriage and Insurance 4/- extra.

!! RECORD ADYERS!!
THE LATEST MODELS ARE IN STOCK MANY AT REDUCED PRICES

喜爱的 R.S. MONARCH Type "A" 4-speed Single Autochanger £21.18.9. MONARCH Type "C" 4-speed Single Autochanger £27.10.0. MONARCH Type "D" 4-speed Single Autochanger £27.10.0. GARRARD Model UA12 in Stock. At "SPEED" £2.7.8. MADELEINE Type "A" 3-heads £4.17.8. MONARCH Type "B" 4-speed Single Autochanger £21.18.9. GARRARD Model TA Mk.II 4-speed Single Autochanger £28.17.6. GARRARD Model RC300, Autochanger 4-speeds, High output Crystal Pick-ups, Carriage and Insurance on each above. 4/- extra.

www.americanradiohistory.com
BRAND NEW AM/FM (V.H.F.) RADIOGRAM CHASSIS AT £13.6.8 (P. & P. 10/-)

Tapped input 220-225 v. and 228-230 v. A.C. ONLY.
Chassis size 15 x 6 x 5 in. high. New manufacture. 12 month guarantee.
Dial 14 x 4 in. in black and yellow.
Covers 1,000-1,900 M.: 220-250 M.; 15-50 Mc.; 25.9.2 down and 25.9.5 up.
Valves: EZ83 rect., E881, E888, EAB80, EL84, E860.
Speaker and Cabinet to fit chassis (table model), 476/7.
10 x 6 in. ELLIPTICAL SPEAKER. 20+ to purchasers of this.

TERMS—(Chassis) £14.16.8 down + 10+ carr. and 6 Monthly Payments of 30+ v. or with Cabinet and Speaker £16.8.2 down and 7 Monthly Payments £12.12.2.

BATTERY ELIMINATOR. Converts your Battery Set to Mains. For 4 x Low Consumption Valves (96 range). 60 v. 15 mA. and 75 v., 10 mA. Also for 220 v. 1.4 v. and 50 v. 15 mA at same price. Specify which, or give Valve line-up.

50 SILVERED MICA AND CERAMIC CONDENSERS. 10- 50 RESISTORS. 5. ALL DIFFERENT VALUES.
12 TUBULAR CONDENSERS (7 values 6.001 to 6.1 mf). 4/6.

FULLY BUILT BATTERY OPERATED TRANSISTOR RECORD PLAYER FOR £7.19.6 (36P. & P.).

Coosor printed circuit 4-transistor-amplifier; Garrard 45 r.p.m. battery player type BA1: speed control. Cabinet size 11 x 9 x 5 in.: less than 81/2 lb. Inc. batteries. Requires two Ever Ready A5B6 batteries. State colour—red/cream or blue/cream.

5-VALVE AMPLIFIER (INC. REC'T). Capable of giving 9 watts. Mains and output transformers. Valves: ECC81, EL84 and Rec't. 3 Controls: volume, bass and treble. On/Off switch. Fully guaranteed. Chassis size 6 x 3 x 2 in. in-built round. With 7 x 4 in. elliptical speaker, state which.

Not suitable for microphone input.

67/- (3/- p. & p.)

TAPE RECORDER ASSEMBLED TO B.S.R. MONARDECK


Enquiries invited for any of the parts.

See additional advertisement on page 459

GLADSTONE RADIO

58A HIGH STREET, CAMBERLEY, SURREY. Tel. 22781
Also at 3 Church Road, Lawrence Hill, Bristol 5 and 247 New Road, Portsmouth, Hants. Camberley closed Saturdays. Bristol and Portsmouth closed Wed. afternoons.
THE RADIO SHOW

It seems likely that this year's Radio Show will be more successful than its immediate predecessors; many innovations have been planned while several exhibits which have been absent in recent years will again be on show. So far as radio receivers are concerned, it seems that the emphasis will be upon portable, battery-operated, sets. The increasing use of transistors enables smaller receivers to be designed and gives longer battery life. The current trend is towards miniature receivers with colourful, attractive cases which women will find especially attractive.

At the recent British Exhibition in New York, great interest was aroused in British audio amplifying equipment which already enjoys great popularity in the United States. Most of the principal manufacturers will exhibit their goods at Earls Court and aerials, valves and other components will be included.

To many visitors, the main attractions at the exhibition will be the stands of the BBC and the T.A., both of which have planned the usual entertainments—with producers, technicians and stars at work in view of the public. Other large stands will be manned by the Royal Navy and the Royal Air Force and after three years' absence the Army returns with demonstrations by a Territorial unit of the Royal Signals (the 65th Signal Regiment, T.A.). The General Post Office stand has been devised to appeal to both technical visitors and laymen. For the first time since 1947, the London Metropolitan Police, a major user of electronic equipment, will also have a stand.

Many of our younger readers will be interested in obtaining information on possible careers in the radio industry; a radio servicing exhibit will show the prospective apprentice the type of work involved as well as illustrating to the public and radio dealers the uses of the latest test equipment used in radio repairs.

The 27th British National Radio Show will be held at Earls Court, London, from August 24th to September 3rd, with a preview for overseas visitors on August 23rd. Our stand at the show is No. 117 on the ground floor and we hope that readers attending the show will visit us there.

OUR QUERY SERVICE

Once again we must remind our readers of the rules of our Free Query Service. The following points should be carefully noted:

(i) We cannot undertake to answer technical queries over the telephone
(ii) All queries must be accompanied by the query coupon from the current issue
(iii) If a postal reply is required a stamped and addressed envelope must be enclosed with the query.

We must also point out that we cannot design circuits to readers' specific requirements. Nevertheless we shall continue to help readers as far as possible but it should be remembered that all information necessary for answering the query should be sent to us.

Our next issue, dated October, will be published on September 7th.
PRACTICAL WIRELESS September, 1960

Round the World of Wireless

POTENTIAL AND CURRENT NEWS

Broadcast Receiving Licences

The following statement shows the approximate number of Broadcast Receiving Licences in force at the end of May, 1960, 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
  - London Postal
  - Home Counties
  - Midlands
  - North Eastern
  - North Western
  - South Western
  - Wales and Border Counties

- Total England and Wales
- Scotland
- Northern Ireland
- Grand Total

Total broadcast receiving licences issued in May, 1960, in England and Wales 4,438,088.

Radio Installation in H.M.T.S. "Monarch"

A comprehensive radio communication installation in the G.P.O. cable-laying ship H.M.T.S. "Monarch" has recently been completed by Marconi's Wireless Telegraph Co. Ltd. Part of this installation is of unusual technical interest in that it is believed to make "Monarch" the first ship in the world to be equipped with HF transmitting equipment which embodies a main amplifier having no tuned circuits.

This facility is incorporated in a new equipment developed by the Marconi Company, the wideband RF amplifier Type NT203. It provides a substantially constant power gain over the whole of the band 1-5Mc/s to 24Mc/s and therefore needs no retuning when the working frequency is changed. Two amplifiers are used in parallel without difficulty in H.M.T.S. "Monarch".

Communications circuit for Caribbean

The world's most advanced inter-island and aeronautical tele-communications system was officially inaugurated in Barbados on June 10th, 1960, when the first call was made to Trinidad by the Federal Minister of Communications, the Hon. Andrew Rose. This £5,000,000 multi-channel VHF scheme was engineered in conjunction with and on behalf of International Aeradio Ltd. by Pye Telecommunications Ltd. and Ericsson Telephones Ltd. It provides modern automatic telephone and teleprinter services for islands operating in the Caribbean and gives instant, round the clock contact between any airport air office and aircraft, irrespective of weather conditions.

Twelve separate and simultaneous voice channels have been provided, along with 12 to 18 teleprinter channels. The main route runs from Trinidad via Grenada, St. Vincent, St. Lucia, Dominica, Antigua and St. Kitts and by a link, through the All-American Cable and Radio Company, to St. Croix, Puerto Rico and on by co-axial cable to North America.

T.C.C. Agreement

An arrangement has been made between the Telegraph Condenser Company Ltd. of the United Kingdom, and Sprague Electric Company of the U.S.A., whereby:

(a) T.C.C. acquire the right to all Sprague United Kingdom patents and applications, together with the technical and engineering information necessary to exploit them.

(b) Sprague will make available to T.C.C. all its present research and technical information and engineering knowledge and for the next 21 years the two Companies will exchange research, development and manufacturing knowledge, extending beyond the field of capacitors and incorporating all the products of the two Companies.

BBC Appointments

The following appointments have been announced by the BBC. Superintendent Engineer, Transmitters, Mr. W. E. C. Varley, Associate I.E.E., A.M. Brit.I.R.E., in succession to Mr. E. F. Wheeler who retired on June 15th after 36 years service. Assistant Superintendent Engineer, London Television Studios, Mr. M. H. Hall M.B.E. in succession to Mr. H. Walker who is retiring after thirty years with the BBC. Engineer-in-Charge, London Television Studios, Mr. W. D. Hatcher, B.Sc.(Eng.), A.M. Brit.I.R.E. who succeeds Mr. M. H. Hall.

E.M.I. Controlled Milling Machine

Three years ago, a large British aircraft company

Nigeria's Minister of Communications, the Honourable Olu Akinfosile, recently visited Marconi's Chelmsford works. The illustration shows Chief Olu talking to two fellow Nigerians who are engaged in training courses at Marconi College.
sought to solve the problem of economically producing the wide variety of components needed in small quantities in aircraft manufacture by the introduction of electronically controlled machine tools. The Company, St. Shear Bros. Ltd., of Belfast, has now been operating a Cincinnati vertical milling machine fitted with an electronic control system designed and manufactured by E.M.I. Electronics Ltd., for over 10,500 hours, working a double shift 16-hour day.

ショルック have now placed an order with E.M.I. for another similar machine. The reduced turnaround time has considerably increased productivity in the department, and the scrap rate is less than 0.3 per cent.

Because they can be programmed from punched tape and require no marking out or expensive templates, E.M.I.-controlled machine tools are ideal for small batch production. Amendments to design drawings can be quickly incorporated in the control tape without the costly delays met in conventional systems.

Outer Space Temperature Research

The radio telescope at Bonn University Observatory will shortly be used for an intensive investigation into the temperatures prevailing in interstellar gas. This new outer space research programme, under the direction of Professor Becker assisted by Herr Heinz G. Muller, is another example of new application for Travelling Wave Tubes manufactured by English Electric Valve Company Limited. Special dual channel amplifying equipment, using two low noise type N1017 Travelling Wave Tubes in cascade in each channel, has been supplied to the University by Marconi’s Wireless Telegraph Company Limited.

The radio telescope, a parabolic mirror of 83ft diameter mounted on a pyramidal tower about sixty feet high, scans the sky picking up the cosmic continuum radiation emanating from galactic and extra-galactic radio sources under observation. The signals in the neighbourhood of the hydrogen line frequency (1420Mc/s) are amplified by one pair of travelling wave tubes, the other pair being used to amplify reference noise signals from a resistor at a known temperature.

The outputs from the two amplifying channels are detected, integrated and compared and the effective cosmic temperature determined; from these, data contour maps are prepared. So accurate has the system proved in initial tests that a discrimination of 0.1°K has been achieved.

South Western Section Convention 1960.

ON 7th and 8th October, 1960, the South Western Section of The British Institution of Radio Engineers is organising a one-and-a-half-day Convention in the Bristol College of Science and Technology.

The Convention is planned to explore the technical potential of developments in electronics in the Aircraft Industry which it is thought could be of benefit to the Manufacturing and Process Industries. At the same time prominent members of these professions have been invited to post their problems to experts in the Electronics field. In conjunction with the Convention, a small Exhibition will be held.

The Convention will be open to all interested persons and further particulars and Registration Forms may be obtained from the Hon. Secretary, South Western Section, The British Institution of Radio Engineers, c/o The School of Management Studies, Unity Street, Bristol 1.

British Consumer Goods Display at Toronto

THE Board of Trade is sponsoring a display of British consumer goods at the Canadian National Exhibition in Toronto, which opens on August 24th and lasts until September 10th. The Board held similar displays last year and the year before at this exhibition, a popular annual event looked upon as both a national festival and an international trade fair.

The Council of Industrial Design has selected on the Board’s behalf more than 200 examples of well designed products to go on a stand covering 2,000 sq. ft. They include carpets, furnishing fabrics, high-class knitwear and woollen fabrics, furniture, kitchen equipment, leather goods, a lighting fitting, a radio set, sports goods, toys, cutlery and other wood and metal tableware. There will also be glassware and pottery selected from British products held in Canada.

The display is being designed by Leslie Gooday, A.R.I.B.A., M.S.A.I. An enquiry counter on the stand will be staffed by the U.K. Trade Commissioner’s office in Toronto.

The above illustration shows members of the Southgate and Finchley Group of the Radio Society of Great Britain at their annual National Field Day in Trent Park, Cockfosters.
Six Valve 9W Amplifier

A VERSATILE, HIGH OUTPUT, CIRCUIT

By F. G. Rayer

This amplifier employs a high-gain, low noise pentode in the first stage, so that adequate power output can be obtained with an input of 2 to 3mV. As a result, it is suitable for use with microphones giving a relatively small output. It can, of course, also be used with a record player or other source providing a larger output than the minimum quoted.

Circuit

The circuit is shown in Fig. 1. To obtain the full 9W an H.T. supply of 120mA at 250V is required, and a mains transformer of moderate size can supply this. The whole amplifier can thus be made as a reasonably compact unit, with protective cover. An input socket is provided at the back, and speaker output sockets at the side, the required speaker transformer being incorporated in the amplifier.

The chassis is approximately 11¼in. x 7½in. x 2¾in. and should be of stout gauge material. If it has sides all round this will strengthen it, and also prove convenient when fitting the case. It will, however, make wiring a little less easy to reach, though this is not very important in a chassis of this size. Some modification in the dimensions of the chassis will not be of any importance, if the parts can be accommodated without crowding.

Positions for the valve holders can be marked out from the measurements indicated in Fig. 2. The 7-pin holders (6AT6) require holes approximately ¼in. in diameter, with 2½in. holes for the 9-pin holders (6BR7 and 6BW6 valves). A hole about 1½in. in diameter is necessary for the 5V4G holder. These holes can be made with chassis punches, an adjustable cutter, or by drilling rings of small holes, and cleaning up with a file.

Fig. 1.—The circuit diagram.
Mains Transformer

The drop-through type of mains transformer also requires a cut-out, which can be made by starting with several holes at each corner, and then using a metal saw. All these large holes should be finished before fixing any parts. The upright type of transformer is equally satisfactory, and does not need a cut-out to hold it.

If the chassis does not have side runners, two pieces of wood should be cut to fit inside the chassis ends. That is, approximately 7/8 in. x 2 1/2. These will be required when making the case, to hold the ends.

When the large components have been bolted to the chassis, this should be arranged upside down so that wiring can be done underneath. It is wise to use blocks of wood to support it, or temporarily place it so that it rests in a box. Otherwise there is some danger of breaking the tag board of the output transformer, owing to the weight of transformers and choke. If a box is used to give support, this should be a little smaller than the chassis, so that the chassis rests on the edges of the box, with the transformers, etc., inside.

Wiring Details

Connections and parts underneath the chassis are shown in Fig. 3. The heater circuit is best wired first, leads being run close against the chassis. Small tags, for chassis connections, should be bolted securely in place when fitting the valve-holders. All these points are marked "M.C."

Short, direct wiring is used in the first stage (6BR7 valve), and the lead from the input socket is screened. The metal braiding is pushed back slightly, wrapped with tinned copper wire, and the joint soldered, the wire being used to connect the braiding to the chassis. A coaxial connector, or screened input jack, may be used instead of the insulated socket. The earth return (chassis) side of the input goes to the amplifier chassis, either by taking the lead to the terminal shown, or by means of the outer contact of the coaxial connector.

The two leads to the volume control are also screened as explained, both ends of the braiding being connected to the chassis. The introduction of hum, owing to long wiring, is much less likely in the later stages, and screening is not required there.

Matching

The two 100k resistors in the second 6AT6 stage should have their values matched to 5 per cent. The resistors do not need to be exactly 100k, provided they are of similar value. If these resistors are taken at random it is possible that they will be of rather dissimilar value, and this will cause unbalance in the input to the push-pull stage. The two 470k grid resistors wired to the 6BW6 valves are also matched to 5 per cent for the same reason.

It will be noted that the junction point of 25µF condenser. 100k resistor, 1M resistor, 3:3k resistor, and 0-01µF condenser must not be in contact with the chassis. With short, direct leads, an insulated supporting tag is scarcely necessary here. But care is necessary that the 25µF condenser is not a type with a metal can common to negative, as, if this were so, and the can were in contact with the chassis, one output valve would receive no signal.
**Bias Resistor**

The output bias resistor value of 120Ω is made up by wiring two 240Ω 1W resistors in parallel, these being attached to tags on the tag-board shown. Two such resistors are in some cases easily obtained, where difficulty may arise in buying a 120Ω 2W resistor. The single 120Ω resistor, would, of course, be satisfactory.

This tag-board also provides mounting points for some other components, as indicated. The indicator lamp is returned to the chassis. A separate mains switch is used, wired to the mains transformer primary, to avoid carrying mains leads near the volume control, and because this is often more convenient, as the volume control can be left at a pre-determined setting.

**Mains Transformer and Choke**

Surplus transformers and chokes may be obtained from many suppliers, and their use will reduce quite considerably the cost of building the amplifier. The heaters and lamp require 6.3V at 2A, with a separate 5V at 2A for the rectifier heater. Windings rated as able to deliver over 2A would be equally satisfactory, as there is no need to take all the current the winding can deliver.

For H.T., a 300-300V winding, rated at 120mA, is satisfactory. On full load, the voltage at the rectifier cathode will be around 265, so 250V may still be obtained with 15V dropped in the smoothing choke. A somewhat higher voltage will not matter. A lower voltage will reduce maximum output slightly. If a 350V transformer is to hand, this may be used. The choke can then have a higher resistance. A winding rated at 125mA or 150mA will, of course, be satisfactory.

**COMPONENTS LIST.**

Valves:
- 6BR7, two 6AT6, two 6BW6, 5V4G.

Valveholders:
- Two B7G, three B9A, one octal.

Fixed condensers:
- Four 0.01µF 500VW, 0.1µF 350VW, 8 plus 8µF 340VW, 8 plus 16µF 450VW,
- three 25µF 25VW, 50µF 50VW.

Resistors, 1W:
- 1.5k, two 3.3k, two 47k, 100k, two 100k matched 5 per cent, two 220k, two 470k matched 5 per cent, 1M, 1.5M, two 240Ω 1W (or 120Ω 2W).

Sundries:
- 300/0/300V 120mA, 5V, 2A, 6.3V, 2A mains transformer for 200/250V. 120mA smoothing choke. 1M volume control with knob. On/off switch. Input and output sockets, etc. Elstone MR/7 output transformer. Chassis approx. 11½in. x 7¼in. x 2½in. Perforated metal approx. 12in. x 24in. Wood, etc.

(To be continued)
**Inexpensive P.A. Equipment**

**COMPLETE CONSTRUCTIONAL INFORMATION**

By V. E. Holley

(Continued from page 302, August issue)

As it is a matter of chance at each connection to the mains which of the leads to the mains transformer becomes neutral, a two-way switch is provided so that C9 may be connected to either. The correct position for this switch is apparent from the reduced hum level but as this is in any case low, it is difficult to distinguish in noisy surroundings. A small neon indicator lamp is therefore connected to the "hot" end of C9 and its other connection taken to a 48 A, bolt in the mains panel. If the position of the switch is not correct, the neon will glow when a finger is applied to the bolt head. Note that if a rotary switch is used it must be a 3-or 4-way so that one or two tags may be left unconnected between those used for mains connections; otherwise the switch will probably short circuit the mains when it is operated. If the neon indicator is of the type designed for direct connection to the mains, R15 may be omitted.

**Speaker System**

The output transformer has secondary tappings for 3, 5, 8 and 15Ω and is suitable for supplying 15Ω speakers in parallel or 3Ω speakers in series. The latter arrangement was selected as 3Ω speakers are easier to come by at reasonable prices on the surplus market.

All the connections from the output transformer secondary are carried by way of an octal plug and 5-way cable to a load control panel. A 4-way switch is fitted here by means of which the correct tapping for the load may be selected. The output is then taken through the first speaker to a closed circuit jack on the side of the amplifier cabinet which permits the insertion in series of an additional speaker as required. In single speaker operation, large currents flow in this circuit and the closing action of the jack is therefore relied upon only for temporary disconnections in multi-speaker working. It is otherwise reinforced by a small shorting plug inserted into a parallel-wired socket. The wiring is shown in Fig. 2.

It will be seen that the same plug, inserted in a different way, serves to short out the first speaker when required; socket D holds it when neither function is required. The plug is used in preference to a switch so that this control shall not be available to inexperienced operators.

The completed equipment in its case.

The amplifier is housed in a cabinet, together with one 10in. speaker. The second speaker is in a cabinet of the same size, shape, and construction and has a closed circuit jack for the connection of a third speaker in series if required. It is necessary of course, that all the speakers should be connected in phase. A 12V battery should be applied to the speaker line; the resultant impulse will cause the cones to move and the direction of movement can be discovered by holding the finger lightly against each cone in turn. Connection should then be arranged so that all the cones move in or out together.

**Open-Air Work**

For open-air work, especially where it is necessary for announcements to be heard over considerable distances, speakers of the re-entrant type will be found most suitable. They are obtainable cheaply from surplus sources, with an impedance of 7.5Ω and will handle 8W with penetrating efficiency. Two may therefore be operated in series with the load control switch at 15Ω and internal speaker shorted out.

Re-entrant speakers are also useful for speech amplification in large halls. They are not very suitable for reproduction of music as the output falls off at the lower frequencies.

**Construction**

The layout was shown in Fig. 3. It is quite straightforward. The placing of the components is not at all critical but those which generate heat should
be given plenty of room. Attention must of course be paid to the rigidity of wiring and the secure anchoring of all components. Sheet aluminium, not thinner than 16s.w.g., is recommended for the chassis, a plan of which was given in Fig. 4a. Note that one end is left open for ventilation. The input socket and volume control are mounted on a screen at one end so that the control should be well clear of floor level when in use. An octal socket is used for connecting the speaker network. The mains lead should be about 15in. long and fitted with a plug to suit a socket fitted inside the cabinet.

Testing
If when the completed amplifier is switched on, it is found that the feedback is positive, the connections to the anodes of V3 and V4 should be reversed. When proper operation has been secured, the voltage at the anodes and screens of these valves should be checked; it should not exceed 285 vac measured between these electrodes and the cathode and the bias should be 18-19V. Some alteration to the value of R16 may be necessary to achieve these figures.

Cabinet
The amplifier is housed in a cabinet 18in. x 18in. x 6in. which contains also one 10in. speaker and a small compartment at the top, fitted with a hinged lid and accommodating mains and load control panels; there is also space for stowing the mains lead, etc., when not in use. (Fig. 5). The cabinet holes in the bottom similarly covered, will provide underchassis ventilation. Some wooden feet should be added to raise the cabinet about 1in. above the surface on which it stands.

External Connections
External access must be provided for the volume control, the input and output sockets, and the speaker shorting plug and it is desirable in order to avoid damage in transit that all these fittings should be flush with the surface of the cabinet. A flushmounting coaxial socket is used for the input, which is then taken by a short length of screened lead and suitable plug to the socket on the amplifier. The output jack socket is mounted on a small aluminium plate screwed to the inside of the cabinet, a 1/16in. hole being cut in the cabinet side for the jack plug. The shorting plug is dealt with similarly. For the volume control, a 2in. diameter hole should be cut and covered on the inside with an aluminium plate having a 1/16in. hole located centrally through which the control spindle can be extended by means of a connector and a short length of 1/16in. brass rod. There is no room to fit a knob flush with the surface but an effective control can be made by soldering a 1in. length of 16s.w.g. wire across the end of the brass rod in the form of a letter T. The mains lead should be brought out at the bottom so that if someone should trip over it, the cabinet will not be upset. A hole must be provided in the back for screwdriver access to VR2.
**Finishing**

The completed cabinet may be rubbed down with glasspaper and painted a suitable colour and a collapsible carrying handle fitted at the top. The appearance can be enhanced by displaying the owner’s business card or printed name and address behind a small sheet of perspex screwed to the front above the speaker aperture.

**Fitting the Amplifier**

The chassis is designed to be a snug fit between the horizontal fillets at the bottom of the cabinet. It needs to be attached very securely and the best method is as follows. Remove the heads from two 1\(\frac{1}{4}\)in. wood screws and with a hacksaw cut new screwdriver slots. Make a cardboard template of the side of the chassis showing the exact positions of the holes A and B (Fig. 4a). Remove the rear horizontal fillet from the cabinet and with the aid of the template insert the headless screws into the front fillet in the correct positions so that they protrude 3in. Place the chassis in position; the headless screws should pass neatly into the holes A and B. Replace the rear fillet and at points corresponding roughly with the positions of the headless screws, drill two 3/16in. holes through the fillet and the side of the chassis beyond. If two 1\(\frac{1}{4}\)in. wood screws of suitable diameter are now inserted, they will have a self-tapping action as they enter the aluminium and will secure the chassis very firmly.

**Operation**

Used in conjunction with a microphone, the construction of which will be described next month, the amplifier has sufficient gain for many purposes with no pre-amplification. It will perform adequately for instance for announcements or speeches at social functions, sports meetings, etc., for the use of a vocalist in a dance band or for emphasising a solo instrument. It is quite free from hum and extraneous noises and the maximum gain is not sufficient to generate acoustic feedback unless the microphone is deliberately introduced to the front of the loudspeakers. It is thus practically foolproof and having been installed on the site, can be left in the hands of an inexperienced operator who is required only to switch the microphone on and off as necessary.

In other applications where the sound source is at a greater distance from the microphone, use is made of pre-amplifiers, of which a description will be given.

The amplifier can, with suitable input arrangements, be used with any type of microphone but for practical reasons the choice for portable equipment lies between the moving coil and crystal types. The former has the advantage of low impedance so that long, and sometimes unscreened, cables can be used without picking up hum or extraneous noise, but it is expensive and requires an input transformer, which is a further expense. Further, it often has a rather distressing overload characteristic. The crystal type on the other hand is cheap and robust, has a high output, is not easily overloaded and requires no transformer. With proper screening and earthing, it can be operated with up to 50 or 60ft of cable without difficulty. It is therefore the preferred type of instrument for this equipment.

**Input Circuit**

The crystal microphone may be regarded for practical purposes as an A.C. voltage generator having in series with its output a low resistance and a very small capacitance which is in fact the self-capacitance of the crystal (Fig. 6). It will be seen that as with any R/C coupling, if the full output in the lower frequencies is to be realised, the load must be high and 5M is a common value. For the best reproduction of speech, however, it is desirable to introduce some attenuation of the lower frequencies and this can be achieved-satisfactorily by reducing the load to 2M. As this is the value of the volume control in the grid-circuit of V1, a crystal microphone is suitable for direct connection to the main amplifier.

**Making a Mike**

Suitable instruments can be obtained commercially from about 35s., upwards and while it may be desirable to have one of these for use on occasions when appearance is especially important, a very satisfactory mike can be made up at the cost of a few shillings from one of the crystal inserts available in the surplus market. The following describes the construction of a hand instrument, using a 2in. round insert but the same technique can be followed for desk and stand models.

![Diagram of microphone case](www.americanradiohistory.com)
Using Absorption Wavemeters

ACCURATE MEASURING METHODS

By M. Longdon

A

n absorption wavemeter is an extremely simple piece of equipment, and requires no battery or mains supplies. With its aid the operating frequency or wavelength of oscillator, receiver, multiplier, and transmitter output stages can be determined. It does not produce any radio-frequency output itself (as, for example, does a mains or battery operated signal generator), but instead extracts energy from the circuit being tested.

One great advantage of the absorption wavemeter arises from the fact that its indication is always on the fundamental. That is, wavemeter and tested circuit will always be tuned to the same frequency, not possibly to a harmonic, as may arise with a signal generator.

Circuit

The simplest practical absorption wavemeter is shown in Fig. 1 and in this form it can be used for any of the tests described. For short wave use a single fixed coil will cover quite a wide band. Other bands can be covered by employing plug-in coils, the holder being attached to the tuning condenser. Alternatively, a separate wavemeter can be constructed for each band, as the cost is so small, especially if only two or three bands are to be covered.

Smooth or ribbed formers can be used for the coils. Ribbed formers approximately 1\(\text{in.}\) in diameter, as available for S.W. receiver coils, are satisfactory. Using these, 80 turns occupying about 1\(\text{in.}\) will cover approximately 1\(\text{Mc/s}\) to 3\(\text{Mc/s}\). For 3\(\text{Mc/s}\) to 8\(\text{Mc/s}\) 35 turns occupying 1\(\text{in.}\) can be used, with 9 turns occupying 1\(\text{in.}\) for 8\(\text{Mc/s}\) to 24\(\text{Mc/s}\) and 3 turns occupying 1\(\text{in.}\) for 23\(\text{Mc/s}\) to 60\(\text{Mc/s}\). Turns should be tight, cemented in place or resting in notches in the ribs.

![Fig. 1.—Simple practicable wavemeter.](image)

Ready-made receiver and similar coils can, of course, be used. The tuning condenser can be of 100\(\text{pF}\) to 250\(\text{pF}\) capacity, though the coverage mentioned is for approximately 150\(\text{pF}\).

The small panel in Fig. 1 serves merely to take the wavemeter scale, and to provide a "handle" by which the instrument can be held while tuning. It is also feasible to build the wavemeter in a cabinet, with plug-in coils on top, or at one side.

![Fig. 2.—Using a wavemeter to check a receiver coil.](image)

This form of construction is usual in high-class instruments which may receive much use, or possibly rough handling. A milliammeter or other indicating device may also be added. This is useful for some applications, and is described later.

Receiver Checking

When the absorption wavemeter has been calibrated, it can easily be used to show the wavelength to which a regenerative receiver is tuned. This allows dial readings to be marked up for home-constructed receivers. The wavemeter will, in fact, be most useful means of quickly calibrating such receivers, or adjusting receiver coils.

To check a receiver, the wavemeter is placed so that its coil is fairly close to the receiver coil, and approximately in line with it, as shown in Fig. 2. The receiver regeneration or reaction control is then adjusted until the detector is just oscillating. When the wavemeter is tuned to the same wavelength as the receiver this oscillation will cease. This tuning point can be found by listening with the phones or speaker. The wavemeter reading can then be marked on the receiver tuning scale.

Accuracy

It is most convenient to adjust wavemeter and receiver tuning a little, by moving them in step, until the wavemeter indicates suitable round figures to transfer to the receiver scale. The most accurate readings will be obtained by keeping the wavemeter as far as possible from the receiver coil. But if reaction is not carefully adjusted, the wavemeter will cease to pull the detector out of oscillation, as the distance is increased.

To obtain an easy visual indication, a meter may be wired to the receiver, to show detector anode current, as in Fig 3. Reaction is then adjusted, as
already explained, and wavemeter tuning brought into resonance. The exact tuning point will be shown by the maximum rise in meter reading, as the wavemeter draws power from the oscillating circuit.

**Wavemeter Calibration**

If a calibrated regenerative receiver is available, the wavemeter scale can be marked up from this. The receiver is tuned to a suitable frequency, reaction adjusted as explained, and the wavemeter is tuned until the circuit is at resonance, as described. The receiver reading is then marked on the wavemeter scale.

If the receiver is not calibrated, it should be tuned to a station of known wavelength, and the wavemeter can then be adjusted to this wavelength. It is best to remove the receiver aerial, or use only a very short throw-out wire.

When a signal generator is available, this can be set to various frequencies, and the receiver tuned to the signal. The absorption wavemeter is then tuned to the receiver frequency, as described.

**Calibration with a Superhet**

Should a calibrated superhet be used, the wavemeter can be calibrated to agree with this by making up a temporary one-valve radio frequency oscillator. The superhet is tuned to a suitable frequency, and the oscillator is tuned until its note is heard on the receiver. The wavemeter is then tuned to the oscillator, a milliammeter in the H.T. circuit being used as an indicator.

When "round" figure wavelength or frequency readings are obtained, they can be marked directly on the wavemeter scale. But, if broadcasting stations are chosen, as a means of calibration, it is most convenient to draw up a graph by plotting frequencies against wavemeter dial readings, as in Fig. 4. Dial readings for "round" figure frequencies can then be found, and marked on the wavemeter scale. Calibrating from known stations can provide a very good degree of accuracy.

Once the wavemeter has been calibrated, care should be taken not to change the coil windings or otherwise modify it. It will then always be available for checking frequency or wavelength.

**Resonance Indicators**

An indicating device may be incorporated in the wavemeter, to show when tuning agrees with that of the circuit being tested. When such an indicator is added, the wavemeter can still be used in the same way as the instrument in Fig. 1.

Two types of indicators are shown in Fig. 5. The meter can be housed in the wavemeter case, and a 1mA instrument is convenient. When checking oscillator and transmitter circuits, the correct tuning point is that giving the highest meter reading. If a strong R.F. signal is present, the wavemeter should be kept far enough away to avoid overloading the milliammeter. If a very sensitive instrument is fitted, it is wise to add a switch and resistor, so that a shunt can be brought into circuit.

A low consumption bulb, coupled by a small loop of about two turns, will also serve as an indicator for small transmitters. Because of its simplicity, this method is popular with model control equipment. Changing the bulb will slightly modify tuning, so it is best to solder this item into circuit. The wavemeter coil should be kept as far from the transmitter coil as possible, as this gives most accurate indication with a bulb indicator.

The coils described are suitable for the circuits in Fig. 5. If it is desired to cover only a very

![Fig. 3.—Coupling the wavemeter direct to a receiver.](image-url)

![Fig. 4.—A calibration graph.](image-url)

![Fig. 5.—Wavemeters with indicators.](image-url)
small tuning range, the tuning condenser can be 15pF to 25pF or so. For example, a wavemeter for model control transmitter tuning only could have 11 turns occupying 1/8 in. on a 3/8 in. diameter ribbed former.

The bulb meter can easily be carried, and is readily held in line with the transmitter coil, as shown in Fig. 6. If used as described, the indication it gives is sufficiently accurate.

**Link Coupling**

A wavemeter with large calibrated dial, or fitted with a milliammeter, may be too large to handle easily. Occasions also arise when it is awkward to bring the meter coil and receiver, oscillator or transmitter coil into line, or when the coil is difficult to reach.

When investigating circuits in these circumstances, a simple link coupling can be arranged between the equipment coil and wavemeter coil. The link can be made with a convenient length of insulated connecting wire or flex. About one turn is made round each coil, and the ends of the wire are joined. This introduces coupling between the two pieces of equipment, as shown in Fig. 7, and it is no longer necessary to have the coils near together, or in line.

The loop at each end of the link line should have the same number of turns. The loop will usually need to be near the “earthed” end of the coils, otherwise coupling may be too tight. With a transmitter or oscillator, particular care is needed not to overload the wavemeter.

**Indicator**

When the wavemeter has an indicator, tuning is for maximum deflection, as explained. If the wavemeter is of the type shown in Fig. 1, a milliammeter should be included in the anode circuit of the stage under test, as an indicating device. With transmitting equipment, this meter will often be present already. It is then only necessary to tune the wavemeter until a rise in meter reading shows that power is being drawn.

If the wavemeter is accurately calibrated and well made, a high degree of accuracy can be achieved, especially when coupling to the circuit under test is loose. With transmitting equipment, it is particularly useful to investigate the harmonics present in crystal controlled or multiplier stages, or in the transmitter output. As harmonics will arise only at well-spaced intervals from the fundamental, even a simple wavemeter, calibrated with only moderate accuracy, will be extremely useful for locating them. For this type of work, a milliammeter is the best indicating device, and loop link connections to various circuits can be made as shown in Fig. 7, care being taken that the meter is not overloaded.

**Calibrating a Generator**

A home-constructed signal generator can be calibrated from the wavemeter, exactly as described for a transmitter. A milliammeter is included in the signal generator H.T. circuit, as an indicating device, if the wavemeter itself does not have an indicator of enough sensitivity to show resonance with the oscillator.

A grid dip meter may be calibrated directly from the wavemeter by placing the coils in line and tuning for maximum dip on the grid current meter.

With other than very low-powered transmitting equipment, the radio frequency field near a crystal oscillator, multiplier or output stage will be strong enough to give an indication on the wavemeter milliammeter, even if the coils are not in line, and in these circumstances the link coupling method need not be used.
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MY older readers will remember the early days of radio and the excitement of daily news of far reaching discoveries. Marconi is the name most easily recalled and it was with great interest that I learned of a private ceremony at Marconi House, London, on July 6th, when Lord Nelson of Stafford, Chairman of the English Electric Group, presented to the National Trust the title deeds of some 40 acres of land at Poldhu, Cornwall—the former site of the historic radio station. This station, which was built by Guglielmo Marconi, was the first to span the Atlantic with wireless telegraphy. The gift was accepted by Earl De La Warr, Chairman of the Trust's Estates Committee.

Also among those present at the ceremony were Sir Ronald German, Director General of the G.P.O., Sir Godfrey Ince, Chairman of Cable and Wireless Ltd., Mr. F. N. Sutherland, Managing Director of Marconi’s Wireless Telegraph Co. Ltd. and Mr. C. S. Franklin of short wave beam radio fame. (Mr. Franklin, who joined the Marconi Company in 1890, was closely associated with Guglielmo Marconi and the Poldhu wireless station, and is very largely responsible for long-range radio communication as it exists today.)

Of Poldhu wireless station nothing now remains—it was dismantled as long ago as 1937—and a granite column is the only reminder of the momentous events which took place on this windswept cliff overlooking Mounts Bay in Cornwall.

Poldhu was the cradle of the Radio Age. Guglielmo Marconi, in 1900, chose the site to build a wireless station of a size never before thought possible. Its purpose was secret until, on December 12th, 1901, Marconi announced that signals from Poldhu had bridged the Atlantic and were being received by him at St. Johns, Newfoundland.

That news, in one dramatic moment, took wireless telegraphy out of the laboratory and into acceptance as a wholly practical new system of communication. As a side issue it confounded the many learned critics who had said that wireless waves would never reach beyond the horizon.

Thus, Poldhu first made the headlines—something it was destined to do at intervals throughout the thirty-four years of its life. For many years, as a commercial wireless station, it was looked on with especial affection by seagoing operators and those in faraway lands as the “old dependable” link with the homeland, bringing them good news and bad—as, for instance, the declaration of war in 1914.

The latter days of Poldhu were to bring a triumph rivalling that of its first, for it was here that the Marconi-Franklin beam system was evolved which in 1924 revolutionised long-range radio communications and gave Britain a system which was technically years ahead of any other nation. The short wave beam stations which resulted from the initial Poldhu experiments are still in use to this day.

On a plane of more common experience it is perhaps of interest to recall that the coaxial cable which is an integral feature of every home television installation was derived from a development by C. S. Franklin in the course of his research work at Poldhu.

The granite column and some six acres of land along the cliff edge at Poldhu were given to the National Trust by the Company in 1937. The latest gift is the remainder of the Marconi Company’s property in this area.

This tribute to Marconi’s memory was received from the Marconi Company and it makes me think with regret that many of the early pioneers of radio—such as Hertz, Lodge and Fleming—have long been forgotten.

The memorial on the cliff edge at Poldhu which commemorates Marconi’s pioneering work at the station.
A Microphone Pre-Amplifier

A STABLE, HIGH GAIN DESIGN

By R. Hindle

A NEED arose to operate a good quality moving coil microphone through a typical high fidelity audio amplifier, but of course the gain of the amplifier was insufficient for this purpose and a separate microphone pre-amplifier was required. A 6BR7 was chosen for the purpose. This valve in a single stage is quite capable of providing a gain of 100 times, which is sufficient for the purpose. The microphone to be used was made by S.T.C. and in fact two different models had to be handled by the design, Model 4105A, which is a directional microphone, and Model 4035A, which has a wider angle of pick-up. These microphones have a low impedance and S.T.C. manufacture a microphone transformer, type 826/10, to match the microphones into a valve circuit.

Circuit

The circuit is given in Fig. 1. It will be seen that very few components are used, though the way that they are put together is important in an amplifier that has to deal with a signal of such a low amplitude as that from a good microphone, and so construction will be explained in some detail. The 6BR7 is operated in a conventional circuit with an anode load (R2) of 220k and a screen series resistor (R1) of 1.5M. As a result the anode current is well under 1mA and the 22k cathode bias resistor gives a bias of just under 2mA. As a matter of fact, the bias is not in any way critical because of the very small signal fed into the stage, and so there was no point in carefully calculating a value in theory and then hunting for a non-standard value. The cathode bypass capacitor is C2 and because it is necessary to ensure that no hum enters an amplifier working at such a low level of signal, this is made comparatively large—100µF 12VW. The screen bypass capacitor is C2. Note that there is a screen internal to the valve designed to screen the grid from the heater to prevent hum entering the circuit via this route: this screen is brought out to pin 6 which must be connected to earth. In this valve the heater itself is wound in the form of a double spiral to reduce hum.

The heater connections are shown to be "floating" in Fig. 1.

This is because the amplifier to be used had the centre-tap of the heater winding connected to earth and any earth at the pre-amplifier heater would short-circuit one half of the heater with disastrous results. If one side of the main amplifier heaters of the reader's installation is connected to earth it will still be better to leave the pre-amplifier heater floating, but care should be taken to see that pin (4) of the pre-amplifier is connected to the side of the main amplifier heater supply that is earthed. In this way, the live heater connection is kept remote from the grid. Nevertheless, it is better from the point of view of hum to connect the centre of the heater to earth rather than one side if possible. If no centre tap is provided an artificial centre tap can be made by fitting a wire-wound potentiometer across the heater, connecting the centre arm to earth having removed the connection from one side to earth, and then adjusting the potentiometer for minimum hum. This method is, in fact, better than using a centre top on the winding itself because a setting slightly off the centre found by adjusting whilst listening to results can cancel out hum arising from some other source. However in the present case, the centre tap earth on the main amplifier was quite satisfactory.

H.T. Decoupling

Another precaution taken in view of the fact that power is taken from the main amplifier is to prevent feedback of signal via the H.T. supply. This is provided for by fitting a two stage smoothing filter at the H.T. input represented by R4, C4 and R5, C5. There is no need to use chokes of course because of the very small current flowing.

The arrangement of the connections to the input

Fig. 1.—The circuit diagram.
The unit can easily be accommodated on a chassis 4in. × 6in. × 2in. deep. The prototype was built, in fact, on a chassis exactly twice this size but it occupied only half of the available space. The reason for this was that there was a likelihood that a second similar pre-amplifier would have to be provided at a later date. Fig. 2 gives the underchassis layout and wiring. The transformer itself has no facilities for mounting but was held in a clip of the type used for large electrolytic capacitors. In order to avoid an undesired earth contact with the chassis the transformer case was wrapped with insulation tape where it was held in the clip.

The two smoothing capacitors, C4, C5, are contained in a single can mounted above chassis, but a tubular with wire ends is used underneath the chassis for C1. A tag-strip provides a convenient anchoring point for leads, but the few components involved in the design are not tag-board mounted; it is better to connect these direct to the appropriate valve pins and only when it is necessary to provide an anchorage for the remote end should a tagboard be used when working on a low signal level amplifier.

Twin Screened Input

Another constructional problem was in connection with the input socket for the microphone connection. It is customary with audio signals of greater amplitude that are to be dealt with in the present case to use a single core in an outer screen (quite typically a piece of coaxial cable), but it is bad practice with low audio levels to use the screen of the cable as one side of the connection. Instead, both sides of the audio signal should be fed through a two-core cable with an outer screen even if inside the amplifier the side of audio signal is to be earthed. The screen of the cable should be looked upon in effect as an extension of the chassis and not a connection. The microphone base is wired therefore with twin core screened cable, but it is not easy to find in normal radio component sources a suitable two-pin plug and socket with screen. A component which is readily available is a four-pin type of small dimensions with the pins staggered to prevent insertion in any but the correct direction. The plug is on a small paxolin base with a metal shroud. On the shroud are small metal lugs which, when the leads are soldered inside the hollow pins with the cable through the shroud, are bent over the base to hold the two parts together. The two inners of the connecting cable are connected to two of the pins and the screen of the cable is soldered to both the remaining pins. A piece of tinned copper wire also connected to the screen was fed back through the shroud, wrapped round the narrow neck of the shroud after carefully filing the metal clean and soldered to make a sound connection tying the shroud to earth. This method is illustrated in Fig. 3.

One further precaution is necessary in constructing a unit such as this. Under no circumstances must the chassis be used for earth returns, particularly for A.C. In practice a bus-bar earth is used. This is a stout piece of tinned copper wire connected to the chassis at only one place, to a soldering tag mounted on one of the valveholder bolts. The other end of this bus-bar is supported by the two tags from the input sockets which are to take the earthy side of the input signal. The bus-bar is carefully preformed so that when soldered into place it runs clear of the valveholder, allowing room for the components which have to be soldered to the valveholder. The only earth that does not go to the bus-bar is the negative side of the smoothing capacitors C4, C5. These capacitors are in the aluminium can which is mounted above the chassis and therefore they are earthed through the mounting clip.

Transformer

The microphone transformer itself does not come into contact with the chassis. A lead is brought out to earth the case and this connection goes to the bus-bar. The can containing the transformer has a coat of paint but, to ensure that it does not contact the chassis, a layer of insulating tape is wrapped round the case where it is held in the clip.
The wiring of the amplifier is given in Fig. 2 and taking account of the points raised above, and particular care with the transformer connections, there should be no difficulty in ensuring good results. It will be noticed that in this case the input signal goes to the primary of a transformer neither side is, in fact, earthed. So far as the output is concerned the signal is of quite reasonable amplitude and the precautions taken at the input side are not so important. Nevertheless care in screening should be taken. There is no need to carry the signal through a two-core screened cable, and in any case the main amplifier will have a coaxial input socket, so a piece of ordinary coaxial cable is used.

The first leads to be fitted when beginning to wire are the two carrying the heater current from the tag strip. These should run close together and also close to the chassis. Next connect valve base pin 9 to pin 3 and wire in the cathode bias resistor and capacitor, earthing to the bus-bar. Proceed now clockwise round the valve-holder. The H.T. end of the screen and anode resistors (both of the high stability type) go direct to the decoupling capacitor C4. R4 is self-supporting between the two connecting tags of C4, C5, and R5 is fitted from C5 to the tag strip. A six-way tag strip was used in the prototype just because it happened to be to hand, but only four tags are used, none of which is earthed. Finally the microphone transformer is mounted and connected up. the screen of the grid lead and the black and brown leads going to the earth bus-bar. The yellow connection is the centre-tap of the primary and is not used in the present application. The two blue leads are the microphone input connections. Three core mains lead is used for the power input. The chassis of the amplifier and the pre-amplifier are interconnected via the screen of the coaxial connector and this completes the circuit of the H.T. negative supply. When the two amplifiers are in their operating position in the cabinets it would be best to strap the chassis together with a stout piece of earthing braid.

![Fig. 3.—The input plug.](image)

**COMPONENTS LIST.**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>1-5 MΩ 1W (high stab).</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>220 kΩ 1W (high stab).</td>
<td></td>
</tr>
<tr>
<td>R3</td>
<td>2-2 KΩ 1W.</td>
<td></td>
</tr>
<tr>
<td>R4</td>
<td>22 kΩ 1W.</td>
<td></td>
</tr>
<tr>
<td>R5</td>
<td>22 kΩ 1W.</td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>8 µF 300V (electrolytic)</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>100 µF 12V (electrolytic)</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>0-1 µF 350VW.</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>16 µF + 16 µF 350V (electrolytic)</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>6BR7 (with screened valve holder).</td>
<td></td>
</tr>
<tr>
<td>Microphone transformer STC 826/10.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chassis, nuts and bolts, etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NEW PLAN FOR LOCAL RADIO STATIONS**

The following statement was made recently by Mr. C. O. Stanley, Chairman of the Pye Group of Companies: "We believe that sound broadcasting can benefit even more from a broadening of its basis than has television. The nature of sound broadcasting and its techniques offer possibilities different from television. I believe that the new trend of sound radio should be for local broadcasting and that important towns should have their own station designed to cater for the needs of their community and to re-establish the sense of civic pride which was once a more robust foundation of our national life."

"How can this be done? One way is to allocate VHF frequencies to each town and I know that frequencies can be made available for this purpose. But VHF sound broadcasting has a long hard pull to get real self sufficiency in this country.

"An investigation and study of the medium wave broadcasting band has not been going on in Cambridge for a considerable time. The team working on this project are in the process of completing a remarkable plan which will permit a great new expansion of medium wave broadcasting. By using the most modern techniques in an area where they have been neglected they are showing that every town in England with a population of over 50,000 and every town in Scotland over 40,000 may readily have its own medium wave broadcasting station at a modest cost of less than £20,000. These medium wave stations would operate from sunrise to sunset and in hours of darkness broadcasting would continue on a VHF transmitter."

"This plan will suggest that 18 important Scottish towns and cities can readily have a medium frequency allocation. The towns are:—

Aberdeen  Coatbridge
Dundee    Glasgow
Ayr       Hamilton
Kilmarnock Motherwell and Wishaw
Dumfries  Edinburgh
Dunfermline Perth
Inverness  Greenock
Airdrie    Paisley
Stirling  "In addition we would suggest an allocation to each Scottish University for educational purposes and further allocations where special cases can be made."

"I think it is essential that these stations must be owned and run by local people who understand the needs and tastes of the towns they serve, and if this comes to pass something very creditable will have been added to our way of life."
An Add-on Bridge Unit
AN OSCILLOSCOPE AS A NULL INDICATOR

By D. A. Collins

AFTER building the 62A Oscilloscope, as described in these pages during Sept.-Oct. 1957*, the writer felt that it would be an advantage to have an add-on bridge unit. The

Fig. 1.—Basic Wheatstone bridge circuit.

unit described here is exceptionally cheap as it draws its energising voltage from the timebase of the oscilloscope and also employs the oscilloscope as a null indicator.

The Wheatstone Bridge

The basic circuit of the Wheatstone bridge is shown in Fig. 1. A voltage is applied across AC, and R2 is varied until the galvanometer connected across BD reads zero. The bridge is then said to be balanced, and the relationship between the resistances in the network is given by

$$R_2 \cdot R_3 = R_1 \cdot R_x$$

from which Rx can be found if the other three resistances are known. In practice, both R1 and R2 are made to vary simultaneously, and the resulting circuit is shown in Fig. 2. R3 is a standard resistance of high stability and close tolerance.

Fig. 2.—Usual form of the Wheatstone bridge.

*These issues are now out of print—Editor

The De Sauty Bridge

The De Sauty bridge is given in Fig. 3. An alternating voltage is applied across AC, and R1 and R2 are varied for zero reading in the null indicator, when the relationship between the components is

$$C \cdot R_1 = C_x \cdot R_2$$

Once again Cx can be found if the other three component values are known. C is a standard condenser of close tolerance.

$$C_x = \frac{C \cdot R_1}{R_2}$$

with

$$R_x = \frac{R_3 \cdot R_2}{R_1}$$

This shows that as R1 and R2 vary, the calibration for capacity is the inverse of the calibration for resistance, i.e. a point marked 2 on the resistance scale will be marked ½ on the capacity scale. This means that the unit must be double calibrated, unless, by means of switching, and employing separate terminals for Cx and Rx, a single scale can be arranged. In the final circuit this has been done.

Fig. 3.—The De Sauty bridge.

The Final Circuit

The basic Wheatstone and De Sauty bridges are combined in the final circuit, which is shown in Fig. 4.

T1 is an interstage transformer of ratio 5:1, the higher resistance winding being connected to the timebase supply. The writer found that there was a great latitude in the choice of T1, and it was found that an output transformer served just as well in this position. Resistor R6 is placed in the circuit to limit the current taken by the bridge network. If a large current is taken here, it will be found that the X-plates of the oscilloscope are robbed of driving voltage and the timebase will not scan the screen. A suitable value of R6 to begin with is 1kΩ. With some transformers R6 may not be needed at all. If the line does not extend across the face of the screen R6 is gradually increased in value until it does.

Switch S1 is a single pole, eleven way type. The contact marked M leaves the bridge open for matching purposes, in which case both sets of terminals are used. The switch S1 may be difficult to obtain and Fig. 5 indicates how a different type of switch with two banks is used in conjunction with a toggle switch. In fact, this is the final circuit adopted by the writer.
Calibration

The instrument may be calibrated by measuring standard resistances and condensers, but it is usually sufficient to divide the scale up into about 50 equal divisions and then proceed as follows:

\[ N = \frac{50 \text{ (No. of Divisions)} - \text{No. of Divisions}}{50 - 30} \]

and N, so found, is marked on the scale. For example, for a rotation of 30 divisions:

\[ N = \frac{50 - 30}{50 - 30} = 1.5 \]

This is marked on the scale. Clearly, the centre of the scale will be marked 1, and this point should be checked by means of resistance standards so that accurate matching may be carried out. Care must be taken to see that the scale is not inverted. If it is found on testing that the scale is calibrated in reverse, the outer leads to VR1 must be reversed. It will be found that the ranges overlap considerably. This is an advantage since it enables the majority of measurements to take place so that the balance point is on the centre portion of the scale, which is the portion on which the bridge is most accurate.

The Power Factor

VR2, which is a 5k wire-wound potentiometer, provides a measure of the power factor of condensers measured on the 1µF range. Provided that a high frequency time-base setting is used, the power factor control may be labelled 0 to 1 with a linear scale, and a suitable frequency range to use is from 1,000 to 5,000c/s. The method of use is as follows: on the 1µF range it may be difficult to obtain a sharp balance if the condenser being measured is leaky. By rotating VR2, a variable amount of resistance is placed in series with the standard. This has the effect of allowing a sharper balance point to be obtained. Resistor VR2 should be wired so that it increases clockwise. The lower the power factor reading, the better the condenser.

Connection to Oscilloscope

A lead from the timebase is brought out to the front panel of the oscilloscope, and connection is made by means of a coaxial plug and socket, the outer braiding going to chassis in the bridge unit. (See Fig. 6.) The output from the bridge is fed to the Y amplifier.

All the components are mounted on a sheet of aluminium 9in. by 8in. and this housed in a suitable container 3in. deep. (Continued on page 414)
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A Morse Practice Oscillator  
A SIMPLE CIRCUIT WITH LOUDSPEAKER OUTPUT  
By D. Noble and D. M. Pratt

It is the ambition of many interested radio experimenters at some time to become radio amateurs and to be able to transmit to other people with the same interest. Before a transmitting licence can be obtained one must pass the radio amateurs’ examination, and also satisfy the Postmaster-General that one can send and receive Morse at not less than 12 words per minute. The technical knowledge required for the radio amateurs’ examination may be readily obtained by reading text books and various articles in radio periodicals, or by attending a course of instruction at the local Technical College. The Morse test, however, is a little more awkward as it is required to practice sending and receiving Morse code in order to attain the required standard.

Much listening can be done over the air, but it is recommended that a friend be approached and practice actually done “across the table”. Many of the radio clubs up and down the country hold special Morse classes and it is suggested that interested readers make enquiries.

One of the first essentials is to make something on which to practice the code. While an ordinary Morse buzzer and key is quite satisfactory, at most Morse test centres a valve oscillator is used as it produces a much more pleasant tone, and hence the Morse is easier to copy. It is proposed, therefore, to describe a Morse test oscillator which will fulfill the requirements of those wishing to learn Morse.

While a simple phase-shift oscillator (p. 135 June 1960 P.W.) may be used coupled into a suitable amplifier installation, a neater method is to build the complete practice set together with power supply, speaker and controls into a self-contained unit. This arrangement is particularly useful in the case of radio clubs which do not have their own permanent premises and in other applications where size is of major importance.

The oscillator unit described uses an EF80 as phase-shift oscillator, with a suitable output valve...
The accompanying photographs show a typical layout of construction. In the prototype, a 7in. x 4in. elliptical speaker was used, and the chassis is 7in. x 5in. x 2in. with a front panel 7in. x 6in.

**Underchassis view.**

—in this case an ECL80—chosen for its low heater consumption, its availability and its small physical dimensions. Unfortunately, the triode section of the valve would not operate as the oscillator, as it had no more than a fraction of the gain required to overcome the losses in the phase-shift network.

Power is provided from a small transformer and half-wave contact-cooled rectifier. The volume control VR2 is fitted with a two-pole switch connected in the mains supply to the unit. In series with the key jack is fitted a potentiometer VR1 which provides a useful variation of the oscillator tone.

---

**BRITISH POSTAL EQUIPMENT**

The Management Council of the Consultative Committee for Postal Studies of the Universal Postal Union held a conference at Eastbourne from June 27th to July 9th. In connection with the conference, eight firms co-operated in staging an exhibition of British postal mechanisation equipment from July 5th-7th in the Grand Hotel at Eastbourne.

A new British export industry has been created by the Post Office. In their drive for mechanising all forms of mail handling, the G.P.O. have themselves developed a whole range of new mail handling devices in conjunction with the unit of engineering firms.

Between them, the firms concerned are able to offer an integrated range of automatic mail handling equipment which will enable mail to be segregated into its proper categories, sorted and distributed with a minimum of human intervention. There firms combined, under the name “The Manufacturers of British Postal Equipment,” to put on an Exhibition for the delegates to a Conference of the Universal Postal Union studying mail handling which was held at Eastbourne.

Britain is unique in having built up a complete industry in this field. The firms concerned, which include such well known companies as Elliott Brothers (London) Limited and Associated Automation Limited of the Elliot-Automation Group, Vickers-Armstrong (South Marston) Limited, Sovex Limited and The Thrissell Engineering Company Limited, have produced a combined brochure showing the complete range of British postal equipment which has been sent to every postal administration in the world. Other companies co-operating in the Exhibition include Sright Registers Limited and Harrison and Sons of High Wycombe, who produce the special stamps used in the automatic mail handling process, and Waterlow and Sons. Already export orders have been received from Russia, Switzerland and Egypt and the Manufacturers say that they are very optimistic that a new export trade in automatic Post Offices will be built up as a result of the research work and initiative shown by the G.P.O.

The occasion is also interesting in that the firms co-operated in the Exhibition and in the production of the Brochure are in many cases normally fiercely competitive one with another. But that in presenting themselves to overseas Postal Administrations they are doing so as an industry although there is no formal association between them of any sort.

According to Brigadier K. S. Holmes, Director of Postal Services in the G.P.O., the recent advances in automatic mail handling constitute a very substantial advance in tackling a most difficult problem and, in his view, it was safe to say that in this field, Britain leads the world today.

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**LIST OF COMPONENTS.**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>33k 1/4W</td>
</tr>
<tr>
<td>R2, R5</td>
<td>18k 1/4W</td>
</tr>
<tr>
<td>R3</td>
<td>100k 1/4W</td>
</tr>
<tr>
<td>R4, R7</td>
<td>1,000Ω 1/4W</td>
</tr>
<tr>
<td>R6</td>
<td>10k, 1/4W</td>
</tr>
<tr>
<td>R8</td>
<td>1k, 1W</td>
</tr>
<tr>
<td>R9</td>
<td>1,000Ω 3W, wire-wound</td>
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<tr>
<td>VR1</td>
<td>100k linear pot.</td>
</tr>
<tr>
<td>VR2</td>
<td>500k log. pot. (with two-pole switch S1)</td>
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<tr>
<td>C1, C2, C3</td>
<td>500pF</td>
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<tr>
<td>C4, C7</td>
<td>25µF, 25V (electrolytic)</td>
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<tr>
<td>C5</td>
<td>0.1µF, 400V (paper)</td>
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<td>C6, C10</td>
<td>0.002µF 350V (ceramic)</td>
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<td>C8, C9</td>
<td>16µF plus 16µF, 350V (electrolytic)</td>
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<tr>
<td>T1</td>
<td>Speaker transformer</td>
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<tr>
<td>T2</td>
<td>Mains transformer—250V, 50mA and 6.3V, 1A</td>
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<tr>
<td>V1</td>
<td>EF80</td>
</tr>
<tr>
<td>V2</td>
<td>ECL80</td>
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<tr>
<td>MR1</td>
<td>Contact-cooled rectifier—(18RA1-1-16-1)</td>
</tr>
</tbody>
</table>

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**PRACTICAL WIRELESS** September, 1960

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Faraday Screen and Line Filter
Static Elimination

AN OLD IDEA REVIVED

WITH a highly sensitive receiver, such as may be used for long distance short wave or amateur band reception, the background noise caused by external static can be troublesome. It may limit the gain which can be employed, or over-ride a weak signal. Even when conditions are less severe, the general level of background noise is increased when static that has been picked up by the aerial is carried into the receiver.

Principle

One method of reducing the static coupled in from the aerial is to introduce a Faraday Screen, as shown in Fig. 1. This screen is of a special type which permits electro-magnetic coupling between aerial coil and tuning coil, but acts as a low-impedance path to earth for electrostatic impulses. Such screens do not appear to be readily obtainable, but can be made fairly easily. For the earth lead, stout copper wire of about 14 or 16s.w.g. can be used. The thinner wires may be about 24s.w.g.

To make such a screen, a piece of thin insulating material such as paxolin is wound with the 26s.w.g. wire, leaving about 1/32in. to 1/16in. between turns. The earth lead is then soldered along one edge of the board, and the wires upon one face of the board are cemented in position. When the adhesive is hard, the turns are cut away where they pass across the other face of the paxolin. This gives a screen like that in Fig. 1, consisting of parallel wires joined at one end only. The cut ends of the wires should not touch each other.

Perforated metal, metal gauze or mesh, or any kind of solid screen, cannot be used, because it would also provide electro-magnetic screening and thus prevent the required signals reaching the receiver.

In home-built receivers, it is sometimes possible to introduce the Faraday screen between aerial coupling and tuned coils, as shown in Fig. 1. This is particularly easy with short wave sets having fixed, self-supporting coils. For best possible results, the receiver can be screened, and the aerial circuit coupled in through an aperture, as described for the tuning unit in Fig. 2, but if the receiver layout prevents too much stray coupling between aerial and receiver circuits, this is not essential.

Tuning Unit

With many ready-made receivers it is almost impossible to add the Faraday screen internally. If so, it may be provided in a screened tuning unit, as shown in Fig. 2. This unit is made in a totally screened metal box having an aperture about 2in. square, which is covered with the Faraday screen. The Faraday screen wires must not touch the metal box, but the paxolin can be bolted over the aperture, and the earth lead bonded to the box.

The coupling coil L1 is outside the box. Coil L2 is tuned to the required frequency band. Coil L3 is a small winding near the earthed end of L2, and is coupled by means of a screened lead to the aerial terminal of the receiver. This lead should not be longer than necessary. A few experiments to find the best number of turns for L3 may be required to obtain best input to the receiver, as this depends on the receiver coils. If no aerial condenser is present in the input circuit, a small fixed condenser of 25pF or so should be included in the lead from L3. C1 is also about 25pF to 50pF.

When listening on one particular band of frequencies, such as an amateur band, readjustment of C2 is scarcely necessary. If most attention is given to one band, L2 should have enough turns so that a small capacity (say 50pF) will suffice for C2. But if a number of bands must be covered, C2 will need to be 150 or 200pF. The turns on L2 are simply adjusted until C2 gives resonance on the desired bands; L1 can normally have one-third the number of turns on L2. L3 will usually be similar to L1. A dipole feeder can be taken to L1 by omitting the earth connection.
230k ohms.
known resistance is 100k. 
reads screen tilted (and ` perhaps curved). Adjust VRI until 
switched connected or condenser

Method

Mains Transformer Screen

In some receivers, a screen exists between primary and secondary windings of the mains transformer, as shown in Fig. 4. This may be of metal foil, and it does not form a completed turn, as this would act as a short-circuited winding. It is not unusual to find that this screen is unused. It should be wired to the receiver chassis, otherwise it cannot provide screening between mains (primary) and receiver (secondary) circuits.

If such a screen is not present, or if additional suppression is wanted, R.F. bypass condensers can be added to the rectifier, as shown in Fig. 4. High-voltage condensers of moderate capacity, such as 0.01µF mica types, will be satisfactory. One condenser will probably be in parallel with a smoothing condenser, but it is still required because electrolytic condensers do not present a low impedance path for radio frequencies. Some receivers draw H.T. directly from the mains, and by-pass condensers of this kind will then be found particularly useful, if modulation hum exists. With the normal half-wave rectifier circuit, there will be only one rectifier anode connection, so only two bypass less condensers will be wanted, instead of the three in Fig. 4.

Mains Circuit Filter

If static interference still remains when the aerial terminal of the receiver is shorted directly to earth on the receiver, the trouble is probably introduced from the mains. In this case, a line filter such as that shown in Fig. 3 will be very helpful.

If interference is not very severe, the bypass condensers alone may reduce it sufficiently. Mica, ceramic, or other condensers intended for high voltages and V.H.F. use are best. The capacity is not critical, and 0.005µF may easily be sufficient if most attention is given to the high frequency bands.

The chokes must be able to carry the required current, so that receiver type chokes are usually unsuitable. These chokes can often be wound with 24s.w.g. or similar wire, according to the current taken by the receiver.

The earth used for the metal screening box should be sound, and it may be worth while trying various earths, if interference persists.

AN ADD-ON BRIDGE UNIT

Method of Use

The unknown resistance or condenser is connected to the appropriate pair of terminals and the timebase is switched on. The line on the screen will be tilted (and ` perhaps curved). Adjust VR1 until the line on the screen is horizontal. The scale is read. Suppose that the scale reads 2-3 and the range is 100k. then the unknown resistance is 230k ohms.

Output from Timebase

To coaxial socket on front panel

Fig. 6.—Obtaining an energising signal from a time base.

Fig. 3.—Mains line filter.

This unit also provides some rejection of image-frequency interference, which can be troublesome with the simpler type of superhet, at high frequencies (say over 25Mc/s).

Fig. 4.—Transformer screen and rectifier bypass.

INDEPENDENT RADIO STATION

The first independent local broadcasting station designed for use in Britain was demonstrated in the grounds of the Royal Show at Cambridge. The station is designed to serve any town in Britain and costs £15,000 complete. It uses two transmitters—a medium-wave transmitter broadcasting during daylight hours and a VHF transmitter broadcasting day and night.

The medium-wave transmitter is used during daylight hours to give immediate access to vast numbers of medium-wave receivers in homes and in cars. It closes down after sunset to avoid continental interference.

The VHF transmitter also radiates during daylight but continues throughout the hours of darkness. The station therefore has two channels during daylight and the Pye Company suggests that the VHF transmitter should be made available for educational and public service broadcasting as required during daylight hours.
In experimental work it is sometimes necessary to measure resistances of very high value. This cannot be carried out with the usual type of multimeter unless a voltage of over 100 is used. Unless the experimenter has a very sensitive micro-meter, such values have either to be estimated or avoided. This article describes an ohmmeter to measure up to 20 M with a 6 V battery and an inexpensive 1 mA f.s.d. meter.

**Circuit**

In the conventional ohmmeter circuit (Fig. 1) the highest resistance measurable depends on (a) the sensitivity of the meter and (b) the battery voltage. With a 1 mA meter and 6 V it would be 0.5 M and the meter would then read 12 µA. A
deflection smaller than this would be very difficult to see unless a large scale were used. In order to measure 20 M a 25 µA meter would have to be used, the cost of which is beyond most experimenter's means. There is however an alternative and that is to amplify the minute current and then measure it. The transistor can do this admirably and was chosen in preference to a valve which requires a large power pack.

The basic circuit for this is shown in Fig. 2. The small current flowing through the base-emitter junction is amplified 40-60 times and causes a large deflection on the meter. The only fault is that the leakage current of the transistor, about 200 µA, would deflect the meter even with no base current.

The modified circuit is shown in Fig. 3. B1 through R1 and R2 counteracts the leakage current. No switch is provided for B1 as when R1 is at maximum only 10 µA is passed. The only other major difference is that the same 6 V battery is used for both purposes instead of having two separate batteries.

**Components List.**

- R1 - 150 kΩ variable.
- R2 - 470 kΩ.
- R3 - 500 kΩ variable.
- R4 - 56 kΩ.
- B1 - 1.5 V.
- B2 - 6 V.
- TR1 (see text).

**Calibration**
The value of “x” may be found by the formula

\[ x = \frac{V}{x'} \cdot R_t \]

where V is the battery voltage (in this case 6), x' is the amplification factor of the transistor, Cc is the collector current as shown on the meter and Rr is the total resistance of R3, R4 and the base-emitter resistance.

This method however is not advisable because of the difficulty of obtaining the exact values of x' and Rr. Also, x' not constant over a range of base currents. A far more accurate method is to form a graph or new scale for the meter by taking the readings from resistors of known value.

The uses of this unit to the experimenter are very wide. Apart from the obvious one of checking resistors with their markings obliterated, it can be used to test partially faulty insulators or the resistance of leaky condensers.

The resistance “x” must not be held with the fingers. The body resistance in parallel with “x” would bring any high resistance down to about 25 kΩ, so giving a false reading.
ANY listeners are now in areas of high field strength and are able to receive VHF/FM transmissions with relatively simple apparatus. This receiver is intended for general purpose reception in such conditions and with modification will give a very good account of itself in less favourable situations.

R.F. Stage
The circuit of the VHF section of the receiver is given in Fig. 1. The signal from the aerial is first applied to the grid of V1 via the coil L1. As this coil is heavily damped by the valve, there is no advantage in providing variable tuning, and it is therefore tuned to the centre of Band II by means of its dust core. Valve V1 is arranged as a conventional R.F. amplifier and gives a worthwhile gain although its main purpose is to prevent radiation from the oscillator. This function is very important because the second harmonic of the oscillator frequency falls in the television Band III. In the anode circuit of V1 is the coil L2 by means of which the amplifier signal is transferred to the grid of V3. Coil L2 is also heavily damped and variable tuning is hardly worthwhile; it is accordingly slug-tuned to the centre of the three transmissions to be received.

Oscillator
One half of a double triode valve ECC81 is used as a local oscillator. This is the only variable tuned circuit in the receiver. The arrangement of the tuning capacitance is of interest. It will be seen that C11 and VC in parallel are together effectively in series with the parallel combination C12, C13, across L3. The result of this arrangement

Fig. 1.—Circuit-diagram of the VHF section.
Drift V.H.F. Receiver

Scried—for fringe area and local option conditions

is that by suitable adjustment, a band-spread effect can be obtained, so that the stations to be received are distributed evenly over the whole range of VC. This makes tuning remarkably easy and dispenses with the need for a slow motion drive and tuning scale. Condenser VC should have a maximum capacitance of 15pF and the Jackson C804, 3-5/15pF is suitable.

Oscillator Drift

Because the cold input capacitance of a valve is different from its capacitance when hot, every oscillator inevitably displays some drift in the first few minutes after switching on from cold. In this receiver, most of the drift has been reduced by the use of a ceramic base for V2, and by good ventilation. The remaining drift has been balanced out by the capacitor C12 which has a negative temperature coefficient (N750K). Condenser C13 is a silver nica component, which for practical purposes has a co-efficient zero. The resulting stability is of a high order.

Mixer

A second R.F. pentode, V3, is employed as an additive mixer, the signal and oscillator frequencies being fed to its grid and combined within the valve to produce in the anode circuit the intermediate frequency of 10-7Mc/s. Condenser C8, by means of which the oscillator frequency is introduced, should be a high stability ceramic of 2-2pF but if such a component is not available, a suitable substitute can be made by twisting two pieces of thinly insulated wire together over a length of half an inch.

I.F. Amplifier

The I.F. amplifier may have one or two stages according to the performance required from the receiver. If it is to be used within 20 miles or so of the transmitter and reception conditions are reasonable, one will be sufficient and if the constructor has any doubt about the need for the second, the set can be completed without it; the chassis is designed so that it can be added later without difficulty.

In the first stage, V4 is arranged as a conventional I.F. amplifier. The only critical point about it is the capacitor C18, which bypasses the cathode bias resistor; it must be a good quality tubular ceramic, completely non-inductive, or there will certainly be instability. If there is difficulty in finding a suitable component of the required value, two smaller ones can be used so long as the total capacity is not less than 10.000pF. In the anode circuit is the second I.F. transformer, which has a 47k resistor R11, across its primary to ensure adequate acceptance bandwidth. If only one I.F. stage is required, the ratio detector transformer should take the place of I.F.T.2 and R11 should be omitted. The wiring diagram for this arrangement is given in Fig. 7.

The second stage is arranged as a limiter. It adds considerably to the sensitivity of the receiver for distant reception and also provides additional protection against impulsive interference which is desirable under these conditions when the signal/noise ratio is less favourable.

Demodulation

In the detector stage, the FM receiver differs entirely from its AM counterpart. The modulation, which up to this stage is expressed as variations of frequency, must be converted to variations of amplitude before it can be reproduced as sound. Of the several ways in which this can be done, the ratio detector has been selected because of its superior interference rejection properties.

The resistors R16 and R17 have been selected to produce the best balance for this purpose and should be 10 per cent or better as also should be R18 and R19. Crystal diodes such as GEX34 can be used in the ratio detector in place of a double diode valve but are more expensive and not quite so efficient. Also, they usually require some form of automatic gain control to limit the voltage applied to them if they are not to be damaged by overloading when the receiver is tuned to a nearby transmission.

De-Emphasis

In FM transmissions, the higher audio frequencies are emphasised at the transmitter. The emphasis is removed in the receiver by the low-pass filter R21, C24, having a time constant of 50µs.
A.F. Amplifier

The circuit of the remainder of the receiver is given in Fig. 2. The output stage uses a 2.5W pentode EL42 was selected in order to keep the total H.T. requirement within the 80mA available from the mains transformer which was to hand. It requires 11V peak on the grid for full output. Any other pentode or beam tetrode of approximately the same sensitivity can be employed provided the required extra current is available from the power pack. The optimum load for the EL42 is 9,000Ω and the output transformer should have a ratio of between 50 and 60:1 for a 3Ω speaker. The required bias resistor of 360Ω is easily found by measurement from a batch of 330Ω, 20 per cent components.

Negative Feedback

A moderate amount of negative feedback is taken from the secondary of the output transformer via R.26 to the cathode circuit of V.2(b). If when the receiver is completed and switched on, the feedback is found to be positive, the connections to either the primary or secondary of the transformer should be reversed.

Construction

The set is constructed on a chassis of 16s.w.g. aluminium 1in. x 6in. x 2in. as shown in detail in Fig. 3. There is room for all the components and construction is not difficult though VHF technique must of course be observed. It is very important that instability be avoided. Even a slight trace will have the effect of reducing the acceptance bandwidth of the receiver so that it will not be able to accept the deviations of the transmissions and there will be non-linearity distortion in the detector stage. Reduced bandwidth will also show up minor random variations in oscillator frequency which would otherwise be of no consequence and frequent adjustments will be required to the tuning. This design is inherently very stable but in order to guard against the effects of minor differences in wiring and positioning of components as between one constructor and another, the chassis has been sectioned so that the R.F., oscillator and mixer stages are efficiently screened from one another and from the I.F. amplifier.

Screens

The screens may be of 18 or 20s.w.g. aluminium to the measurements given next month and should be fitted close against the underside of the chassis. Cut-outs are provided for the only two connections which must pass beneath them, viz., C8 to pin 2 of V2 and the heater line between V2 and V6. The screens should be made and fitted to the chassis with bolts or self-tapping screws before wiring commences; their positions should be marked on the chassis for guidance when fitting components and the screens can then be removed and replaced when construction is practically complete.

Wiring

The constructor should make all the connections as short and direct as possible and should not make any attempt at orderly and symmetrical layout in the VHF section of the receiver. On the other hand, there is no need to go to extremes; shortening a wire by say 3in. will not have any effect and generally speaking 3in. is a reasonable length of connection to be aimed at where possible.
It should be noted that in the wiring diagrams, the wiring has been opened out and all the components are shown in a horizontal position. This has been done for clarity; in construction the connections should be short and direct and components will of course be mounted in the positions in which this aim is best achieved.

It is suggested that the mains transformer and other power pack components be mounted first and the valve heaters and their associated bypass capacitors wired up. Work can then commence on the R.F. stage and proceed stage by stage to the output, taking care to place all components clear of the screen positions as marked on the chassis. It is convenient to mount the H.T. dropping and decoupling resistors vertically; the screens can then be fitted and the H.T. rail run round above them to each stage in turn. Condenser C11 is conveniently mounted by soldering it to a solder tag bent at right angles and bolted to the chassis.

Ventilation

To minimise long term drift in the oscillator, vents are provided in the deck of the chassis and ventilation is provided through the bottom of the cabinet of which a description will be given later. Resistor R30 which is the greatest heat producer, is mounted vertically on a tag strip above a 1½ in. hole in the chassis and inside a “chimney” about 2½ in. high, made from an octal-valve screening can. In this position, it not only cools itself adequately by convection but also draws air through the chassis from below. Further assistance is provided by a heat deflecting screen in the cabinet.

Coils

The aerial coil, L1, is wound on a ½ in. former having a ½ in. adjustable dust core. The grid winding is 3½ turns of 20s.w.g. tinned copper wire, spaced rather more than one wire diameter and the aerial winding is one complete turn of 22s.w.g. enamelled. Coil L2 is three turns of the same wire on a similar former with the same spacing. Coil L3 is wound on a ⅛ in. former with a ½ in. core and consists of 4½ turns of 22s.w.g. enamelled wire spaced one diameter. A convenient method is first to wind the wire closely on a slightly smaller former, putting on an extra turn. It can then be removed and slipped over the larger former where it will be a tight spring fit and the turns can then be adjusted for number and spacing. All the windings should be secured in position with cellulose cement.

Operation

The tuning drive is taken from the tuning capacitor by a 2½ in. drive drum to a 1½ in. drum mounted on the tuning spindle giving an almost 2:1 reduction. A projecting lug soldered to the smaller drum and a 4B.A. bolt located in the front of the chassis limit the angle of rotation to about 350 deg and the stations are marked on the tuning knob in such positions that they come into tune when the appropriate mark is brought to the top. The prototype has “L,” “H,” “W” and “3” engraved in white, corresponding to the Light, Home, Welsh and Third programmes. An old volume control with the body removed makes a good tuning spindle.

In the absence of modulation, there is nothing at all to be heard from the speaker and the pilot light is necessary to indicate that the receiver is switched on. (To be continued)
A Precision Pick-up Arm

AN INEXPENSIVE, LOW-WEAR UNIT FOR THE HIGH FIDELITY ENTHUSIAST

By N. A. BARGERY

(Continued from page 330 of the August issue)

Following the actual construction of the pick-up, we now come to the counterbalancing system. This is most important in pick-ups, with low pressures in the region of 2 grammes or less. The system I have used is very simple; a length of bolt screwed into the end of the arm, with a cast lead weight on it. Two nuts locate the weight. It is necessary, however, to fit the cartridge to the platform first. Protect the stylus by means of a piece of plastic sponge and tape (Fig. 9).

When the cartridge is fixed, and the 1/2 in. length of bolt in the end, pivot the arm in its sockets (Fig. 9) and add pieces of lead until the arm balances. (The pedestal should, of course, be screwed firmly to a piece of board).

Treating

When the arm balances, for the freedom of movement can be tested. A piece of good quality note-paper, 4 in. wide and 4 in. long, is held at one end by the thumb and forefinger. The other end bears against the platform adjacent to the stylus. Pressure against the platform exerted via the paper strip should cause the arm to move freely without bending the paper more than a fraction. If the arm tends to swing easier one way than the other, check the levels of the pedestal first. This tendency means inaccuracy in (a) cutting the stirrup, or (b) mounting the tube, or (c) cutting the pick-up arm slots and pivot holes. It is also caused by the mounting of the pedestal on a surface which is not level.

If good care has been taken with the work so far, however, with the base-board level, the embryo pick-up arm in its balanced state should be easily moved by the paper strip to any point in a horizontal plane, and remain there with no tendency to swing backwards, or inwards, if the pedestal and board are dead level. If this is so, then the success of the arm is assured, for all there is left to do is to install the conductor wires.

Pick-up Wires

For the stereo model, this is a light plastic covered and shielded wire carrying two conductor wires, obtainable from most electronic dealers. Tie the thread projecting from the hole in the rear of the arm to one end of about 10 in. of this wire, and carefully pull it through the hole, down the tube, until it comes out the other end. Bare about 4 in. of each of the two conductor wires, push the bare wire through the holes in each of 2 of the three connector tags supplied with the cartridge (if there are none, ask for them) and then solder. The copper shield is soldered similarly to the third tag. Then the tags are pushed on to the appropriate terminals of the cartridge—the copper braid one is for the middle terminal.

If the mono cartridge is used, then single conductor shielded wire is used.

Now, the other end is stripped of its outer plastic sheath exposing the copper braid, which in turn is stripped off, by making a hole in it and pulling through the conductor wires. The copper braid is then twisted tightly into a strand. The wires should be arranged with the earth braid in the centre and the two conductors on either side bare, about 4 in. out of the hole. Formono wiring, then there will be one conductor only, of course.

Now take the pedestal by itself, and drill three holes as shown in Fig. 11a to take three 4B.A. bolts, long enough to project 4 in. beyond the top of the pedestal (Fig. 11b). Make also three small brass tags to slip over the bolts, after they have been secured (Fig. 11c). These tags will take the connections from the conductor wires inside the pick-
up. Of course, if a mono cartridge is used, only two bolts will be needed.

Now cut three lengths of very thin wire (I have found the fine stranded silk covered wire used on radio coils ideal) each around 3in. long and coil them over a 3in. diameter rod as shown in Fig. 12a. Bare the ends of each coil carefully. Slip a 3in. piece of sleeving over one end of each coil when the coils are made; lay them aside for a minute whilst you connect the conductor wires to the underside of the pedestal. The stereo cartridge will need two lengths approximately 2ft each of plastic covered shielded wire (single conductor type). The mono pick-up will need one length of wire (Note. all the diagrams refer to stereo versions; for mono versions use the only two connectors in all cases instead of three). Now solder the amplifier leads to the heads of the brass bolts. When this is completed you may proceed to the soldering of the three coil wires. The final appearance will be as shown in Fig. 13.

Unimpeded Movement

A word of warning.—The flexibility of these leads has the greatest possible effect on the freedom of movement of the arm. On a 12in. disc, the movement of the stylus will be about 3fin. in a horizontal direction across the disc. The coils, however, will move less than 3fin. but this movement must be unimpeded; the coiling of the wire and its flexibility should make this possible. However, set up the pick-up as before. Balance it and test for this movement using a strip of notepaper as before. Aim for 3fin. of free movement, which will be obtained generally when the three coils are extended slightly to one side, through their upright position to a position where they are extended slightly to the other side (see Fig. 13).

It is not necessary to obtain unimpeded movement of the arm over a wider arc than this. If this can be secured in your pick-up then it will perform in an extremely efficient manner indeed.

Template

It will be remembered that the really unimpeded movement of the arm took place over a distance of about 3fin. at the head. This means that the middle of the recorded material on a disc will be the point at which the pick-up arm is in the middle of its arc of free movement, i.e. when the connector coils above the pedestal are vertical, so arrange to mount the pick-up so that this occurs, but also remember that the stylus must overlap the turntable spindle by 3fin. An easy way to do this is to cut a disc of stiff paper to the size of a 12in. disc, and slip it on the turntable. Now, temporarily disconnect the leads from underneath the pedestal so that they will not be in the way. With the pick-up held securely on the motor board in a position where the head can be easily handled when in use, move the head until the stylus reaches a point 3fin. in front of the spindle (allow the pedestal to move until this situation is reached). Make a pencil mark at this point on the paper. Now, without moving the pedestal base, swing the arm until it reaches the outer edge of the paper disc. Make a mark with a pencil where it occurs. Now move the pick-up gently inwards inch by inch, marking on the paper at intervals, until the centre point, 3fin. in front of spindle, is reached again. Now remove pick-up arm to a safe place; take the paper and join up the marks on it. This will make a line showing path traced by the pick-up stylus across a record. About 3fin. from the outer edge will be the extreme inner limit of recorded material. Make a mark where this is. Now you have a “map”, of the pick-up path and the half way point. Between the outer edge of paper and the point of extreme limit of recorded material, is the point where the pick-up should be when its connector coils are upright, i.e. in the middle of its unimpeded arc of swing.

This “map” can be slipped on the turntable and used to mount the pick-up. Wedge the turntable so that it does not move. The stylus should be on this “half-way” point when the connector coils are vertical. (Arrange for this by rotating the pedestal base.) When this has been achieved, mark...
the position of the pedestal base on the motor board, remove the pick-up and in the centre of the rectangular mark bore a 1 in. hole (to take the pick-up leads when re-soldered to the base of the pedestal. This can be carried out and the pick-up arm screwed to the motor board. A pick-up rest is a useful item here. It can be fashioned by plastic sheet bent to an "L" shape, with a groove in the top to take the pick-up tube, then screwed to a convenient place in the motor board.

**Weighting**

When all this has been carried out, the pick-up is ready for use. Re-balance it by adjusting the counterbalance weight, then add a 2½ gramme weight (a small washer) to the pick-up platform with a contact adhesive to provide the pressure for the stylus. Fig. 14 shows an easy way to obtain 2½ grammes (a newish penny weighs about 9 grammes).

By calculation it is found that a penny placed 1 in. from the point of balance of a small bar, will exactly balance 2½ grammes placed 3¾ in. away from the centre on the other side.

Hence, cut a ⅛ in. x ⅛ in. bar of hardboard 8 in. long. Cut a small nick in it for the balance point (Centre point). Cut a slot also, above the nick and 1 in. from it to hold the penny. Now insert a slot in the other 3¾ in. from the centre point, to hold washers for testing.

Set up the bar on its pivot, insert a newish penny in the slot and then put washers in the other slot until you obtain a balance. These washers (or washer) will then weigh 2½ grammes, and will be cemented to the cartridge platform just above the stylus point, but the arm must be in a state of balance before the washer is affixed. You could of course ask a friend who has a metric balance to weigh 2½ grammes for you.

Now the pick-up is all set up in its correct position on the motor board. It may be, however, that the arm is too high or too low for the turntable. This can be attended to by the user by means of the grub screw, or packing under the pedestal.

**Dynamic Balance**

One final refinement; the user can "dynamically level" the pick-up for optimum performance in the following way. First of all ensure that the turntable motor board is level in two directions at right angles by means of a spirit level. Next a blank record will be required. If one is not available, one can be made by using a 12 in. disc of hardboard, highly polished on the smooth side by three layers of cellulose paint rubbed down each time and finished with metal polish and good wax to a smooth brilliant shine to simulate a smooth disc.

Put this disc on, set the turntable revolving and set the arm on the disc. Wherever you put it on the disc it should remain with no tendency to move in any way. If it has such a tendency, a little packing under the arm will counteract this. When you have achieved this steady tracking your pick-up is "dynamically balanced" and ready for superb performance and low wear.

Dynamic balancing "cleans up" the reproduction from records to a remarkable degree and is practised by most serious gramophone users. It is essential for good stereophonic reproduction from low-pressure pick-ups such as this.

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**SILICON TRANSISTOR PROGRESS**

The first year of full-scale production of high-frequency silicon alloy transistors has just been completed by Silicones Limited, and in this period increased demand and production improvements have allowed the prices of the two types to be reduced considerably.

There are two key production processes which give these transistors their high-frequency performance. The first is the electrolytic jet-etching of the base region to the required thickness with continuous intra-red monitoring. This process has been developed to provide an extremely thin base region of uniform and precisely controlled thickness.

The second key process is the evaporation of uniform circular films of aluminium on opposite sides of the base region through accurately aligned holes in the stainless steel mask, which allows emitter and collector with diameters of 0·005 and 0·007 in. to be used with a concentricity better than 0·0004 in. The film thickness is monitored during deposition.

The small controlled thermal mass of the aluminium electrodes and silicon base region allows a very rapid alloying cycle to be used. Consequently, the alloy regions formed are very thin and uniform.

The resulting transistors give excellent performance in tuned and video amplifiers at frequencies up to 5Mc/s, and can be used in directly-coupled switching circuits at rates well above 2Mc/s with the prime advantage that performance is maintained up to junction temperatures of 140deg C. These simplified high-speed switching circuits demonstrate the advantage of the combination of low saturation voltage, high and sharply defined turn-on voltage and high reverse base-emitter voltage rating which the special production process provides.

These same parameters contribute to the new level of accuracy and stability obtainable when these transistors are used in chopper-amplifier systems.

Finally, the very thin base width makes these transistors remarkably insensitive to gamma and neutron irradiation, a significant feature in many military and instrumentation applications.
RESISTORS. Preferred values.

Multirado puah - pull, for HIGH RESISTANCE PHONES. 4,000 ohms, and loud speakers.

LOUDSPEAKER FORMERS. 4 V. and 10,000 ohms.

STANDARD, 250.0.250, or 1.25 V.

Plessey, 19/8. 6in. trimmers.

-250. Optional 25% and 60% watt.

Rectifier/ -watt. 10.000 mA.

-1, 200ft. 50 ohms.

-1, 10.000 ohms.

Heavy 6.3 v. 10 amp. 6/8.

-1. spare parts.

25%, 60%.

V. etc., 4/6.

GARRARD RECORD PLAYERS

AUDIO PERFECTION

Designed to play 16, 33. 45, 78 r.p.m. Records 78s or 10 in., 12 in. lightweight, with pick-up, 6CS in-turn head. Stereo Wire. Single Play TA. £6.8.

Transcription 4 HF £18.

Auto Changer R.C. 210 £10-10. (Stereo bands 82 extra). Largos, S.A.E.

Volume Controls

80 ohm.

COAX PLUGS

1-15 - 250 V.

LEAD SOCKET

-250-

BALANCED TWIN FEEDER 50. 80 or 300 ohms. Ditto screened per 25. 80 ohms only. Significant.

WIRE-WOUND POTS. 3 WATT, Baxster, Mike TV. All types. Values over 25 to 25,000.

-250.

WIRE-SHOWER 4 WATT. Price. Long speaker.

-1,000.

CONDENSERS. New stock. 0.015 mid. 7 kV.

T.C.C., Ditto, 200 kV. 0.1, 0.01. 0.001. 0.005.

200. 1. 0.1, 1.0. 0.01. 0.001. 0.005. 0.01.

1.05. 1.05. 1.05. 1.05. 1.05. 1.05. 1.05.

1/9.

CERAMIC CONDENSORS, 500 p. 0.1 p. to 0.01 mid. 0.001.

-250. 100 mg.

-25. 2000 ft. to 2000 ohms, 1.2. 10.000 ohms.

-1, 10.000 p. 6.000-ft. 2.000.

-1. 10,000 ohms.

Waste 3500 LF. 465, 650. kg. 10/- per pair.

Waxmouth Condensers.

-1, 10.000 p. 6.000-ft. 2.000.

-1. 10,000 ohms.

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1/300v. 2/300v. 3/300v.

1/300v. 2/300v.

1/300v. 2/300v.

1/300v. 2/300v.

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NEW! INEXPENSIVE!
Highly sensitive

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OUTSTANDING FEATURES
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"RECO" PUSH-PULL FOUR TRANSISTOR KIT
(Medium and Long Waves with two S/W Coils FREE upon request.) Case size as PPS. New improved Circuit: 3 in. High Grade Moving Coil Speaker. Bias sensitivity volume control. Ferrite Rod Aerial. Gleaming Pale Blue Poly styrene Case with contrasting Speaker Grille in Red. Complete Kit with 4 1st grade EDISWAN TRANSISTORS and 3 volt battery. £5.3.6, p.p. 2/6.

"RECO" SUPER TRANSIGEN FOUR

"RECO" TRANSIGEN THREE TRANSISTOR KIT
(Case as PPS.) (Medium, Long Waves and Trawler Band.) Fitted Super High Gain Ferrite Rod Aerial. R.F. Stage, EDISWAN TRANSISTORS. On test: tuned in Home, Light, Third, Radio Luxembourg, A.F.N. and many others at good listening level. The Prototype was tested at approximately 50 miles from nearest transmitter. Complete Kit, with super dynamic miniature earpiece, 79/6, p.p. 2/6. With B.A. rep. 75/-

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Sensitive 2½-in. Moving Coil Speaker, ¾-in. deep, 17½.

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Closed 1 p.m. Saturdays.
A Three Valve Quality Amplifier

A CIRCUIT FOR THE BEGINNER

ANY amateurs will, at one time or another find use for an audio amplifier capable of good quality reproduction. This type of unit is especially useful for the reproduction of the large range of gramophone records which are now available.

Circuit

The circuit diagram of the amplifier is shown in Fig. 1. It will be seen that power for the unit is supplied by T1, the mains transformer working in conjunction with the full wave rectifier valve V3. The output from the rectifier is filtered and smoothed by C5, R7, and C4. The resistor R7 is a 5W wire-wound component. A L.F. choke could possibly be used with some little advantage in place of R7 if such a component was readily available. In the original model however, it was found that the wire-wound resistor was quite adequate for smoothing purposes and any additional smoothing by a L.F. choke was negligible. Transformer T1 also supplies the heater current for all three valves. The on/off switch S1 is wired in the “live” lead to the A.C. mains. If a two-pole toggle switch is available this could be used in the S1 position thus isolating the mains completely from the equipment when the switch is in the “off” position. Valve V1 is the first audio amplifier. Input to the grid of V1 is via the audio gain control R1 and the bass/treble network consisting of R3 which is the bass control, R12 the treble control in conjunction with the network C1, C2, C3, R2, R4, and R5. The input to the audio gain control and to the grid of V1 is screened to minimise hum pickup. Valve V1 is a double diode triode 6AT6. In this circuit however, the diodes are not used and in construction, the connections for the diodes should be strapped together and earthed. To simplify the circuit diagram, the valve V1 is shown without the diodes. V1 is resistance/capacity coupled to V2, the output valve, which is a 6BW6. Resistor R8 is the anode load for V1 and the input to V2 is via C7 and R9. A grid leak for V2 is provided by the inclusion of R10. The filtered H.T. supply for the anode circuit of V1 and the screen circuit

Fig. 1.—The Circuit Diagram.
of V2 is taken from C4, while the unfiltered supply for the anode of V2 is taken from C5. Automatic bias for V2 is provided by R11. The H.T. consumption at full volume is approximately 40/50mA and the undistorted output is about 4W.

Construction

The chassis is made from 16s.w.g. aluminium and the dimensions are shown in Fig. 2. These dimensions are not at all critical and the intending constructor may vary them slightly to suit a chassis that is already to hand. From the illustrations it will be seen that the power supply is arranged at the right hand side of the chassis and that most of the smaller components are mounted on a 9-way tagboard, bolted to the chassis and held clear of the chassis by means of insulated sleeving on the mounting bolts. Insulated sleeves approximately 4in. long will suffice to prevent accidental contact with the chassis. The front panel which carries the on/off switch S1 is slightly longer than the chassis and is held to the chassis by the mounting bushes of R1, R3, and R12. If the constructor desires, additional securing of the front panel to the chassis can be provided by means of 4 B.A. nuts and bolts.

The valveholders for V1, 2, 3, the power transformer, the mounting lugs for T2 and the capacitors C4 and C5 should be spaced out as shown. If the chassis is to be made from flat material it is sufficient to have the back and front edges of the completed chassis 2in. high. The front panel and chassis should be then assembled so that the bottom edges of the chassis and panel are parallel. Holes for the mounting bushes of R1, R3, and R12 should be made, drilling through the front panel and chassis edge in one operation to ensure correct alignment. The apertures for T1 and V1, V2 and V3 should be completed before finally assembling the chassis to the panel. It will be noted that C4/C5 is one unit and that about approximately 4in. projects on the underside of the chassis. This part is secured to the chassis by means of a mounting clip supplied with the capacitor.

The valveholders, transformers T1, and T2, may then be assembled to the chassis. T1 should be very firmly bolted to the chassis to prevent vibration in operation. The input and output sockets should be assembled to the back of the chassis and S1 should be installed on the front panel. The tagboard can be made up as shown in Fig. 2 and when completed may be installed on the underneath of the chassis as shown. Resistor R7 should be soldered directly across the tags of C4 and C5. Capacitor C9 should be soldered directly across the primary connections of T2. One heater tag of each valveholder should be soldered to the chassis by fitting a soldering tag to the mounting bolt and soldering a short piece of stiff wire between this earth connection and one heater connection on the valveholder. The heater wiring may then be completed by wiring with heavy gauge stranded plastic insulated wire from T1 heater winding to all three valveholders. The wire should follow as direct a path as possible with sufficient slack to allow it to be pressed close to the chassis when the heater circuit is completed.

The centre tap of the power transformer should be earthed directly near to the transformer by means of a soldering tag under the fixing bolts of the valveholder V3. The A.C. H.T. connections should be wired directly to the anodes of the valve V3 by means of thin twisted flex.

The bias resistor and condenser for V1 are soldered between the cathode connection for V1
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HOME CONSTRUCTOR CHASSIS SERVICE

Our chassis are made with new 16 s.w.g. heavy duty bright aluminium. Front Panels in 19 s.w.g. Steel with attractive Hammered Gold finish and clearly marked with neat control positions; all finishes and construction are made to enable constructors to match one unit with another.

MULLARD CHASSIS

"5-10" Amplifier Chassis, Base, Screen and Screws...

"5-10" Slim Line Chassis, without control positions, complete with Base and Screws...

Complete Metalwork for the "5-10" T.C.C. Printed Circuit...

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"20 Watt" Amplifier Chassis, Base, Transformer Covers, Transformer Adaption Plate and Screws...

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MULLARD FRONT PANELS

"5-10" Amplifier, 15 x 5in....

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Type "B" Pre-amplifier, 10 x 21in....

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"5-10" Amplifier Chassis, Base, Screen and Screws...

"5-10" Slim Line Chassis, without control positions, complete with Base and Screws...

Complete Metalwork for the "5-10" T.C.C. Printed Circuit...

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Type "B" Pre-amplifier Chassis and Front Panel (unprinted)...

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"20 Watt" Hi-Fi Amplifier Chassis...

"20 Watt" Amplifier Chassis, Base, Transformer Covers, Transformer Adaption Plate and Screws...

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Mullard Tape Recorder Type "D" or "E" Chassis...

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3 Valve Stereo Amplifier Chassis and Printed Front Panel...

Stereo Pre-amplifier Chassis, Printed Front Panel and Screws...

Mullard "7 Watt" D.C./A.C. Amplifier Chassis with Paxolin and Bracket...

Four-Channel Input-Mixing Pre-Amplifier Chassis, Printed Front Panel and Screws...

Note—Transformer holes are not drilled in the above Chassis excepting for the "20 Watt" Amplifier.

MULLARD FRONT PANELS

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"5-10" Amplifier, 14 x 21in....

Type "A" Pre-amplifier, 10 x 21in....

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WPI388 Push-pull Bias and Erase Tape Deck Oscillator Coil for the Mullard Type "C" Tape Pre-amplifier...

Mullard Type "C" Tape Pre-amplifier with EM81 Eschutchen Cut-out, 11 x 4 x 4 in....

Note—Transformer holes are not drilled in the above Chassis excepting for the "20 Watt" Amplifier.
and chassis. Likewise the bias capacitor and resistor for V2 are soldered between the cathode of V2 and earth. The unfiltered H.T. lead is taken from C5 through the hole in the chassis to the primary of T2. The other primary connection from T2 passes back through the same hole to the underneath of the chassis and thence to the anode connection on the valveholder of V2.

**Input Circuit**
The "live" input connection from the audio input socket should be made with a short piece of screened cable. This is fitted between the appropriate input socket and R1, the audio gain control. The screening or outer braid portion of the cable should be stripped back far enough at each end to make a connection and connected to the "earthy" end of R1. The lead from the slider on the treble control should consist of screened cable with the screening earthed as before.

The remainder of the wiring is simple and straightforward. Connection to the smaller components is made by soldering the appropriate wires to the tags on the tagboard. Use should be made of thin plastic insulated stranded wire for the remainder of the wiring. If a stock of different coloured wire is available then the connections can be colour coded using blue for grid, red for anode, yellow for screen and black for earth or chassis connections.

**Testing**
When all wiring has been completed and checked the amplifier may be tested. The loudspeaker should be plugged in and the mains lead connected to the mains. The switch S1 should be closed whereupon all three valves should light up. The warming up time for the unit is about 30 seconds after which the speaker should become "live" producing a slight hissing sound. Rotation of all three controls should be smooth and noiseless giving rise to no howling or cracking noises in the speaker. Touching the grid of V2 with a screwdriver blade should produce a sharp click in the speaker. Touching the "live" input lead to V1 should produce a loud hum in the loudspeaker. With the gain control turned fully down there should be no sound from the speaker on touching the input to V1. On first trial of the unit, beginners would be well advised to position the amplifier so that the underneath parts can be inspected while the power is on. There should be no signs whatsoever of overheating. After extended operation, the resistor R7 should be slightly warm to the touch (with the power switched off). It should not become so hot that it cannot be touched with the fingers. Likewise the power transformer should become only slightly warm after extended use.

**Record Player**
A record player may be tried by connecting the unit to the input of the amplifier. With the gain control turned full up the reproduction from the speaker should be extremely loud since the full output power of the amplifier is some 4W. The operator should also have wide control over the tone of the resulting music or speech by manipulation of the bass and treble controls. It will be found that at full volume there will be very little appreciable distortion. Since the unit will be mostly used at half or less volume, the quality of the output will be very high and indeed far better than reproduction from the amplifier of the average household radio receiver.
Combined Receiver and Signal Generator

A NOVEL, FOUR-VALVE CIRCUIT DESIGN

By J. Severn

The circuit in this piece of equipment is so arranged that it will operate in several ways, and it thus has a very wide field of usefulness. When employed as a receiver, the circuit has a regenerative detector followed by two A.F. stages, and this has enough sensitivity for long distance reception. For ordinary listening, the regeneration control is adjusted to keep the detector nearly on the point of oscillation. Plug-in coils are used because this method is simple yet efficient and permits all-wave coverage, or concentration on fewer bands, by winding only two or three coils. With the full number of coils, the set will tune from about 13 to 2000m. If the 28-30Mc/s band is of particular interest, it is possible to use a further coil to allow coverage from 10m.

Uses

When the equipment is used as a receiver, high impedance and low impedance outputs are available (in addition to the self-contained speaker) and this is occasionally useful for working tests.

Fig. 1.—The circuit diagram.

(The heater of the rectifier must be connected so as to be unaffected by operation of the heater switch.)
2-TRANSISTOR POCKET RADIO
INTEGRATING MINIATURE SPEAKER, PRINTED CIRCUIT, AND FERRITE ANODE
A wonderful little instrument which fits snuggly into a breach pocket. Size: 3 3/4 x 3 1/16. Tunable over medium and long waves. Set of parts including ivory coloured case, 2 transistors, and all necessary components. £4.19.6- deposit and 6 monthly payments of £1.6. Post and Packing £5 extra. Coverage 100 Kcs to 100 Mecs. Comprising 100 Kcs on fundamentals and 100 Kcs to 200 Mecs on harmonics. Metal case 6 1/2 in. x 6 1/2 in. x 3 1/2 in. grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains 200/250 v. Internal modulation of 400 c.p.s. to a depth of 30%, modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch, variable A.F. output. Incorporating magic eye as output indicator. Accuracy plus or minus 2%.
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Cost £4.19.6 or £5 deposit and 4 monthly payments of £1.6. Postage and Packing £5 extra.
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PUSH-PULL OUTPUT STAGE
inclusive of transistors with input and output transistors to match 1 ohms speech coils, and 10 ohms telegraph transistors, plus kit. Kit of parts including transistors £19 6/ | Plus Post and Packing £1 ½. All parts sold separately. Point to point wiring diagram 1/6. free with kit.

CHANNEL TUNER
Will tune to all Band I and Band III stations. BRAND NEW by famous manufacturer. Complete with PCG01 and two valve (in series) I.P. 18-19 or 22-26. Also can be modified as aerial converter (instructions supplied). Complete with knobs. £32 6/ | Plus 3 ½ P. & P.

8-WATT PUSH-PULL AMPLIFIER
COMPLETE WITH CRYSTAL MIKE AND 8 in. 1L41, IF620 SPEAKER
A.C. mains 200-250 v. Size: 10 in. x 4 in. x 3 1/2 in. Incorporating 6 valves, H.F. pen, 2 triodes, 2 output pens and rectifier. For use with all types and makes of pick-up and mike. Negative feedback. Two inputs, mike and gram, and controls for same. Separate controls for bass and treble lift. Response flat from 40 cycles to 15 Kcs. Noise level 40 db below all hum. Output transformer tapped for 3 and 15 ohm speech coils. For use with std. or L.P. records, musical instruments such as £4.19.6 | Plus Guitars, etc. £2 2/6. Or 50/- deposit Plus P. & P. 7/6. and 4 monthly payments of 23/-.

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A.C. Mains 200-250 v. D.C. Output 250 v. at 75 m.A. Also 6.3 v., 2 amp. heater winding. £2 1/-. | Plus 3 ½ P. & P.

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L.W. Aerial in case mounting bracket for external use. Complete with 12 vs. of coaxial cable. 15 in. 4 element. 17 1/2 in. P. & P. on above £4 6/.

BATTERY RECORD PLAYER & AMPLIFIER
(including 45 r.p.m. "Stars" motor. "Acos" crystal pick-up. 3 transistor push-pull amplifier complete with transistors. Output 500 millivatts, 45/- | Plus 3 ½ P. & P.

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of other output transformers or speakers. It also means that the internal speaker can be used with another receiver, or for test purposes, if necessary.

To produce a R.F. signal, a test prod lead is connected instead of the aerial, and the regeneration control is advanced so that the detector oscillates. The unmodulated R.F. output may be used for aligning the I.F. stages of superhets, or any similar trimming or padding adjustment, with the aid of a tuning indicator. To obtain a modulated R.F. output, the Receiver/Oscillator switch is turned to the oscillate position, and the two A.F. stages then act as an audio oscillator, modulating the detector through the common 47k anode load resistor seen in Fig. 1. This signal will then be heard on a receiver being adjusted for alignment by ear, or by output meter. The tone can be adjusted to some extent by means of the volume control in the generator/receiver.

For testing audio frequency circuits, a test lead can be taken from the high impedance or low impedance output terminals, and applied to various points in the A.F. equipment, working back from the speaker. Turning the regeneration control to zero stops R.F. output.

**Power Supply**

When a power supply is required for other equipment, the detector and A.F. stage heaters can be cut out by means of the heater switch. This leaves available approximately 250V smoothed H.T. at 60mA, and 6.3V at 2A. The 100k resistor serves merely to discharge the smoothing condensers. With external equipment taking only a small current, such as a radio tuner or pre-amplifier, the heaters in the generator/receiver can be left on. The output from the tuner or pre-amplifier may then be taken to the grid circuit of the first A.F. stage, to allow a working check of the tuner or other item, with reproduction through the generator/receiver speaker. A terminal point for this purpose can be provided and connected from the 0.5M volume control, if this is desired. The lead should be screened to avoid picking up hum. Alternatively, it is quite easy to clip the lead to the grid circuit, according to the number of A.F. stages required.

For testing pick-ups or similar outputs, two A.F. stages will be sufficient, so that the connection to the 0.5M volume control is best. For very low level outputs, such as obtained from some microphones, all three stages will be preferable, and a screened lead should then be clipped on the detector cap. This should not be left permanently connected because of the stray capacity.

The circuit is shown in Fig. 1, and somewhat similar valve types, or actual alternatives, may be used in the A.F. and rectifier stages. In general, component values are not very critical. The two 0.01µF condensers should be mica, or of high quality as any leakage here will upset the A.F. stages. The coils are described later, and can be wound for any of the bands over which the set is to tune.
Above The Chassis

The layout is shown in Fig. 2, and a fairly large chassis is most convenient. A surplus chassis approximately 9in. x 11in. was used with the unwanted holes covered with an aluminium plate. The type with runners all round is recommended. The panel is of aluminium, 74in. x 12in., with ¾in. flanges bent to fit against the sides of the chassis. This strengthens the panel, and provides a support for the sides, which are 9in. x 7½in. At the rear corners, two angle pieces 7½in. long are fitted, and the sides are similarly bolted to these. The side near the coil and tuning condenser should be left off until wiring to these items is completed. It is also easier to do the output transformer wiring before fitting the right hand side, which also carries the terminals for 6.3V, 250V, and high and low impedance outputs.

The layout is not very critical, provided connections in the detector stage, and including those to coil and tuning condenser, are short. Referring to Fig. 2 (1) is the grid end of the coils, (3) the earthed end, and chassis, and (4) the aerial connection. (The cathode tap lead (2) passes directly underneath the detector.) The plug-in coil holder is mounted on a piece of paxolin, so that the prongs clear the chassis, and this shortens leads to the tuning condenser. A small terminal from point (4) is used to clip on the aerial lead or prod connection.

The tuning condenser is fixed near the coil holder, with a flexible coupling and extension shaft from the tuning drive. The drive should be smooth, with an accurate scale or dial. Many different drives are obtainable, surplus and new. The cheapest is the small ball drive. Others, of more expensive type, will have dials or scales, and may be of two-speed ratio. A scale marked in frequencies or wavelengths is not suitable because it will generally be impossible to match any of the coils with these markings.

It is as well to leave the speaker off until most of the other constructional work and wiring are finished. Note that one side of the speaker is returned to chassis, and that one set of contacts on the oscillate/receive switch interrupts the circuit from the other speaker tag to output transformer, as in Fig. 1. The low impedance output terminal is wired to the transformer secondary. The Earth terminal, in contact with the chassis and shown in Fig. 3, acts as return for both low impedance and high impedance speaker outputs, as well as H.T. negative, when the equipment is used as a power supply. The 1µF condenser in Fig. 2 should be 350VW, or similar paper type (not electrolytic).

Below The Chassis

Wiring and components are shown in Fig. 3. The chassis used in the prototype had a central screen, but this is not necessary and tends to make wiring a little awkward. The terminals or tags of the mains transformer and large smoothing condenser project through apertures in the chassis.

The heater switch is fixed directly below the speaker, but above the chassis, two leads passing to it from the tag board. This switch must be so connected as to leave the rectifier operating.

The rear of the oscillate/receive switch is shown, this item being mounted on the front runner. One set of tags switches the speaker, as mentioned. The second set switches the output valve anode from speaker transformer primary to 47k resistor. The last set of contacts brings the detector anode circuit to the same 47k resistor, and also allows feedback to the first A.F. stage, to produce oscillation.

The output terminals fixed to the side are all above the chassis, but the common earth return terminal is below the chassis, and passes through the side runner. Insulated terminals are recommended, and identification marks should be placed near them.

A hole near the detector allows the cathode lead (2), and earth connection (3) to pass up to the coil holder. For 10m use, all leads in the detector circuit, including those to the 200pf and 0-1µF condensers, must be as short as possible.

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ELECTRONIC COMPARISON OHMMETER

A ONE-VALVE CIRCUIT GIVING A LINEAR SCALE

(Continued from page 321 of the August issue)

The previous article was concerned largely with the theoretical aspects of the design. We now deal with the final constructional details and the values of the resistors for the various ranges.

Notes
The accuracy of the unit is determined largely by the accuracy of the "known" resistances. If good quality high stability 1 per cent resistances are used, then this will suffice for most purposes. If greater accuracy is required, specially calibrated resistances or potentiometers can be substituted.

To obtain accurate zero-setting, reduce the meter potentiometer to zero when the unit is warmed up. Return to maximum again before use. If C2 is of the can or metal cased type with negative taken to the metal, then this casing must be insulated from the chassis. Care must be taken when using the lower ranges to check that the resistance or component under test can accept the relatively high D.C. employed, i.e. 1Ω range—max. 1.5A; 10Ω range—max. 125mA; 100Ω range—max. 12mA; (all approximate values).

Control
Switch

Meter
Potentiometer

Range
Switch

To junction
C2-ve and
MR1-ve

To junction
C3-ve and
Meter ve

MC.

denotes earthing
connections to
chassis

Connections to C1, C3 and T1
are beneath tag board

Fig. 7.—Underchassis wiring diagram.
The resistance under test should not be handled during measurement, more especially on higher ranges, as this will introduce errors. The valve voltmeter described, using the cathode circuit, is remarkably free from drift (after the usual warming up period) and frequent zero adjustment is not necessary. If excessive drift is experienced, a replacement EF50 will very likely effect a cure. It is possible, by using a two stage valve voltmeter and a low f.s.d., to obtain a very useful "low ohms" reading meter or to reduce the current requirement for the existing low ohms scales i.e. less voltage drop would be required for f.s.d. Drift, however, becomes a difficulty with these conditions and very careful design is necessary.

Practical Details

As this unit is designed around the spares box, constructional details will vary according to the components at hand; but generally, a chassis dimensioned as in Fig. 5 (shown last month) will be quite suitable.

SUGGESTED RESISTOR VALUES

<table>
<thead>
<tr>
<th>Value of RI, etc.</th>
<th>Value and Type of XR1, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1Ω</td>
<td>0-1Ω Hand wound, tapped coil.</td>
</tr>
<tr>
<td>10Ω</td>
<td>100Ω Potentiometer for calibration.</td>
</tr>
<tr>
<td>100Ω</td>
<td>1k Potentiometer for calibration.</td>
</tr>
<tr>
<td>1k</td>
<td>10k Potentiometer for calibration.</td>
</tr>
<tr>
<td>100k</td>
<td>1M Potentiometer for calibration.</td>
</tr>
<tr>
<td>1M</td>
<td>5-7M Resistors in series for calibration.</td>
</tr>
<tr>
<td>10M</td>
<td>50-70M Resistors in series for calibration.</td>
</tr>
<tr>
<td>50M</td>
<td>Not required Shunt 9V D.C. supply with 0-5Ω to give 2V output.</td>
</tr>
</tbody>
</table>

Note: the use of a 4-way switch for S1 as shown in the circuit diagram will enable four of the ranges given above to be used; and 8-way switch would enable all eight ranges to be incorporated.

The front panel layout was shown in Fig. 6. If the zero-set potentiometer RV2 is not available as a midget type, then a cut-out in the chassis below the meter will enable the standard size potentiometer to be used. Major components are arranged on top of the chassis in the manner of Fig. 8, although the choice of the mains transformer may necessitate slight rearrangement to suit. It should be remembered that condenser C2 must be insulated from the chassis (if it is metal cased). This can be done simply by sleeving with polythene and clipping in the usual way or by mounting it on paxolin or bakelite. The underchassis arrangement is shown in Fig. 7. A terminal board is a convenient and neat way of securing the resistors although it does hide other connections. Components can, however, be soldered directly to the valve base, switches, etc, without much difficulty if the terminal board is not desired. Resistor R9 should be wired directly to the grid pin as shown. During calibration it is convenient to solder flexible leads to the XR 1-4 terminal tags and run them to calibration potentiometers externally until fixed resistor values are determined.

Connections from components C1, C3 and T1 will be accessible under the chassis if drop-through types are used, and must therefore be wired before fixing the terminal board into position. Wiring between top chassis components has been omitted, but is evident from the circuit. The unit may be boxed in with sheet metal and "crackle" finished for effect, but whatever cover is decided upon, ventilation louvres or holes should be provided to dissipate the heat produced by the EF50.
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PRESET POTENTIOMETERS

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 ohm</td>
<td>small Colvern w/w.</td>
</tr>
<tr>
<td>60 ohm</td>
<td>Plessey carbon, linear</td>
</tr>
<tr>
<td>100 ohm</td>
<td>Burco w/w.</td>
</tr>
<tr>
<td>270 ohm</td>
<td>Colvern w/w.</td>
</tr>
<tr>
<td>400 ohm</td>
<td>4 watt w/w.</td>
</tr>
<tr>
<td>400 ohm</td>
<td>small Colvern w/w.</td>
</tr>
<tr>
<td>2K w/w.</td>
<td>for CR.100</td>
</tr>
<tr>
<td>2.5K Colvern large precision w/w.</td>
<td>4/6 ea.</td>
</tr>
<tr>
<td>3K American w/w.</td>
<td>with switch</td>
</tr>
<tr>
<td>3K Burco w/w.</td>
<td>instrument</td>
</tr>
<tr>
<td>5K + 50 ohm Colvern tandem</td>
<td>1/6 ea.</td>
</tr>
<tr>
<td>5K transistor preset</td>
<td>1/6 ea.</td>
</tr>
<tr>
<td>10K Colvern w/w.</td>
<td>6d. ea.</td>
</tr>
<tr>
<td>10K + 10K American, ganged type</td>
<td>2/6 ea.</td>
</tr>
<tr>
<td>10K + 10K Morganite, ganged carbon</td>
<td>2/6 ea.</td>
</tr>
<tr>
<td>20K Colvern w/w.</td>
<td>2/6 ea.</td>
</tr>
<tr>
<td>50K Colvern w/w.</td>
<td>2/6 ea.</td>
</tr>
<tr>
<td>50K + 50K Colvern ganged w/w.</td>
<td>3/6 ea.</td>
</tr>
<tr>
<td>75K Colvern precision, new and boxed</td>
<td>6/6 ea.</td>
</tr>
<tr>
<td>200K Instrument, new and boxed</td>
<td>6/6 ea.</td>
</tr>
<tr>
<td>500K carbon</td>
<td>1/6 ea.</td>
</tr>
</tbody>
</table>

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Burco Jack plugs | 1/- ea. |

VALVES

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>900H</td>
<td>6d. ea.</td>
</tr>
<tr>
<td>954</td>
<td>1/3 ea.</td>
</tr>
<tr>
<td>EF50 (red)</td>
<td>1/- ea.</td>
</tr>
<tr>
<td>4/6 ea.</td>
<td></td>
</tr>
</tbody>
</table>

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Mini-7, Mk. 11, 7-transistor Pocket Receiver
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A DECIBEL METER FOR THE BEGINNER

USEFUL FOR SIGNAL STRENGTH REPORTS

By B. Goodwin

Many novices joining the ranks of short wave listeners will be anxious to contribute their share of signal strength reporting. Accuracy is important in this field if the report is to be of any value. Scientific measurement will always be preferred to estimation by the ear.

The Circuit

The simple circuit in Fig. 1 is basically an A.C. voltmeter designed to give readings of the output power of a receiver. The capacitor C block H.T. (see Fig. 2) and must be of high capacity to minimize its impedance. Full wave rectification is obtained with germanium diodes and the meter is 0-1mA to be graduated in decibels.

The Decibel

For readers unfamiliar with this unit, the "decibel" is used to compare sound intensities and electrical power ratios. It is defined as ten times the logarithm of the ratio of two powers, and can be written:

$$\text{dB} = 10 \log \left( \frac{P_1}{P_2} \right)$$

where $P_1 =$ input and $P_2 =$ output of an amplifier or attenuator.

This expression becomes less fearsome when the original reason for its adoption is considered.

Dealing with amplifier gains in the hundreds caused the power ratio $P_1/P_2$ to become astronomically large. Consider for example two amplifiers of gain 100 and 1000, expressed in decibels, these would be 20dB and 30dB respectively. Should the two amplifiers be connected in series the total gain would be 50dB, a far more convenient number than the product of (1000 $\times$ 100).

Added to this, difficulty was being experienced owing to the human ear responding logarithmically to different intensities of sound. An increase of loudspeaker output from 8—40mW would seem to the ear identical with the change from 40—200mW, since the power ratio is the same.

Thus by making the expression for gain logarithmic, calculations became easier and a convenient bridge was made between the twin sciences of acoustics and electronics.

Originally the unit was entitled the "bel" written as:

$$\log \left( \frac{P_1}{P_2} \right)$$

This also proved too large however, so the decibel was introduced, hence the 10 in the first equation.

A similar expression can be evolved when dealing with voltages, since

$$P = \frac{E^2}{R}$$

then $\text{dB} = 10 \log \left( \frac{E_1^2}{E_2^2} \right)/R_1$

and by a theorem of logarithms

$$\text{dB} = 20 \log \frac{E_1}{E_2}$$

The reader should note that as the decibel is based on a ratio of powers or voltages, a common reference power must be chosen when calibrating the meter.

Calibration

Power in any circuit can be best determined in terms of voltage across a load, this in turn being measured in terms of current.

The circuit in Fig. 2 employs this principle, the voltage drop across $R_1$ the anode load producing a current in the meter $M$.

The value of this current can be varied by means of $R_1$ and use of this facility will be made in designing the scale. Choosing 1W as the reference power to be represented by the mid-point of the meter scale, the value of $R_1$ corresponding to a current in $M$ of 0-5mA when the power in $R_1$ as 1W must now be determined.

Considering the circuit in Fig. 2 for an output of 1W the voltage across the load can be calculated if the anode load is known as:

$$P = \frac{E^2}{R}$$

Assuming the valve is operating under the manufacturer's condition the anode load can be found in the valve characteristic tables, for a 6V6 this would be 8500$\Omega$, thus:

$$E = \sqrt{(1 \times 8.500)}$$

Therefore $E = 92.2V$.

Since $E$ is the voltage applied across the meter, the value of $R_1$ to give a current of 0-5mA can be found from:

$$R = \frac{E}{I} = \frac{92.2}{0.5} = 184,400\Omega$$

A combination of resistors will be necessary to obtain this value, but although every effort should be made to obtain the correct resistance an error of 2000$\Omega$ would still only be 1 per cent.

Having thus fixed a value for $R_1$, the position on the meter scale for a series of wattages can be determined.

For 2W as before:

$$E = \sqrt{(P \times R)} = \sqrt{(2 \times 8.500)}$$

Therefore $E = 130V$.

Since $E$ is the voltage applied across the meter, then with a series resistance of 184-4k

$$I = \frac{E}{R} = \frac{130}{184-4k}$$

Therefore $I = 0-706mA$.

The decibel level above 1W, the reference power, can also be calculated since

$$\text{dB} = 10 \log \frac{P_1}{P_2} = 10 \log \frac{1}{2}$$
The result is therefore (+3)dB.

Similar calculations for other powers will result in Table I.

<table>
<thead>
<tr>
<th>dBA</th>
<th>Power in Watts</th>
<th>I in mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>-9</td>
<td>0.125</td>
<td>0.076</td>
</tr>
<tr>
<td>-6</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>-3</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td>-4</td>
<td>0.5</td>
<td>0.31</td>
</tr>
<tr>
<td>-5</td>
<td>0.5</td>
<td>0.35</td>
</tr>
<tr>
<td>-2</td>
<td>0.593</td>
<td>0.38</td>
</tr>
<tr>
<td>-1</td>
<td>0.794</td>
<td>0.44</td>
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<tr>
<td>0</td>
<td>1.0</td>
<td>0.5</td>
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<tr>
<td>+1</td>
<td>1.26</td>
<td>0.55</td>
</tr>
<tr>
<td>+2</td>
<td>1.85</td>
<td>0.65</td>
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<tr>
<td>+3</td>
<td>2.0</td>
<td>0.70</td>
</tr>
<tr>
<td>+4</td>
<td>2.52</td>
<td>0.79</td>
</tr>
<tr>
<td>+5</td>
<td>3.162</td>
<td>0.885</td>
</tr>
<tr>
<td>+6</td>
<td>4.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

The meter scale can now be re-marked according to Table I. The reader may prefer, however, to convert from millamps by consulting this chart.

**Using the Meter**

The meter must be applied across the transformer of the output valve, see Fig. 2, and the gain of the receiver turned to maximum. Should the signal be strong, muting of the speaker by substituting a resistor of equal impedance may be necessary; merely switching the speech coil out of circuit will upset the loading conditions of the valve, giving a false reading.

When reporting, readings should be accompanied with details of the receiver’s valve line up, and type of aerial. If an R.F. signal generator with a variable output is available, the sensitivity of the receiver and therefore the approximate signal at the aerial can be determined. Short wave listeners thus equipped for scientific measuring will be of great service to the “Ham” world.

---

**Short-wave Listeners’ Log - 1**

Numerous programmes in English from many parts of the world can usually be heard daily on the 25, 31 and 41m bands. As would be expected, these bands are generally of most interest during the late afternoon and evening.

Berne, Switzerland, usually provides a powerful signal on 31 and 41m bands, with news at 8.15 p.m., B.S.T. News comments at 7.45 p.m. from the Swiss station in the 41m band are also in English. Station calls, frequencies and wavelength are given regularly.

Radio Pakistan gives data at 8.30 p.m., using 7010kc/s in the 41m band, and may be heard in the 31m band. Belgrade, using a frequency near 7-3Mc/s may be well received with news at 7.45 p.m. and data on transmissions at 8 p.m. “The Voice of Indonesia” near 9-8Mc/s at 8.15 p.m. is an interesting and fairly easy station to log.

Good reception over long distances is often possible on these bands at this time of day, and Radio Peking using frequencies near 9-4kc/s and 7-1Mc/s can be clearly heard when conditions are reasonably good, at 8.35 p.m. Tuning around 9-5Mc/s at 8.45 p.m. should then bring in Radio Brazzaville, which may also be heard at 6.45 p.m. on 11-75Mc/s in the 25m band. Generally, South African news and reports can be heard at 6.15p.m. on 15-2Mc/s and 25-8Mc/s, in the 19 and 12m bands. Listening on the 17m and adjacent bands between about 8 p.m. and 10 p.m. will usually provide some Dx signals at good strength.

All India Radio, Delhi, can be well received with its programme continuing at 9.45 p.m., near 11-9Mc/s, and gives data at this time. This station may also be heard in the 17 and 31m bands this time. News from Canada often provides a powerful signal at 9.30 p.m. around 17-8Mc/s in the 17m band. News from Sofia, Bulgaria, may be heard up to 9 p.m. on about 9-7Mc/s, or 30-9m.

A number of USA stations are usually well received. Of particular interest is the news in Special English, from WVSI, Washington, to 9.15 p.m. in the 13m band. This would seem to have developed out of their earlier news items in Basic English, and to some extent this can be recognised by the vocabulary. “The Voice of America” can be well received on many frequencies, such as that near 25-9Mc/s, until 6.15 p.m. Schedules, frequencies, and stations are regularly announced. If necessary, the Special English news mentioned may be listened for around 9-5Mc/s in the 31m band.

If frequency checks are required, for receiver calibration, or to check a harmonic frequency spotter, it should be remembered that these are always available at 2-5Mc/s, 5Mc/s and 10Mc/s (120m, 60m, and 30m). Reception on the various frequencies varies according to the time of day, but the transmissions can easily be identified by the 1-second pulses, interrupted at the minute, which resemble a clock ticking. The signal is modulated (a BFO is not required), data is announced regularly, and frequency accuracy is extremely high.
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**POST OR CARRIAGE EXTRA.** FULL LIST OF RADIO BOOKS, ETC., 3d.
GRUNDIG POCKET RADIO

A NEW pocket radio is the smallest receiver produced by Grundig to date—the Micro Transistor Boy—weighs only 11/4 oz and is small enough to fit the average pocket or handbag. It has a high quality loudspeaker, a ferrite aerial, full medium wave coverage and a battery life of approximately 80h. The size is 4½ in. x 3 in. x 1½ in. A miniature 9V battery with press-stud connectors is quickly and easily fitted. The Micro Boy is controlled by two thumb wheels, the first is the On/Off Switch and Volume Control, the second selects the station required.

The radio is available in two colours—a muted grey or flame—both with gilt, and a grey leather loop for carrying. A speaker enclosure containing a larger speaker is also supplied. This slides into the side to form a compact table or bedside radio. The price of these units complete is 25 guineas.


ELECTRONICS
CONSTRUCTIONAL KIT

A NEW “do-it-yourself” electronics constructional outfit has been produced by Clarke-Smith Manufacturing Co., Ltd., and Griffin and George Ltd. The Griffin-Clarke-Smith “Mechtronics” apparatus enables pupils to assemble for themselves a large number of experiments and demonstrations illustrating many of the fundamental principles of electronics. The equipment can be used for both qualitative and quantitative work by individual pupils or groups. The complete set, type 97-100, contains valves, transistors, a photo-electric device, transformer, relay loudspeaker, circuit board, neon tube, crystal diode and potentiometers, bulbs, holders, switch parts, special connectors, wires, valve holders, resistors and capacitors and other standard components. For further details write to Griffin and George Ltd., Ealing Road, Alperton, Wembley, Middlesex.

CARTRIDGE HEATED SOLDERING IRON

Unlike other soldering irons, the Quik-Shot does not require electricity, flame, blow-torch or external heat of any kind. The heat is provided by a patented cartridge which contains 10,000 calories of heat energy supplied by a thermic mixture sealed in a steel shell. The cartridge brings the copper tip up to 862 deg F and maintains a steady soldering temperature for 6 to 8 minutes. Continuous soldering is achieved merely by replacing the used heat unit. Further information on the Quik-Shot may be obtained from Jenolite Ltd. (Engineering Supplies Division), 13/17 Rathbone Street, London, W.1.

STEREO RECORD PLAYER

All sizes and speeds of stereo and mono records can be played on the new stereophonic record player, Model CR.1800A, announced by Cossor Radio and Television Ltd. The two 6in. diameter loudspeakers have been built so that both can be moved away from the instrument to give a full natural sound effect. When the record player is not in use, the loudspeakers form the lid of the portable cabinet. A stereophonic crystal type pick-up head with turnover cartridge and incorporating two sapphire styli is used and separate volume, tone and balance controls are provided. Retailing at 28 guineas (tax paid), this record player has been produced by Cossor Radio and Television Ltd., 71 Endell Street, London, W.C.2.

The first ever “do-it-yourself” electronics kit, "The Mechtronics."
STEREO BALANCER AND AUDIO WATTMETER

A DEVICE from Eagle Products, Model VU-49, provides an accurate visual check on speaker output balance which makes balancing of unmatched amplifiers quite simple. The controls may be set to favour either channel to compensate for room acoustics, unmatched speakers, or listeners' preference. This model incorporates two independent movements, each being connected through a rectifying and compensating network to each stereo channel to provide a continuous comparison of speaker levels. Matched meter readings denote balanced outputs to the speaker systems. Model VU-49 is an accurate audio wattmeter for monitoring audio outputs. It is an ideal recording level indicator for tape recorders and other features of the audio wattmeter are of aligning A.M. and F.M. receivers and testing the frequency response of audio amplifiers. This model retails at 7 guineas, size 6½in. x 3½in. x 4½in., and is manufactured by Eagle Products, Eagle Works, 32a Coptic Street, London, W.C.1.

T.C.C. INSULATED CONDENSERS

AN entirely new range of insulated condensers has been announced by The Telegraph Condenser Co. Ltd. These condensers are of foil and paper dielectric non-inductively wound and impregnated with the T.C.C. "Visconol-X" compound which improves the performance of paper insulation by inhibiting ionisation and checking the fall in insulation resistance following temperature rises. The elements are housed in epoxy-phenolic resin bonded fibre-glass, with end seals of rock-hard setting "Plimoseal." Further details of these condensers may be obtained from The Telegraph Condenser Co. Ltd., North Acton, W.3.

PHILIPS NEW AM/FM MODEL

MODEL 399U is a table A.C./D.C. model which will receive VHF/FM broadcasts virtually anywhere in the British Isles. It is housed in a dark brown plastic cabinet with an off-white front. This model incorporates six valves, and features of the receiver include an anti-radiation circuit, built-in aerials—with sockets for external aerials—and a large high-efficiency elliptical loudspeaker 6in. x 4in. The dimensions are: height 8½in., width 14in. and depth 7½in. The retail price is £19 guineas (tax paid). It is manufactured by Philips Electrical Ltd., Century House, Shaftesbury Avenue, W.C.2.
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6AC7 8, 6KC7 6, 35L6 9/6
6AG5 5, 6K7M 6, 3524G 9/6
6ALS 5, 6KB8 7/6
6AM6 5, 6N7M 6, 954 9, 16
6AT6 7, 6Q7G 6, 136 2, 6/6
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September, 1960

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REPORTS OF CURRENT ACTIVITIES

MITCHAM AND DISTRICT RADIO SOCIETY
Hon. Sec.: M. Pharaoh, G3LCH, 1 Madeira Road, Mitcham.
The second 144Mc/s Field Day was held on July 3rd. Considerable interest is being shown in entering a multi-operator entry in the next CQ DX contest. No final details have yet been arranged and further details will be given in due course.
Future Events:
September 23rd.—Talk by G3JJG on “Single Sideband”.
November 18th.—Talk by Collins Radio Co. on their equipment.

PETERBOROUGH AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: D. Byrne, G3KPO, Jersey House, Eye, Peterborough.
Meetings are held on the 1st Friday in each month at Peterborough Technical College. The “Bucket and Spade” party and Mobile Rally held at Hunsanton in July proved a great success and attracted over 60 licensed amateurs and SWL’s from all over East Anglia. Members are now busy putting their new riverside HQ in order—it has been generously given for their use by a local benefactor.

THE READING AMATEUR RADIO CLUB
Hon. Sec.: R. G. Nash, G3EJA, “Peacehaven”, 9 Holybrooke Road, Reading.
The June meeting was well attended and VQ1WVR gave a very interesting talk on amateur affairs in his district, including a description of the national emergency arrangements in which they participate. This was followed by a jinck sale for the benefit of Club funds. A 2m Field Day was held on July 3rd under call sign G3FKH and a good score was reached. At the meeting on July 30th a recorded lecture was given.
Future Event:
August 27th at 7.30 p.m.—A lecture on “Transmission Lines” by G3GHE.

COURSES OF INSTRUCTION, ETC.
BATTERSEA MEN’S INSTITUTE
Principal: G. A. Stevens, Latchmere Road, Lavender Hill Battersea, S.W.11.
A course for the Radio Amateurs’ Examination will be held at the Spenser Park section of the Institute next session. Classes will be on Wednesday evenings from 7.30 p.m. to 9.30 p.m. commencing September 28th and the course will be arranged to enable students to sit the City and Guilds examination in May 1961. The fee for the session is £1 0s. 0d. for students over 21 with reductions for students under this age, and old age pensioners. There are also classes in General Radio and Short Wave Radio on Tuesdays and Fridays. A short wave club functions at the school.

GLASGOW FURTHER EDUCATION DEPARTMENT
Allen Glens School, Montrose Street Glasgow.
During the 1960-61 session the following classes will be held.
R.A.E. Course, Tuesday evening, 7.30-9.30 p.m., Theory.
Thursday evenings, 7.30-9.30 p.m., Morse code.
General Radio Course, Thursday evenings, 7.30-9.30 p.m., Theory.
Enrolment for both courses will be at the school during the week commencing September 12th, 7.30 p.m., Monday to Friday.
The courses start the following week. The R.A.E. course is to prepare students for the Radio Amateurs’ Examination to be held in May 1961. No previous knowledge of radio is necessary to either course.

WANSTEAD YOUTH CENTRE
Classes for radio amateurs, leading up to the examination for a transmitting licence and for general advancement in amateur radio knowledge, will be held at Wanstead Youth Centre. Classes will include Morse practice and are designed to help young people and adults to take up radio as a hobby. Entries concerning enrolment should be made to K. Smith G3JJX, 82 Granville Road, Walthamstow, London E.17 or The Warden, Wanstead Youth Centre, Nightingale Secondary School, Wanstead, on or after September 1960.

Club News

PRACTICAL WIRELESS

September, 1960

HOMER, RADIO MOBILE SOCIETY
Hon. Sec.: G. E. Storey, 10 Avon Road, Sunbury-on-Thames, Middlesex.
On June 20th a Mobile Meeting was held at the U.S.A.F. Transmitter Site at Borden St. John, Oxfordshire. The Annual General Meeting was held on June 25th and was well attended. Eleven new members have enrolled during the last month.

BLACKWOOD AMATEUR RADIO CLUB
This is a newly formed club which will meet every Friday evening at 7.30 p.m. at the Blackwood Miners’ Welfare Institute. It is intended to hold courses for the R.A.E. and G.P.O. morse test. Interested parties should contact Mr. P. M. Fulton, 36 Sunnybank Road, Blackwood, Mon.

BRADFORD AMATEUR RADIO SOCIETY
Hon. Sec.: Michael T. Powell, G3NNO, 28 Gledhow Avenue, Roundhay, Leeds 5.
On June 14th the club visited the Holme Moss TV station and June 28th a meeting was held to arrange the syllabus for the coming session. Amateur radio stations were visited by the club on July 12th and an informal evening was held on July 26th.

FUTURE EVENTS—Informal Evening.
September 6th.—First meeting of the new session.
Meetings are held at 7.45 p.m. at Cambridge House, 66 Little Horton Lane, Bradford 5.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: F. C. Ward, 5 Uplands Avenue, Littleover, Derby.
Meetings are held at the College of Art, Green Lane, Derby, for informal evening events.
August 14th.—Third annual mobile rally at Rykneld School.

HALIFAX AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax.
On June 14th Mr. G. Sunter gave a lecture on “Workshop Practice”. June 28th was an informal evening and on July 5th the club held a demonstration event for a demonstration station at the Halifax Agriculture Show to be held on August 12th.
The call sign which will be used is G3MDWA.

FUTURE EVENTS:
August 16th.—Informal Evening.
August 30th.—A talk by G3JKD on “Printed Circuits”.
September 6th.—A recorded talk on “St. Pierre and Miquelon De-Expedition”, by WIPFA given by G3LD.

INTERNATIONAL RADIO CONTROLED MODELS SOCIETY
Hon. Sec.: R. F. Pratt, 87 Gincro Road, Coventry Warwickshire.
On August 21st the I.R.C.M.S. will hold their annual contest for radio-controlled model aircraft at G3BEW. Mountford, near Stratford-on-Avon. There are three classes, Single Channel, Intermediate and Multi-channel. Prospective entrants should write to A. E. Newby 56 Lime Avenue Leamington Spa, Warwickshire.

INTERNATIONAL SHORT WAVE RADIO
The Secretary has informed us that he would be pleased to send a specimen copy of “International Short Wave Radio” to any reader who may be interested.

LEEDS AMATEUR RADIO SOCIETY
Hon. Sec.: D. Dinsdale, 69 Spen Lane, Leeds 16.
The Secretary has informed us that he would be pleased to send a specimen copy of “International Short Wave Radio” to any reader who may be interested.

LIVERPOOL AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: H. James, G3MCN. 448 East Prescott Road, Knotty Ash, Liverpool 14.
Meetings are held every Tuesday at Gladstone Hall, Queen’s Drive, on July 14th to 18th the Liverpool Show was held. On July 26th a talk was given on Electronics in Hospitals. At the Liverpool show, separate H.F. and L.F. stations operated 24 hours per day and a special call sign G3BLS, was used.

www.americanradiohistory.com
Letters to the Editor

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

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

A.C. OR A.C./D.C.?

SIR,—You commented some time ago on continental wiring and suggested some law to control the mains connections to avoid danger or risk of shock. I feel that the time is ripe for a law to be introduced to make it illegal to sell A.C./D.C. apparatus. As one side of the mains is joined to the chassis there is always the risk of contact with the mains with fatal results, and in these days, the sale of amplifiers, tape decks, record players and other odd items, some of which may be A.C./D.C. renders the assembly of a complete radiogram or tape recorder a very risky business, and I know several amateurs who have cried off from modern apparatus because it is difficult to obtain equipment which is reasonably "safe".—F. R. ALDIS (Newmarket).

RADIO PARTS

SIR,—I am 14 and wish to correspond with other amateurs.

Concerning Mr. Immelman's letter, I consider him lucky. In Germany there are no Government radio surplus even spare parts where I live. This puts me back as the postage on things advertised in various magazines is fantastic. Also one wants to see what one is buying.

People ought to be thankful in Britain as where I live many a grumble comes from us amateurs when we have to huddle around with the same old parts.—T. LAMB (64, O.M.Q., R.A.F. Bruggen, B.F.P.O.40, Germany).

TRANSISTORS v. VALVES

SIR,—I have been following, for several months, the Valves v Transistors controversy which has figured so prominently in recent issues. Some points raised by protagonists of valves, and by protagonists of transistors are quite sound, but nobody has presented quite such an ill-assorted set of reasons why he does not like transistors as your correspondent D. J. L. of Kenton.

I expect that many radio enthusiasts felt as strongly as I did when I read that there was "not enough information re transistors to make them really interesting." This is a complete misrepresentation of the facts since if your correspondent looked more carefully through his copies of "PRACTICAL WIRELESS" then he would see that there have been many advertisements which mention several excellent books on the subject—and I dare say that if he browsed around his local radio parts shop, he would find an even greater range.

The technical information department of many manufacturers of semi-conductive devices are usually only too glad to help amateurs with information on the performance and circuit applications of their products. I suggest that he writes to one or two. For the cost of a 3d. stamp and envelope paper he would have, almost by return, a wide range of information—enough for anyone!

His second point, that the designs so far published are for the wrong class of reader is likewise, in my opinion, quite invalid. A quick glance through past issues of P.W. and other radio and sound magazines will show that the designs published so far include a tremendous variety of equipment, even down to a transistorised tape recorder/amplifier. Tone control circuits have been quite widely described in various magazines and papers—D. J. L. cares to do a bit of "digging" for them, which may or may not be necessary; likewise "mid" or "Hi-fi" amplifiers. Many transistorised miniature radios give better quality of sound than do their mains counterparts—even at the 250mW level! The public wanted personal portables, and now they have them! They were never intended as Hi-fi sets. For anything like that you must employ larger loudspeakers and more substantial output transformers. The average 2½m-3in. speaker as used in respect has a cut-off round about 150c/s or so depending upon the make, so you cannot expect to have the lower frequencies reproduced as well—hence the rather shrill, but not unpleasant, tone of the average miniature.

One final point. Transistors are certainly not treated as toys in industry. One finds them in computers, guided missiles, servo-mechanisms, communications equipment, public address and scores of other applications, and transistorising has meant, in many cases a dramatic reduction in size and weight, and reliability under adverse conditions has been increased.—P. D. COKER (Exeter).

PRINTED CIRCUITS

SIR,—I had always accepted the common assertion that the removal of multi-contact components from printed circuit boards was impracticable, until I succeeded in removing one as the only alternative to throwing the board away. I am promised that a friend's printed circuit transistor radio, built from a well-known and excellent kit. Finding the mixer-oscillator stage dead, I soon found that the oscillator coil carrying three windings and six pins had been inserted in the board the wrong way round. Throwing the set away was clearly out of the question, the coil must be removed somehow.
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I finally adopted the following method:—a small screwdriver was inserted between the coil base and the board, and the two pins between which this wedge was placed were bridged on the other side of the board by the bit of a 25 watt iron. As the solder on the pins melted it was found possible to lever them a little way out of the board with the screwdriver, and the solder was allowed to cool with the pins in this position. The other two pairs of pins were then treated in the same way, using a bent lever, since other components were in the way of the screwdriver.

In this way the coil was moved a little way out of the board, and was finally removed after this treatment had been repeated three or four times. The whole operation took about 15 minutes.

I fully expected the coil connector to be deformed by the repeated bending, and was worried that the coil might lift from the board. In fact neither of these things occurred, and the resoldering of the coil the correct way round cured the original trouble, and when the alignment was completed I considered that the set was the best portable radio I had ever heard.

Can it be that printed circuits and miniature components are much more robust than we have been led to believe? I hope that this account may be helpful to others who find themselves in a similar predicament, and who are not keen on throwing a printed circuit board away because of one so-easily-made mistake.

—D. M. Payne (Norwich).

COIL WINDING

SIR.—I follow with extreme enthusiasm the articles in which coil windings for valve receivers are given for the reader who likes to amuse himself winding his own coils. However I have never come across a medium wave aerial and anode coil such as used in modern T.R.F. Receivers described.

I would be much obliged if any of your readers can give me hints or any information how to wind such coils for use with twin gang 0-0005 tuning condensers.—J. Consiglio (31 Lytton Street, Glenroy, W9, Australia).

TRANSISTOR REFLEX RECEIVER

SIR.—I would like to apologise for the error that occurred in the February instalment of “A Transistor Reflex Receiver.” The number of turns for L4, which should have been 43, appeared in print as 33.

Some readers in strong reception areas have written to express difficulty in winding L2 in this receiver so as to give the exact degree of sensitivity required. The following technique has been found to simplify this part of the construction.

Prepare a sleeve of thin cardboard to fit the ferrite rod so that it will slide along freely. This should be half the length of the rod used. Wind 30 turns evenly along the whole length of this sleeve in an open spiral. Secure both ends of the coil by adhesive or other means. Place the tip of the coil over the end of the rod and move the sleeve on gradually while testing for results.

When the correct degree of sensitivity is reached, the sleeve should be secured at that point with Sellotape, whether it is fully on the rod or partly off it.

This method will save much time.—D. B. Pitt (Nottingham).

GRID DIP OSCILLATOR

SIR.—Some queries have arisen about the Grid Dip Oscillator published in the August 1960 issue of “P.W.”

I have already received a letter from a Scottish reader keen to build the G.D.O. but he had doubts about the diameter of the formers. These are Aladunn 0:3in. diameter.

Also I noticed an inadvertent error in the Coil Table. The frequency range of the VHF loop was marked “20-17Mc/s.” This should of course have read “95-170Mc/s” (as indicated on the scale in Fig. 4).—K. Smith (GJ1IX).

INTERFERENCE

SIR.—I see my letter published in the March issue has caused some comments.

As regards Mr. Hutchins, I am well aware of International Frequency allocations, but how many countries have kept to them?

I have perhaps overdone the interference caused by morse. A lot depends on the Rx and local conditions as we all know. I notice Mr. Hutchins has nothing better to offer, unlike Mr. Hallahar who suggests the system of SSB. The whole fact of the matter of course, is that the medium waveband is too small. There will have to be some very very big changes soon.—M. Reynolds (Nailsea).

19 SET

SIR.—There seems to be some confusion as to the various forms of W/S No. 19. I show some of the different forms below.

W/S 19 Mk 2.

The common one on the market. Fitted with P/B “NETT” button, NO RF gain, one-speed tuning, frequency drift not satisfactory.

W/S 19 Mk 3 (British).

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W/S 19 Mk 3 (Canadian).

Same as British Mk 3 but fitted with “Flick Adjustment Control,” even greater saving of battery but smoothing not as good as British Mk 3.

One word of warning, do not slacken off the flick screws, which are situated on both the “A Tune” and “PA Tune,” more than ½ a turn as these screws are very difficult indeed to put back into position if they are removed. —J. Hewson (Chalfont-St.-Giles).

INFORMATION WANTED

SIR.—Could any reader please supply 2 Lissen ‘PTZA’ battery valves? I believe they were used in many Lissen Q.P.P. circuits including the ‘SkyScraper 4’. I would be grateful to hear from anybody willing to dispose of 1 or more of these valves.—K. Muscutt (5 Tilbury Road, East Ham. London E.6.).
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<td>50</td>
<td>C</td>
<td>50</td>
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All voltages quoted are WORKING.

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<table>
<thead>
<tr>
<th>Type</th>
<th>Wkr Volts</th>
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<tr>
<td>1DS</td>
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<tr>
<td>1HS</td>
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<tr>
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<td>6/56</td>
</tr>
<tr>
<td>1/6</td>
<td>6/56</td>
</tr>
</tbody>
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<table>
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<th>METER</th>
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<tr>
<td>AVO Model 8</td>
<td>£87.0.0.0</td>
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<tr>
<td>AVO Model 8 with leather carrying case</td>
<td>£90.10.0.0</td>
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<tr>
<td>AVO Model 7 with leather carrying case</td>
<td>£85.0.0.0</td>
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<td>AVO Model 7 Multi-amp</td>
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<td>CARD A-10</td>
<td>£14.17.6</td>
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<tr>
<td>CARD B-6</td>
<td>£2.6.6</td>
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Transmitters. Red Spot 4/6; White Spot 4/6, 5/6 Multiplier, 2½in. scale. Flux coated diode and tube, prompt delivery home and abroad.

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A NEW 12th EDITION Illustrated Catalogue

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56 pages photographically illustrated on art paper. Over 2,000 new and guaranteed lines by the leading makers. No junk or ex-Government goods.

Special components for the short-wave listener and amateur transmitter. New features for the beginner including pre-punched metalwork for chassis construction eliminating all drilling, and radio design construction envelopes. All orders dealt with by return.

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Build your own electronic keyboard and Play everything! Send for free leaflet. Guitar, organ, loud and trumpets are all easy. Write now.

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SO-RAD WORKS

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25 DOMINION AVENUE, LEEDS 7

18n. SPEAKER and 3in. TWEETER by leading man ufacturers. 75-125. This is less than half list price. 3 or 4 ohms.

5/6 PRICE TWO-WAY SPEAKERS. 5.0, 5.5, 6.5, 6.8, 6.8, 6.8. Plate or resonant tuned diaphragm. 8.5, 9.5, 10.5, 11.5, 12.5. Round wire 50µA, 1K, 1%, 5%, 2%, 7%, 1%, 3%. Pocket, neon testers with retractable screwdriver. 5½, 7½, combination diaphragm, 6.5, 8.5. Steel Block Panels 1½, 4½, 7½, 10½, FULL SIZE 1½ TWIST DRILLS. Solid 75, 1½ inch, 1½ in. Mesh, 6½, 8½. Special size sets. 4½, 7½, 10½. Set 85, 6½. Set 1½, 1¼, 2½.

TRANSFORMERS. 230/239, 1 a and 230/239-32 v. 4 a, 3/6 each.

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PAXOLIN PANELS, 12 x 6 1½ in., 3/6.

PAXOLIN TUBING, 1½ x ½ in., 12½, 17½.


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RELAYS. We hold large stocks. Any contact combination and operating coil voltage supplied from 3/6.

KEY SWITCHES from 3/6.

12 v. RELAYS. With 4 make contacts. 0-6½ to 12½, 4½ for 2½.

VERY POWERFUL GEARED MOTOR 12 v. D.C. MOTORS, 3 x 1½, 10/6.

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A New Transistor Portable Design from

REPAÑO

Two Transistors only Fully portable Loudspeaker 7in. x 4in. Long and Medium Wavebands Twin Ferrite Aerials Provision for External Aerial

SEND NOW! 1½ (post free) for easy wiring plans, instructions and price list.

RADIO EXPERIMENT PRODUCTS LIMITED

33 Much Park Street

COVENTRY
The ideal book for every serious maker...

**RADIOS - CONTROLLED MODELS**

F. J. Camm

Contents


Fully illustrated with circuit details, diagrams and photographs.

12. 6d. FROM ALL BOOKSELLERS...

_Tel.: Cleckheaton 2866_

TX1154 Model M complete with valves and meters. Four wave band model. Clean condition. £8. 10/. U.S.A. Tube Unit with five inch 5CP1 tube short P. 10/- Less valves. Carr. 6/6.

Tube Unit Type H36. Complete with VCR79 Seven 8BF01 valves in very good condition. 25/- Carr. 7/6. B.R.S.

Special TV offer, fifty only. Ultra 14m. BBC-TV, Models M10 and M20. Supplied in perfect working order. New units with one months guarantee. Only £12/6.0. Carr. and Insurance 17/6. New tube is packed separately in its manufacturer's carton.

New Valves. All post free, three months guarantee. Two valve Super-Valve: Standard; 20/-; 8BF0; 3/-; E909; 3/-; 699; 2/6. 844; 2/6; 8BF07. 3/-; 8SM0; 2/6; 6A9S; 2/6; 8F15; 2/6; 6A9; 2/6. Special offer, 10/6 each. 20/6 each.

New Co-Axial Cable. Multi-strand, best quality. 50/6 per yard, 100/- per 10 yards. 3/-; All post free.

_40 MEADOW LANE, LEEDS II_

_2/6 - 25/-_ _2/- - 3/-_ _3/- - 5/-_ _5/- - 6/-_ _6/- - 8/-_ _8/- - 10/-_
STEREO 3-D
FULL 3-D EFFECT CAN BE HEARD WITH OUR NEW-HIGH-GAIN CIRCUIT
Can be used with Stereo or ordinary records
★ Output 2 watts each speaker.
★ Valves ECC83, 2-ECL82.
★ Tone, balance and volume controls.
★ Mains operated 110/250v A.C.
Completely built and tested with knobs and calibrated dials, speaker sockets, etc.
£5.75 P.P. 2/6
including (circuit and notes).
★ BARGAIN OFFER ★
9 x 6in. speakers for use with above 18/6 ea.
COLLARO STEREO 4-speed auto-change crystal pick-up—BRAND NEW £7.10 P.P. 3/6.

PRACTICAL TRANSISTOR CIRCUITS
Produced for the Home Constructor—containing 14 easy to build circuits with practical layouts, trans-istor information, etc. 1st Edition 2/- post free.

CRYSTAL MICROPHONES
ACOS 39-1 Stick microphone. Brand new. Includes detachable Stand and screened lead. 39/6, P.P. 1/6. ACOS 40, Hand or Desk microphone. Fold away Stand and screened lead, 35/6, P.P. 1/6.

* UNBEATABLE VALVE PRICES!

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Volts</th>
<th>P.P. 1/6</th>
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<td>3Q4</td>
<td>6C4</td>
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<td>12</td>
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FULLY GUARANTEED: SEND FOR COMPLETE LIST OF OVER 600 TYPES. INCLUDES TX, TUBES AND INDUSTRIAL UNITS.

ALL TRANSISTOR BABY ALARM THE "BABY SITTER"
★ 100% Safe—Guaranteed
★ Fully Portable—Very Sensitive
★ No Mains—Battery Operated
★ Can be used over any distance
Use it at home, take it on holiday
Every Sound can be heard on large 5 inch Speaker
Completely Assembled with Battery £5.10.0 P.P. 2/6
— BE WITH YOUR CHILDREN ALL THE TIME —
(Inillustrated leaflet free on request)

VALVE REDUCTIONS
(WHEN PURCHASED IN SETS)
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Voltage</th>
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<td>6G8 6S7 6J7</td>
<td>6</td>
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</tbody>
</table>

TYPE 28 TRANSMITTER/RECEIVER
Complete with 5 valves. In new condition. These sets are sold without guarantee, but are serviceable.
Coverage 7 to 9 M/cs Headphones 7/6 pair. Throat Mike 4/6
$22.6 P.P. 2/6
Aerial Rod 2/6

TRANSMITTER/RECEIVER ARMY TYPE 17, MARK II
BRAND NEW £4.44-61 M/cs Calibrated Wave-meter for same. 10/- extra. P.P. 2/-

HENRY'S RADIO LTD.
5 HARRROW ROAD, EDGWARE ROAD, PADDINGTON, LONDON W.2
Opposite Edgware Road Tube Station, PADDINGTON 1098/9. OPEN MONDAY to SAT. 9-6. THURS. 1 o'clock.

See BACK PAGE
**Practical Wireless**

---

**SERVICE**

**BLUEPRINT**

All of these blueprints are drawn full-size and although the issues containing descriptions of these sets are now out of print, an asterisk in the list below denotes that constructional details are available free with the blueprint.

The index letters which precede the Blueprint Number indicate the periodical in which the description appeared. Thus PW refers to PRACTICAL WIRELESS; AW to Amateur Wireless and WM to Wireless Magazine.

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

---

**SPECIAL NOTE**

The following blueprints include some pre-war designs and are kept in circulation for those constructors who wish to make use of old components which they may have in their spares box. The majority of the components for these receivers are no longer stocked by retailers.

### CRYSTAL SETS

<table>
<thead>
<tr>
<th>Title</th>
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<tr>
<td>Junior Crystal Set</td>
<td>PW94*</td>
<td>2/6</td>
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<tr>
<td>Dual-wave Crystal Diode</td>
<td>PW95*</td>
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### STRAIGHT SETS

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<td>Modern One-valver</td>
<td>PW96*</td>
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<tr>
<td>All-dry Three</td>
<td>PW97*</td>
</tr>
<tr>
<td>Modern Two-valver</td>
<td>PW98*</td>
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### SUPERHETS

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<td>A.C. Band-pass Three</td>
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<tr>
<td>A.C. Coronet-4</td>
<td>PW100*</td>
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<tr>
<td>A.C./D.C. Coronet</td>
<td>PW101*</td>
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### MISCELLANEOUS

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<tr>
<td>The PW 3-speed Autogram</td>
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<td>The PW Monophonic Electronic Organ</td>
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### TELEVISION

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<tr>
<td>The PT Band III Converter</td>
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**QUERY COUPON**

This coupon is available until 7th September, 1960 and must accompany all queries in accordance with the notice on our “Open to Discussion” page.  

PRACTICAL WIRELESS, SEPTEMBER, 1960
"CONTINENTAL-6"—Just right for a day's outing
COMBINED PORTABLE CAR RADIO

Medium and Long Wave Full Tuning
Plessey Printed Circuit
6 "TOP GRADE" EDISWAN TRANSISTORS
5in. High Fidelity Speaker
400mW Push-Pull Output
Internal Ferrite Aerial
Slow Motion Tuning
Fully Illustrated Instructions
Printed Circuit marked out
Car Radio aerial socket and A.V.C.
ALL COMPONENTS GUARANTEED
Double Tuned IFs
Size 9½ x 7 x 3½ins. Weight 4½lb

Total Cost of all Components
£11.10.0 P.P. 3/6
including Cabinet, Battery,
Transistors, Car Radio, A.V.C
and all necessary items.

A highly sensitive and selective portable fully tunable on medium and long waves. Performs equally well as a car radio. Low running costs, good looks and ease of construction combine to produce a radio equal to commercial receivers in the 20 gm. class.

ALL COMPONENTS AVAILABLE SEPARATELY

Wherever you are
"First Class in every way"

CONTINENTAL AND LOCAL STATIONS AT YOUR FINGERTIPS

NO EXTERNAL AERIAL OR EARTH—NO REACTION CONTROLS

COMPLETE STATION SEPARATION — EASY AS A B C TO BUILD AND A THRILL TO USE

MAJOR—2 (Two-Transistor Pocket Radio)

IDEAL FOR BEGINNERS

4-stage reflex
Medium wave; tunable
Very sensitive
No aerial or earth
Complete layout
Over 6 months on one battery
4½ x 3 x 1½in.
Weight only 4 oz
Personal phone included

All components said separately
TOTAL COST 69/6 P.P. 1/6.
NEW BOOKLET FREE
RECEPTION GUARANTEED ANYWHERE!

NOT TOYS BUT REAL WORKING RADIOS!

MAJOR—3 (Three-Transistor Pocket Radio)

5-stage Reflex Circuit
No Aerial or Earth
Miniature Volume Control
3 Ediswan Transistors
Medium Wave Tuning
Size 4½ x 3 x 1½in.
Personal Phone included

(As described in R.C., Sept. '59)
TOTAL COST 87/6 P.P. 1/6.
NEW BOOKLET FREE
FANTASTIC OUTPUT, TERRIFIC RECEPTION
GUARANTEED ANYWHERE

Mercury Batteries
1·3 volt, 500 mAh. Size 9½ x 3 in. 1/3 each, P.P. 3d.
each, or 12½ dozen, P.P. 9d.

Crystal Microphones
ACOS 39-1 Stick Microphone with screened lead and stand
List (5 gns.) 3/6 P.P. 1/6
ACOS 40 Desk Microphone with built-in stand and screened lead (List 50-1) 2S/ P.P. 1/6.

3-TRANSISTOR HEARING AID
High-gain circuit with built-in crystal microphone and battery. Includes miniature earphone. Size 3 x 2 x 2 in. All components
89/6 P.P. 1/6.

CRYSTAL CONTROLLED OSCILLATOR
3-12 Mcs Spot Market Unit. Uses 58305 Transistor. Ideal for short wave calibrator, etc. All components (less crystal). 22/6 P.P. 1/6.

TRANSISTOR TRANSMITTER
1·8 to 2 Mcs coverage. 3 transistors unit size 4½ x 3 x 1 in. Range of 3-section rod aerial up to 300 yards. Includes built-in microphone, battery and 3-section rod aerial. All components
57/6 P.P. 1/6.

PRICES DOWN!
RED-SPOT TRANSISTORS 3/6 each
WHITE SPOT 5/ each
NEW FREE LIST ON REQUEST
FULLY GUARANTEED

Telescopic Chrome Aerial
7-Sections, 3ft. 6in. open 6in. closed. Ideal for Portable Receivers. Walkie-talkies, Radio Control, etc. With clips 12/6 P.P. 1/6
Also 64 inch version 17/6 P.P. 1/6.

Crystal Microphone Inserts
Latest ACOS, 2in. Round Hi-Fi Insert. 14/-. P.P. 6d. 1in. square (ex-units) 3/6 each. P.P. 6d.

RF. IF AND AUDIO SIGNAL TRACER
Ideal signal peaker or quick fault-finder for receivers, amplifiers, etc. Size 4½ x 3 x 1½in. All components, with phones. 37/6 P.P. 1/6. Less 'phones. 32/6. P.P. 1/6.

250mW PUSH-PULL OUTPUT AMPLIFIER
For use with any 2, 3 or 4 transistor, earpiece or headphone radio to give room-filling volume on 3in. speaker. All components including 2 Ediswan transistors. speaker. battery. special input socket to take earpiece plug. cabinet, etc., 59/6 P.P. 1/6.
Ideal for use with Major-2 or Major-3.

27 Mcs RADIO CONTROL RECEIVER
3-Transistor regen. circuit. Size 2 x 1½ x 1½in. Weight with batteries. 1½ oz. Uses 58305 transistor. Multi-channel reed operated. All components (less reed). 50/- P.P. 1/-.

See Other Adv. Inside
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Opposite Edgware Road Tube Station. PADdington 1008/9
OPEN MON. to SAT. 9-6, THURSDAY 1 o'clock

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PADDINGTON, LONDON W.2

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