MAKING A 4-VALVE MIDGET PORTABLE

PRACTICAL WIRELESS

AUGUST 1957

EDITOR: EJ. CAMM

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400-0-200 400 MA, 50 c/c, 7.99 v. 2 a, 2.99
400-0-200 500 MA, 50 c/c, 9.99 v. 2 a, 2.99
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Type BM1. An all-dry battery eliminator.
Size 5 x 1 x 2 in. approx.
Completely replaces batteries supplying 1.4 v. and 90 v., where A.C. mains 200-250 v. 50 c/c, scowered. Suitable for all batteries up to 150 v. and also for receivers requiring 1.4 v. and 90 v. This includes virtually all consumption types.

Complete kit with diagram, 39.9, or for ready use, 49.9.

H.T. ELIMINATOR AND TRICKLE CHARGING KIT. Input 200-250 V. 50 c/c, scowered. Fully smoothed, rectified supply to charge 2v. accumulator. Primarily intended for radio sets in cold andcountry regions.


R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM2. Size 8 x 5 x 1 in. Supplies 12 v., 5 v., and 0.5 v. 30 mA, and 2 v. 0.4 A to 1 amp. Fully smoothed. Specially designed for use in battery cabinets.

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EXTENSION SPEAKERS

Ready for use in a walnut veneered cabinet.
Sin. 2.3 ohms, 35.9.

Very limited number.

VOLUME CONTROL with long (1 in. diam.) spindle, all values less 2.5; with S.P. switch, 3.9; with D.P. switch, 4.6.

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

Assembled 6 v. or 12 v. 2 Aamps.
Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Louvered steel case, with stoved blue hammer finish.

75.9. Ready for use with mains and output leads. Carr. 3.9.
R.S.C. A8 ULTRA LINEAR 12 WATT AMPLIFIER

High-Fidelity Push Pull Amplifier with Special Tone Control. Three stages, high sensitivity. Includes 3A5 outputs. High-quality transformers, input and output, specially designed for Ultra Linear operation. Meets current standards of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE. 35, 30-30,000 c.e.s. Six negative feedback loops. Hum level 15 dB. Only 70 milliwatts N.R.M.V. required for FULL OUTPUT. Suitable for use with all modern tubes and types of tubes and practically all microphones. Compared very well with the best designs. FOR further details see R.S.C. Ultralinear Long-Playing £7-15-0. MUSICAL INSTRUMENTS, including stringing, tuning, cords. OUTLET SOCKET with plug provides 300.20 v. 20 mA and 6.3 V 5.5 A. For supply of a RADIO FEEDER UNIT. Size approx. 12.5 x 7.5 x 5.5 cm. Made of bakelite and 15 ohm speakers. Kit complete for 15 nut. Chaos is fully furnished. Full instructions and diagrams supplied. Unadaptable color at a factory built 45 x 45 x 30 x 10 cm.

R.S.C. 45 WATT AS HIGH-GAIN AMPLIFIER

A highly sensitive Push-Pull, high output unit with self-contained pre-amp. Tone Control Stages. Separate Bass and Treble Controls. A complete Kit with diagrams. Carriage includes all necessary parts and tubes fitted. Minimum input required for full output is only 12 milliwatts so that ANY KIND OF MICROPHONE can be used. The unit is designed for use with 45 long-playing records, ORANGE or OUTDOOR FUNCTION, etc. For use with Electronic, GUITAR, STROBE BASS, etc. For Standard or Long-playing records. OUTPUT SOCKET PROVIDES L.T. and H.T. for a RADIO FEEDER UNIT. All extra input with associated control valve provided so that two small inputs such as Gram and 'Mike' can be mixed, cut, or reversed. Amplifier has 1200 miliwatts N.R.M.V. for 25 cm. A.C. Mains and has outputs for 2300 miliwatts for a complete Kit of parts, fully furnished. Chaos is point-to-point with microphones. Only 10 G.N.S. TIDES: DEPOSIT £5 11s and 9 monthly payments of £5.2s.0d.

R.S.C. 20 WATT RE-ENTRANT SPEAKERS, 15 ohm high fidelity. For Outdoor use, only 8 GNS. SPEAKERS. RE-EVENT SPEAKER, 23 cm. Suitable for use with L.E.O. or P.W.E. Speakers etc. £3 15s 6d. Complete Kit with diagrams. £12 / 1941. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEAKERS, 29 ohm, 6m. R.A. hight, £2 14s. 6d. M.E.R. SPEA
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Superhet 5V, AC DC class. Medium and high power. Used. Condition: standard, all parts. Calf price: £2.50, worth more. £7.60, carriage 6d.

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Rectifier Unit. Ex Electric Silicon Co. for working d.c. instruments, motors, etc. Used. Condition: standard, all parts. Calf price: £2.50, worth more. £7.60, carriage 6d.

Fluorescent Transformer. 200 volts, primary, 200V, Output 200V. Output 200V, 100 per 35, carriage 7G.

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Fluorescent Transformer. 200 volts, primary, 200V, Output 200V, 100 per 35, carriage 7G.

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Metal rectifier. 200-250, 400 mA. Ideal for mains set or instrument to replace that expensive valve.

Superhet Coils, Low and medium. Aerial and oscillator circuits included. Per set £3.

.0055 twin gang tuning component. 49, post 9d.

Midget coils. Ideal for larger set, etc. with dust cores. £4 per doz.

Midget I.F. Coils, dist reduced. £11 each, 405 Kc/s, 40 pair per.

Standard size I.F. Coil, dist constant. £4.50, 40 pair per.

Moving coil meters. 21m. Iron core. Scaled 0-600, 7.8 each.

Mullard 510, Output transformer. 27G, plus 2.6 post and packing.

Mullard 510, Mains transformer. 27G, plus 2.6 post and packing.

D.C. Rotary Converter. Suitable for all experiments. £5.64.

Hi-F. 15 Tuning Unit. New, unused and complete with valves. £8, post 2G.

Hand magneto generator, as used on telephones. £6.

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Fluorescent Tubes 20 watt. Standard in all respects. Calf only, £6 each.

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Cathode Ray Tube, VCR 517, 6.8 each, carriage 7G.

Where the value of your order for small articles exceeds £2, there are no post charges. Under £2 and sufficient to cover, and where carriage or postage specifically mentioned add this in any case.

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10 core flexible cable, 220V, cores. Price £1.60 per yard.

7 core flexible cable, 220V, cores. Price £1.90 per yard.

5 core flexible cable, 220V, cores. Price £1.00 per yard.

Superhet chassis. Long and medium. Complete with valves. Unused but must be serviced. 25, post and insurance 16.

Mains Transformer 20-4-250, 60/40 ma. Standard mains input, Half wave rectified. 12, post and insurance 26.

D.C. Rotary Converter. Suitable for all experiments. £5.64.

Many more bargains at our branch here. Please telephone before calling to pick up something special in case stocks have been cleared.

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V.H.F./F.M. HOME, LIGHT AND THIRD PROGRAMMES INSTANTLY SELECTED AT THE TURN OF A SWITCH

Full constructional details, point-to-point wiring diagrams and alignment instructions for building the "MAXI-Q" PRE-SET F.M. TUNER and also the VARIABLE TUNED version are given in Technical Bulletin BT 1/6. The "MAXI-Q" of each unit is complete, fully assembled, and ready to be fitted into the cabinet. The "MAXI-Q" PRE-SET F.M. TUNER, is available completely wired, assembled, and housed in a sturdy molded plastic case. The "MAXI-Q" VARIABLE F.M. TUNER is completely assembled, with the following components:

- 3-BAND SUPER
- CONDENSER TRIMMERS
- 3-BAND TUNER
- VARIABLE F.M. TUNER
- TUNER TRIMMERS
- BAND SELECTOR SWITCH
- POWER REQUIREMENTS

CASE DIMENSIONS: 6 1/8" x 3 1/8" x 5 1/4".

STOP PRESS: "MAXI-Q" 60 kc TAPE DECK OSCILLATOR COILS, TDO.1 - for high impedance transformer, polyethylene, copper, silver mica condensers. Can size: 1 1/2" dia. x 2 1/2" high, 12.6. I.F. TRANSFORMER, IF1.11:10.7 Mc/s. Miniature I.F. Transformer of nominal frequency 10.7 Mc/s. The "Q" of each winding is 60, and the coupling coupling. Case size: 1 1/2" dia. x 1 1/4" high, 6.6.

COILS TYPE: IF1.11 and 12. Special design used for use in this unit, are wound on polyethylene forms complete with iron dust core, 3.11 each.

THE "MAXI-Q" PRE-SET F.M. TUNER, is available completely wired, assembled, and housed in a sturdy molded plastic case. The "MAXI-Q" VARIABLE F.M. TUNER is available completely assembled, with the following components:

- 3-BAND SUPER
- CONDENSER TRIMMERS
- 3-BAND TUNER
- VARIABLE F.M. TUNER
- TUNER TRIMMERS
- BAND SELECTOR SWITCH
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- TUNER TRIMMERS
- BAND SELECTOR SWITCH
- POWER REQUIREMENTS

CASE DIMENSIONS: 6 1/8" x 3 1/8" x 5 1/4".
PORTABLE V.H.F. AND CAR RADIO SETS

The D.G. of the BBC, in an address to the Radio Industry in a speech to the R.I.C. of Scotland, said that the Radio Industry had been tardy in developing portable V.H.F. sets and car radio V.H.F. sets. He stated that he had seen excellent German portable V.H.F. sets five years ago, and by this time there should be many on the market in Britain. He said that the BBC had been ready to build V.H.F. transmitters immediately after the war, but had been prevented from doing so by financial policy of successful governments. What would have been the purpose of the industry producing V.H.F. sets before the BBC transmitters were ready? There are only comparatively few areas in this country where V.H.F. would have brought any benefit, and it was not to be expected that people would scrap existing receivers giving reasonably good quality reproduction and purchase V.H.F. receivers. Sir Ian here, however, was putting the cart before the horse. The industry is in business to make money. Its own market research, however, showed that there was little likelihood at the time of the public responding to a campaign to sell V.H.F.

THE RADIO SHOW

Next month’s issue, on sale August 7th, will contain a preview of this year’s show at Earls Court, which takes place from August 24th to September 7th. A cordial welcome is issued to all readers to visit us on our Stand No. 117.

THE NEW BBC CHAIRMAN

The Headmaster of Rugby is to be the new chairman of the BBC governors and we hope he will be permitted to exercise greater authority than some of his predecessors have been enabled to do. In Reith’s time the job was a sinecure, merely to comply with the terms of the Charter. Reith seemed to make the decisions. His notes to the staff commenced: "The Director-General has decided..." It seems to us that the Director-General should be there to carry out the decisions of the Governors.

WELSH RADIO STATION

A POST Office radio station is now being used to link the two BBC Welsh transmitters, in order to skip the Welsh mountains. Signals from the Wenvoe transmitter near Cardiff are received at the P.O. microwave station at Mynydd Penrareg, near Lampeter, and are relayed to the new BBC West Wales Television transmitter at Blaen Plwy, near Aberystwyth. During the early stages of testing a "ghost" was seen on the picture transmissions, apparently caused by a cliff face on the 2,900 feet Brecon Beacons, situated some 6½ miles laterally from the direct path from Wenvoe. The unwanted image was eliminated by installing an aerial arranged so that it would not pick up reflections from the Brecon Beacons. F.J.C.

Our next issue, dated September, will be published on August 7th.
Round the World of Wireless

By "QUESTOR"

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of April, 1957, in response of 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.

<table>
<thead>
<tr>
<th>Region</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>London Postal</td>
<td>1,724,439</td>
</tr>
<tr>
<td>Home Counties</td>
<td>1,171,933</td>
</tr>
<tr>
<td>Midland</td>
<td>895,918</td>
</tr>
<tr>
<td>North Eastern</td>
<td>1,144,191</td>
</tr>
<tr>
<td>North Western</td>
<td>91,209</td>
</tr>
<tr>
<td>South Western</td>
<td>737,992</td>
</tr>
<tr>
<td>Wales and Border Counties</td>
<td>464,228</td>
</tr>
<tr>
<td>Total England and Wales</td>
<td>6,479,734</td>
</tr>
<tr>
<td>Scotland</td>
<td>836,150</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>191,124</td>
</tr>
<tr>
<td>Grand Total</td>
<td>7,509,008</td>
</tr>
</tbody>
</table>

New Anglo-American Company

THE formation of a new company to manufacture transistors and other semi-conductors in England was announced recently in London. To be known as Semiconductors, Ltd., the new company has been formed by The Plessey Co., Ltd., and Philco Corporation of U.S.A.

This joint enterprise, which is likely to have a considerable bearing on the development of the transistor industry in this country, was undertaken following a comprehensive survey of the electronic industry in the United States.

This new Anglo-American company will have an initial paid-up capital of £500,000, of which 51 per cent. will be held by The Plessey Co., Ltd., and the remaining 49 per cent. by Philco Corporation.


Pye for U.K. Atomic Energy Authority

PYE, LTD., are designing and supplying all the equipment for a laboratory for the Atomic Energy Authority at Dounreay, in which irradiated fuel elements from the Dounreay fast breeder reactor are to be examined.

The equipment to be supplied includes manipulators, universal cutting machines, lathes, furnaces, X-ray and density measurement, inspection and material testing machines, optical and TV viewing facilities, and all the associated handling and shielding equipment: in fact, the complete laboratory, except for the concrete structure, is being supplied by Pye, Ltd.

Owing to the highly radioactive nature of the elements, which can only be handled by remote control, the laboratory is a cave of U-shaped form—a concrete cave with an area of 1,100 square feet. To form a biological shield, the walls of the cave are 4ft. 6in. thick, partly lined with steel.

For observation of the processes inside the cave there are windows at intervals in the dense concrete walls. These windows are composed of glass-walled tanks containing a saturated zinc-bromide solution, thus providing a shield from radioactivity equal to that of the walls, and at the same time permitting observation of all the processes. At each window, facilities are provided for Pye Master Slave Manipulators for remote handling of the elements. Pye manufacture these manipulators by agreement with AMF Atomics, a division of the American Machine and Foundry Co.

Marconi Radio for B.O.A.C. Britannias

B.O.A.C. has ordered Marconi radio equipment for its fleet of Series 312 long-range Bristol Britannias, some of which are expected to be in passenger service in a few months' time. Each aircraft will have a dual Marconi transmitter/receiver installation for multi-channel H.F. communication, a high discrimination receiver, and a dual radio compass.

The communication equipment, Type AD.307, is a multi-channel high-power radio transmitter/receiver, particularly suitable for pilot-operated radiotelephony. It is simple to operate: any one of 200 crystal-controlled channels can be selected, frequency changing being entirely automatic by self-tuning circuits. The equipment, which is built in unit form to fit the standard aircraft racking, conforms to S.B.A.C. standards and meets all British Civil Airworthiness requirements. It is remotely controlled from two positions.

The receiver, Type AD.118, is intended for direct control only and is provided with a high discrimination scale. Particular attention has been devoted to obtaining a high degree of electrical and mechanical stability so that full use can be made of the high discrimination without constant scale checking.

Solartron to Manufacture Gunnerly Trainer

AS a result of arrangements finalised by Mr. John E. Bolton, chairman and managing director of The Solartron Electronic Group, Ltd., Thames Ditton, Surrey, during his recent visit to the United States, Solartron will manufacture under licence in Britain the Rheem F.151 Gunnerly Trainer.

The agreement is with the Electronics Division of the large Rheem manufacturing company of New York, whose many factories are spread out over the United States and several continents. This Division specialises in electro-mechanical equipment.

The gunnery trainer gives a full three-dimensional target representation in colour and is in many respects comparable to the Solartron Radar Simulator. The latter enables full-scale tactical radar naval, land or air exercises to be carried out without involving the heavy expenses of full-scale tactical exercises. The gunnery trainer, like the radar simulator, may be attached to a flight simulator.

The Late John V. Palmer

THE news of Mr. J. V. Palmer's recent death was received with sincere regret by his many friends at Mullard, Ltd.

John Palmer, who was 69, was for many years Manager of the Valve Division of Mullard Overseas Ltd., and contributed materially to its leading position in the export field to-day.

Joining the company in June, 1925, Mr. Palmer was appointed valve export Manager in 1926.
PRACTICAL WIRELESS

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ON their stand of over 2,000 square feet, Pye showed a wide range of exhibits, including television transmission equipment for studio and industry, and fixed and mobile V.H.F. communications equipment.

Creation of an International Association of Cybernetics

THE First International Congress of Cybernetics, which was held at Namur from June 26th to 29th, 1956, met with a great success as much because of the number of participants as because of the quality of the work presented.

At the close of the Congress, it was decided to create an International Association of Cybernetics. The latter was constituted at Namur on January 6th, 1957. It counts at present over 1,000 members (of which 300 industrial firms), representing 26 different countries.

The aim of the Association is to ensure a permanent and organised liaison between researchers whose work in various countries is related to different sectors connected with Cybernetics.

It endeavours to promote the development of this science and of its technical applications, as well as the propagation of the results obtained in this field.

It utilises all adequate means for the achievement of these objects.

All enquiries should be sent to the Permanent Secretariate of the Association: 13, rue Basse-Marcelle, Namur (Belgium).

Pye Multi-Channel Equipment for Venezuela

A CONTRACT for the supply of a six-channel radio-communication system has been awarded to Pye Telecommunications, Limited by the Socony Mobil Oil Company de Venezuela. The system will be installed between the company’s administrative offices in Anaco and the oil field at Guico, a distance of approximately 25 miles.

The equipment will provide the company with a trunk connection between private automatic telephone exchanges at each terminal by means of a V.H.F. multiple radio link. This link provides six telephone circuits, plus an engineer’s circuit simultaneously over a single pair of radio frequencies, and consists of Pye V.H.F. 50-watt F.M. transmitters and F.M. receivers at each exchange.

The new link will be connected into the public exchange at Anaco.

survey of the British Radio Equipment Manufacturers’ Association—radio sets by 21 per cent., television receivers by 20 per cent, and radiograms by 42 per cent.

Retailers’ sales of television receivers during April were 66,000, an increase of 6 per cent. on April, 1956, but a decrease on the previous month of 16 per cent. Sales of radiograms were 14,000, the same as in April, 1956, but a decrease of 30 per cent. on March this year. Radio receiver sales, at 78,000, showed an increase on April, 1956, of 20 per cent., but a decrease on the previous month of 6 per cent.

The proportion of hire purchase and credit sales, 53 per cent., for both radiograms and television receivers in March, fell to 50 per cent., and 52 per cent., respectively, in April. For radio receiver the percentage rose from 33 per cent. to 35 per cent.

BBC V.H.F. Station at Rowridge

THE BBC’s new V.H.F. sound broadcasting station which has been built on the same site as the television station, at Rowridge, Isle of Wight, transmits the West of England Home Service on 92.9 Mc/s, the Light Programme on 88.5 Mc/s, and the Third Programme on 90.7 Mc/s, each with an effective radiated power of 60 kW. The transmissions are horizontally polarised as at other V.H.F. sound broadcasting stations, which means that receiving aerials must be fixed horizontally.

The area served by this station has a population of nearly three million. It includes the counties of Hampshire and Dorset, most of Wiltshire, and substantial parts of Somerset, Berkshire, Surrey and Sussex.

Pye at the Poznan Fair, 1957

FOLLOWING their success at the Leipzig Spring Fair, in March, Pye, Limited, launched another export drive in Eastern Europe when they exhibited at the Poznan Fair in Poland in June.

Testing the “Tellurometer”—a micro-wave measuring instrument. It is claimed that this has an accuracy of 2 in, to 6 in, over distances ranging from 10 to 30 miles.
This receiver was built primarily for use on wavelengths of 10-180 m and is a fairly conventional T.R.F. type (Fig. 1); 6D6 (R.F.); 6SJ7 (Det.); 75 or 6SQ7 (L.F.); 42 or 6F6 (O.P.).

Denico cored coils plugging into Noval holders are used. They have proved most satisfactory in the prototype. Regeneration is controlled by varying the screen grid voltage of the detector valve and is smooth and silent.

**Construction**

The receiver is built on an aluminium chassis 10in. x 8in. x 21/4in. (The power pack is separate.) All construction must be absolutely firm or frequency stability may be poor.

Chassis drilling dimensions are given in Fig. 3, but the mounting of the gang capacitor is not shown since this depends on the type used by the constructor. The keyways of octal holders or the heater pins of UX6-type sockets face the rear runner of the chassis, with the exception of the keyway of the output valve which points towards the front right-hand corner of the chassis. The locators on the Noval holders face the gang capacitor.

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**LIST OF COMPONENTS**

- **C1, C6—300 pF gang with ceramic insulation.**
- **C2, C7—30 pF ceramic trimmers.**
- **C3—0.1 μF paper 200 v.**
- **C4, C5, C11—300 v. 0.1 μF paper.**
- **C8, C9—100 pF mica or ceramic.**
- **C10—500 pF mica.**
- **C12, C13, C16—8 μF 300 v. electrolytic.**
- **C14—0.05 μF 500 v. paper.**
- **C15—25 μF 12 v. electrolytic.**
- **C17—0.01 μF 500 v. paper.**
- **C18—25 μF 25 v. electrolytic.**
- **C19, C20—0.01 μF 500 v. paper.**
- **C21, C22—8μF 450 v. electrolytic.**

- **R1—600 Ω.**
- **R2—20 K Ω wirewound pot.**
- **R3, R8, R15—100 K Ω.**
- **R4, R12—1 K Ω.**
- **R5—2.2 meg. Ω.**
- **R6, R7—10 K Ω.**
- **R9—5 K Ω.**
- **R10—50 K Ω carbon pot. (Dubilier).**
- **R11—75 K Ω.**
- **R13—0.5 meg. Ω.**
- **R14—2,200 Ω.**

**R16—20 KΩ.**

**R17—0.22 meg. Ω.**

**R18—470 Ω ± 10%, 1 watt.**

(Resistors ± 20%, 1 watt, unless otherwise stated.)

**Valves**

- **6D6, 6SJ7, 75, 42, and holders.**
- **MR1, MR2, 250 v. 60 mA metal rectifiers (2 DRM1 B's).**
- **MT1 250-0-250 60 mA 6.3 v. 2.5 A. Tapped primary.**
- **Two UX6 valve screens and bases.**
- **2—Noval holders.**
- **M.E. speaker 600-1,000 Ω field 3 Ω; with transformer to match 7,000 Ω to 3 Ω (85:1).**
- **Aerial-earth terminals, L.S. and 'phone sockets (preferably non-interchangeable), plugs and sockets for power pack.**
- **SW1, 250 v. 1 A toggle or "push-push", SW2, SW3.**
- **1—70 mA fuse, 1—.25 A, fuse+holder.**
- **2—Dial bulbs; 6.5 v. 0.3 A.**
- **4in. dia. drive drum, cord and pulley to give 15:1 ratio.**
- **10in. x 8in. x 2in. chassis.**
- **Nuts, bolts, wire, etc.**
Wiring

Wiring of the heaters should be carried out first. Use twin flex and keep it close to the chassis. After this, any order of wiring may be used, but some methodical system is preferable. Note that the grid capacitor of the L.F. valve is clipped to the rear runner of the chassis. All screened wiring shown on the circuit diagram was carried out in coaxial cable which has low capacity losses. A 2in. long x 3in. high aluminium screen is mounted between the coil holders and a similar screen will be required for the trimmers if they are not within the screening of the gang capacitor itself. The medium-wave green coil has a 4 KΩ resistor across pins 3 and 4. Care is essential when soldering this.

Power Pack

The construction of the power pack is straightforward and needs little comment. Do not omit the H.T. switch and use it when changing coils. When the receiver and power pack have been completed and the wiring checked, plug in the medium-wave coils and attach 8ft. or so of wire to the aerial terminal.

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Fig. 1. Theoretical circuit of the Mains T.R.F. Short Waver.

Fig. 2. The power pack.
Adjustment

Adjust the trimmers to minimum capacity with a non-metal tool, and screw the coil cores fully out. Tune a signal to zero-beat at the high-wavelength end of the scale and adjust the core of the blue coil to give maximum signal (it is best to turn the regeneration control back a little). If there is not a noticeable “peaking” of the signal, screw in the core of the green coil a few turns and repeat. Then turn to the low wavelength end of the band and tune another signal to zero-beat. If the cone of the blue coil must be screwed in, increase the capacity of the R.F. trimmer; if it must be screwed out, increase the capacity of the det. trimmer. Repeat the whole process until the core of the blue coil needs no adjustment (or very little) at any part of the band. The stray capacities of the det. and R.F. circuits are now balanced and on other bands it is necessary only to adjust the coil cores.

Considerable benefit may be derived from tuned aerial systems such as dipoles on the short waves. Even a simple link coupling tuner on the writer's long wire aerial gives an appreciable reduction in ignition noise on 20 metres.

Machine for Printed Circuits

A NEW semi-automatic screen printing machine was the highlight of the demonstration of radio and electronic circuits printed by the screen printing method arranged by Gordon & Gotch Ltd. at Trapinex Works on May 23rd.

The machine is the SPS Model 90-A which has been specially designed by the manufacturers for the production of printed circuits.

The machine has been specially designed to incorporate an extremely powerful suction over a relatively small area.

The printing base on the machine has a total of 10,000 special apertures. These are connected to an extremely efficient suction system from the vacuum turbine. This is capable of completely flattening material which is in a bowed condition.

This machine for producing printed circuits is equipped with an accurate precision micrometer with an adjustment of 1/12 in. in every direction. The height adjustment is up to 3 in. The electrical foot switch on the machine is entirely movable and can be placed in any desired position to suit the operator. This means that one person can operate the machine no matter what the job.

SPS screen printing machinery and equipment is manufactured by the Siebdruckerei von Holzschuh KG, of West Germany. Sole agents in the United Kingdom and Republic of Ireland for the SPS range are Gordon & Gotch Ltd., 39-40, Farringdon Street, London, E.C.4.

An operator printing a circuit on a laminated insulated sheet by means of a screen-printing process.
Stereophonic sound is well known to all of us today in connection with the more recent developments in the cinema. I have heard it said, however, that it is difficult to tell any difference between it and ordinary sound. There is, of course, a vast difference. Unfortunately some cinemas are not as good as others, no doubt due to the acoustics of the building and it is also a fact that the more natural a thing becomes the more we tend to take it as something ordinary. My aim, however, is not to discuss stereophonic sound in the cinema, but to show the average recording enthusiast that this can be comparatively easily applied to tape resulting in a recording that we might call "living."

Briefly, let us examine the function of the human ears. Let us assume we are listening to a piano, a violin and drums equally spaced in front of us. Our left ears will hear the piano, our right ears will hear the drums, but the violin will be heard equally by both ears at the same time. Even if we could not see these instruments we could tell where they were by the direction of their sounds. Now if we replace our ears by two microphones set at angles equal to our ears and couple them to recorders, we can make recordings of what the left ear heard and what the right ear heard. If these are played back simultane-
ust be perfectly synchronised, which is not a practical proposition under such conditions, so the obvious way is to put both recordings side by side on the same tape. This appears to be reasonably simple—a recorder comprising one tape deck and two amplifiers. This basically is all it does mean, but unfortunately there are several things that do not work at quite as simply as they should. Although I intend describing my own recorder I feel that the majority of readers may have their own

Another. Unfortunately this caused interaction between the two amplifiers, but was overcome by decoupling in the smoothing arrangement as shown in the circuit diagram. The two oscillators were tuned to the same frequency but at times there was a certain amount of drift and, finally, I settled on one oscillator only. This did not cause too much interaction during recording as might have been expected. The two erase heads were replaced by one covering the full width of the tape. Balancing was effected by

\[
\text{Fig. 2.—The power pack and oscillator.}
\]

Note.—To avoid height valve 5V4 can be replaced by 2 valves 5V3 connected in parallel.

leas as to the amplifier circuits and certain modifications in switching thus expanding the uses for the recorder to their own requirements. Bearing this in mind I would first like to discuss some of the problems experienced in the development of my own machine and how I was able to solve them.

My first attempt was not exactly spectacular. I bought two well-known amplifiers and a tape deck and fitted them into a large cabinet with two speakers forming a lid, removed the head assembly from the tape deck and fitted two record playback heads and two erase heads. This arrangement gave me my first tereophonic recordings but was far from satisfactory. It was too large and heavy for one person to carry. The mains hum was bad. Although the two recording amplifiers were independent there was interaction between them, resulting in a low-pitched whistle on the tape. Finally, there was no method of balancing the two amplifiers to give equal output on playback.

Size, perhaps, was the easiest difficulty to combat. As each other difficulty was overcome the size automatically became reduced. One power pack to supply both amplifiers cured most of the hum and it was eventually brought to a minimum by building both amplifiers on one chassis and the power pack on the addition of an audio oscillator which could be fed to the input of both amplifiers and the resulting signals measured at the output of each by means of a meter. By use of a peak signal indicator in the first amplifier the volume could be set for recording in the usual manner employed in a single-channel recorder and, by the method just explained, the second amplifier could be set to record at equal volume.

Finally I decided once more to completely rebuild the recorder and build it up in the form it is today. The amplifiers were rebuilt on one small chassis and fitted on its side along the front of the tape deck. All the controls are fitted to a panel level with the tape deck itself and have been kept to a minimum. Separate volume, treble and bass controls are provided for each amplifier but all other switching is synchronised into a 10-button selector unit. Pressing the “play tape” button, for example, connects both amplifiers for playback, starts the motors running and completes the circuits for the speakers. All valves were replaced by modern miniature types.

As regards the circuits themselves very little need really be said as can be seen from the diagram. Switching could be reasonably simplified by con-

Switch functions in the circuit, Fig. 1.

Switches are normally open and in some cases contacts earthed. They are closed for the following purposes.

<table>
<thead>
<tr>
<th>Switch</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Playback of tape.</td>
</tr>
<tr>
<td>S2</td>
<td>Balancing for playback.</td>
</tr>
<tr>
<td>S3</td>
<td>Recording.</td>
</tr>
<tr>
<td>S4</td>
<td>Playback of tape.</td>
</tr>
<tr>
<td>S5</td>
<td>Balancing for recording.</td>
</tr>
<tr>
<td>S6</td>
<td>Microphone for recording.</td>
</tr>
<tr>
<td>S7</td>
<td>Gram or radio for recording.</td>
</tr>
<tr>
<td>S8</td>
<td>Amplifying gram or radio.</td>
</tr>
<tr>
<td>S9</td>
<td>Playback of tape amplifying gram or radio.</td>
</tr>
<tr>
<td>S10</td>
<td>Switch located on rear of recorder for use of internal speaker.</td>
</tr>
<tr>
<td>S11</td>
<td>Balancing for recording and playback.</td>
</tr>
</tbody>
</table>
trolling each item separately but this, however, would complicate operation. The press button is therefore the answer. At this point, may I say that as such a press-button unit is not on the market, two surplus units were purchased and adapted for this use. The "off" button is entirely mechanical as it only trips the "hold bar" and releases any other button which has previously been pressed down. The stop button is separate from the rest as it only applies D.C. to the motors bringing the tape to a standstill before the "off" button is pressed. Much trouble was caused through feedback in this unit but it was finally overcome by careful positioning of contacts and earthing of circuits which were not being used. Buttons are clearly marked with transfers and are mounted in a perspex panel which shows a diffused light when the main switch is on. They are marked as follows:

OFF --- BALANCE PLAY --- BALANCE RECORD --- PLAY GRAM --- PLAY TAPE --- RECORD MIC. --- RECORD GRAM. --- FAST FORWARD --- FAST REVERSE --- STOP.

Amplification in the first stage of each amplifier differed considerably due to tolerances in component values, and as these are only used for play back, it became necessary to have two balancing positions. For "Balance record," therefore, the balancing signal is fed to the grids of parts "B" of the 2AX7 valve and for "Balance play," to the grids of parts "A." As an extra stage of amplification is employed in the latter position, a reduced balancing signal is tapped off from a preset potentiometer.

The power pack chassis is fitted underneath the tape deck and includes the oscillator circuit for recording and the audio oscillator for balancing. All connections between tape deck, amplifiers and power pack are by means of octal plugs and sockets. It will be noticed that two rectifiers have been used in parallel, but this is simply to save height. Resistance smoothing has been used for the amplifiers and choke for the oscillator.

Remaining Controls

The few remaining controls not already mentioned are on the back of the power pack chassis which are readily accessible from the back of the recorder. These consist of an on off switch for the internal speakers and a safety switch cutting the H.T. from the oscillator to avoid accidental erasure. A neon is employed to give indication when this safety switch is closed. Mains input socket, microphone sockets and various other inputs are also placed at the rear of the recorder. There is also a switch on the tape deck for "normal" or "stereophonic" reproduction. A dual meter has been fitted for signal level indication on both amplifiers during recording. As previously described, one is only used for setting the volume controls, but during actual recording it is useful to be able to see what is going on on both channels at the same time. The tape deck has been completely rebuilt. Whilst two record-playback heads are quite satisfactory for making recordings and playing them back on the same machine, it must be remembered that the pre-recorded tapes on the market are recorded with the two tracks in line, one immediately above the other, and, therefore, a special head must be used for playing them. This type of head is rather expensive and could be added at a later date. Having two heads it will follow that one track will be at least the diameter of the head behind the other. Personally, I found the purchase of a "stacked" head was money well spent.

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**Fig. 3. - Press-button unit with buttons in "off" positions. View from top of amplifier chassis.**

| A9 | H.T. audio oscillator. |
| A12 | Potentiometer audio oscillator. |
| B9 | H.T. audio oscillator. |
| H11 | Contact G2. |
| G14 | Switcher amplifier "B" |
| H14 | Earth. |
| J14 | H.T. peak signal indicator valves. |
| K14 | Neon. |
| L12 | D.C. braking supply. |
| L14 | H.T. record oscillator. |

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| M8 | Capstan motor resistance. |
| M10 | Take up motor resistance. |
| M14 | H.T. supply for record oscillator. |
| P9 | Take up motor resistance. |
| S9 | Rewind motor. |
| S12 | Take up motor. |
| T8 | Mains. |
| T9 | Common motor supply. |
| T10 | Earth. |
| T11 | Mains. |
as the pre-recorded tapes are exceptionally good and the first one I bought was a great help to me in my experiments. The complete recorder now measures 17\text{in.} \times 15\text{in.} \times 7\text{in.}

Two speakers built in separate cabinets fitting together for portability complete the equipment and for the sake of convenience, so that recordings can easily be played back for checking purposes, two small speakers are included one at either end of the recorder itself. It must be emphasised, however, that these internal speakers, although reproducing a slight stereophonic effect will not replace the use of the two conveniently spaced external speakers for normal playback. It will be seen that my aim has been for a versatile portable recorder even to the extent of the external speaker cabinets which, when assembled together, measure only 12\text{in.} \times 8\text{in.} \times 14\text{in}. They separate at an angle and contain 6\text{in.} speakers. The quality of reproduction is surprisingly good, but many readers will agree that a recorder of this type is worthy of even better speakers.

Microphones

Finally, a word about microphones. I found the ribbon type was the most satisfactory. The first obvious thought, no doubt, is to place them well apart, but in actual fact best results are obtained by placing them side by side or one above the other, set at an angle of 60 to 90 degrees. These microphones are not unidirectional, however, but this may be overcome by placing a felt baffle on the back of each.

Basically, I consider the recorder to be finished, but who can say I might not think of an odd modification here and there? It has been built to suit my own requirements but, no doubt, some readers will consider certain modifications to be advantageous.

In conclusion I would say to the amateur recording enthusiast that if your recording stretches further than the wireless and the gramophone then stereophonic recording will open up a new field of reality for you. I hope I have proved that perhaps the building of such a recorder is not as difficult as at first it might appear.

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**Diagram: Press-button unit with buttons in "off" positions. View from bottom of amplifier chassis.**
Making an OUTPUT INDICATOR

A USEFUL ACCESSORY FOR THE EXPERIMENTER

By J. Brown

ONE of the main essentials for a radio set to make it work 100 per cent, is alignment. Many times the condensers across I.F. transformer windings alter in value as do the modern iron cored slugs. I.F.'s, valve and component changes also affect this most important thing in radio. The instrument to be described was termed an output indicator for one reason—it indicates any change in the settings of the cores or capacitors of the I.F. transformer when being adjusted, and does not measure any particular voltage change. If it did it could rightly be called an "output meter." If accuracy is required, we can make R1-4 wirewound variable resistors, and the meter can be set using known A.C. voltages as standards, or even calibrating it against a multi-range meter. This little instrument will prove an asset to any "shack" or workshop. We will not, however, go into the signal source as this has been covered by many articles in the past. There are also many fine signal generators on the market already built and calibrated for £6 and even less. Multi-range meters can be used for alignment, but have one disadvantage, e.g., the minimum range of most is 5 volts A.C., except in the case of the more expensive types which are "more professional." The aforementioned types when used for alignment on the 5 volts range are inadequate, as the signal source and the audio side of the set under repair have to be turned up to nearly maximum so as to get a reading on the meter. This means that we have the A.V.C. circuit coming into action, and it is this which we are trying to avoid. In the case of the indicator, the lowest range is approximately 1 volt A.C., hence these gain controls are in a much lower position. We have four ranges to select from, and the

Fig. 1.—Theoretical circuit of the indicator.

Fig. 2.—Layout and wiring.

COMPONENTS

1—1 amp. R.F. meter (reference 10A/8481)
4—Crystal diodes (G.E.C. type).
1—4-way Yaxley switch.
1—S.P. switch.
1—1 μF paper condenser.
4—Resistors (carbon):
R1—Made up 1.5 KΩ plus 100 ohms in series.
R2—Made up 1-10 KΩ plus 1-90 K in parallel.
R3—Made up 15 KΩ plus 1.5 KΩ in series.
R4—Made up 50 KΩ plus 30 KΩ plus 2.5 KΩ in series.

Or four wirewound potentiometers:
Suitable case made from a beverage cube container.

2—Terminals
2—Crocodile clips.
2—Wire for leads.

2—2BA solder tags.
2—6BA solder tags.
2—6BA nuts and bolts.
The complete instrument could be built for approximately £30. or less.

The Circuit
This is a bridge type circuit using crystal diodes as the meter rectifiers. The meter used was a surplus $\frac{1}{2}$ amp. R.F. meter, with the thermocouple removed. This, then, gives a 2 mA. movement, and as we are not concerned with measurement the scale calibration does not matter. We have four ranges: 1. approximately 1 volt; 2. approximately 5 volts; 3. approximately 10 volts; 4. approximately 50 volts. These are selected by S1, a four-way single pole switch; S2 selects the input required. In position 1, the input is low impedance for speech coil, extension L.S. connections. In position 2, we have a high impedance input. This is via C1 which gives a path for the A.C. and isolates the D.C. and will pass 400 and 1,000 cycles which is the normal modulating frequency of the signal sources. In position 1 the indicator unit is connected to the speaker connections, either the speech coil or the extension L.S. sockets. In position

\[ \text{To Crystal diodes X1 and X4} \]

\[ \text{6BA bolt and solder tag} \]

\[ \text{Connection to C1 and S2} \]

\[ \text{6BA bolt and solder tag} \]

\[ \text{Connection to S1} \]

\[ \text{Diode} \]

\[ \text{X7} \]

\[ \text{Red ends of Diodes} \]

\[ \text{2BA tags} \]

\[ \text{Red ends of Diodes} \]

\[ \text{X3 Diode} \]

\[ \text{X4 Diode} \]

\[ \text{Fig. 3.—Details of the diode mount.} \]

Fig. 5.—The switch, wiring and the diode mount.

2 the connections are: one leads to chassis, the other connects to the anode of the output valve, the D.C. is isolated by the condenser C1.

Great care must be taken when soldering in the diodes, as the heat destroys them. A thermal shunt must be used, or leave the wire ends long and insulate the surplus with sleeving.

Operation
Connect for either high or low impedance whichever is required; set the signal source for the correct frequency; keep input as low as possible to give a reading, trim the cores or the trimmers of the I.F. transformers for maximum reading on the indicator. During the operation, however, as the meter reading increases the audio control of the set must be turned down, so that the A.V.C. does not come into action.

\[ \text{N} \]

\[ \text{Nut soldered to tin case thus} \]

\[ \text{Asterisks mark nuts soldered to case as above sketch} \]

\[ \text{1/2" dia holes for Range Switch} \]

\[ \text{3/8" dia hole for Range Switch} \]

\[ \text{1/8" dia hole for High-Low Switch} \]

\[ \text{1/4" dia. hole for grommet} \]

\[ \text{1/8” dia hole for High-Low Switch} \]

\[ \text{4-1/8” dia holes to suit meter. Cut with tank cutter} \]

\[ \text{Fig. 4.—Details of the panel.} \]

\[ \text{Fig. 6.—Details of the method of mounting.} \]
ADDING AN EXTRA L.F.
STAGE TO THE RECEIVER
DESCRIBED IN OUR
ISSUE DATED
NOVEMBER, 1956
By V. M. Meadows

In the November and December, 1956, issues of this magazine, we published details of this A.C. operated short-wave receiver, which was designed specifically for the beginner in radio construction. Since that time, many requests have been received from readers who have built the receiver, asking that details be published on the addition of a further L.F. stage in order to increase the gain as a whole.

The addition of a further L.F. stage to the receiver will not only result in greatly increased audio gain but will also increase the apparent range of the equipment. Signals which were previously only just audible will now become much stronger, and those formerly inaudible will now resolve themselves into intelligible signals.

Before proceeding with the circuit description and other details, however, it is as well to note that the bias resistor of V2 (R8 in the circuit of page 611, November, 1956, issue) should be of 270Ω and not 270 KΩ as inadvertently stated in the component list. The substitution of this much lower value resistor will itself greatly increase the audio gain of the receiver, as it stands, before proceeding with the additional L.F. stage.

Circuit

This is shown in Fig. 1, from which it will be seen that a Brimar 6AT6 double diode triode has been utilised as the additional L.F. stage. The circuit is simple enough, and the extra components required have been kept to a minimum consistent with reasonable efficiency. It will be noted that both of the diode connections are left blank, no connection.

<table>
<thead>
<tr>
<th>COMPONENT LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modifications to existing circuit</td>
</tr>
<tr>
<td>One 8 µF Electrolytic, 350 V, wkg., T.C.C. type CE17E.</td>
</tr>
<tr>
<td>One 220 KΩ 1/2 watt resistor.</td>
</tr>
<tr>
<td>6AT6 Stage</td>
</tr>
<tr>
<td>R10 - 47 KΩ 1/2 watt.</td>
</tr>
<tr>
<td>R11 - 220 KΩ 1/2 watt.</td>
</tr>
<tr>
<td>R12 - 3 KΩ 1/2 watt.</td>
</tr>
<tr>
<td>One 87G valve holder.</td>
</tr>
<tr>
<td>C11 - 25 µF, Electrolytic, 50 V, wkg., T.C.C. type CE16E.</td>
</tr>
<tr>
<td>C12 - 0.01 µF, Tubular, T.C.C. type 37N.</td>
</tr>
<tr>
<td>C13 - 0.1 µF, Tubular, T.C.C. type CP45N.</td>
</tr>
<tr>
<td>Valve - Brimar 6AT6.</td>
</tr>
</tbody>
</table>

Three-quarter rear view of the converted chassis.
to these being required. The valve functions very effectively as an L.F. triode—moreover, it is easily obtainable both on the new and the surplus market. The resistors R10 and R11 form the anode load with C12 acting as the coupling component to the output stage 6BW6. Bias for the stage is supplied by the components R12 and C11. C13 is the anode de-coupling capacitor. In this circuit, using the component values specified, the stage gain is approximately 42, this drive to the 6BW6 resulting in more than sufficient audio for the average den or shack. Consequently, more than enough gain is at hand over and above normal requirements—this being ideal; a little gain in reserve for that weak station being often all that is necessary in order to establish station identification.

Before proceeding with the wiring instructions for this stage, however, a few modifications will be required to that circuit of the receiver published in the November, 1956, issue of this magazine. Having drilled the necessary hole for the additional valveholder, the position for this being obvious from the illustration shown herewith, mount the valveholder with pins 1 and 7 nearest the rear wall of the chassis.

An underside view of the chassis after the conversion.

From pin 2 of the output 6BW6, unsolder the connection to the potentiometer R7. In place of this solder one end of a 220 KΩ half-watt resistor, and one end of C12 (the black end). Solder the other end of the 220 KΩ resistor to that earthed tag of the 6BW6. Connect the other end of C12 to pin 7 of the 6AT6. Having done this, solder that end of the lead from the potentiometer—previously removed from the output stage, and solder this to pin 1 of the 6AT6.

From the anode circuit of the detector stage (EF41) remove the condenser C3—an 0.01 µF component. In its place insert an 8 µF electrolytic condenser, T.C.C. type CE17LE, one end of this being soldered to the earthed connection of the potentiometer and the positive end to the junction of R2 and R3.

It may be noted here that the removed C3 may be used again as the C12 of the added circuit.

These are all the modifications necessary before proceeding with the wiring up of the added stage.

Wiring the 6AT6

We have already dealt with pin 1 of this valve above; the next thing to be completed is the heater wiring. From pin 4 connect, by means of a short length of P.V.C. covered wire, to pin 1 of V1 (EF41). This wire should be the L.T.—connection. Next, connect pin 3 of the 6AT6 to the central metal spigot of the valveholder, and from there to that earthed tag associated with V3. This should be done with a short length of bare wire.

To pin 2 of the 6AT6 solder one end of R12 and the positive end of C11. Solder the other end of R12 to the earthed tag of V3, and the other end of C11 to the earthed tag of the tag strip mounted on the rear chassis wall. Pins 5 and 6 of the 6AT6 are left blank and no attachments at all should be made to them. To pin 7 (to which is already soldered one end of C12), solder one end of R11, the other end of which is connected to a free tag of the tag strip on the rear chassis wall. Next, from this same tag, solder one end of R10, the other end of which should now be soldered to that tag of the tag strip containing the H.T.+ connection. From the junction of these two resistors, solder one end of C13, the negative end being soldered to pin 3 of the 6AT6.

This completes the actual wiring instructions for the addition of the extra audio stage. It will be found that layout is not at all critical and components do not necessarily have to be located as shown in the illustrations. Those readers who have not fitted the tag strip on the rear chassis wall will find no difficulty in wiring the stage provided they follow the circuit, as shown in Fig. 1.

![Fig. 1.—The circuit of the extra stage.](image-url)
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A MIDGET 4-VALVE PORTABLE

A BATTERY-OPERATED SELF-CONTAINED MIDGET

By T. Walker

**Construction**

The chassis is made out of sheet brass, and although the prototype set is made up of pieces soldered together, it is possible to make the chassis in one piece.

After cutting, bending and drilling the chassis, an insulated tag is riveted on to form the positive contact for the I.T. cell.

The valve holders are soldered to the chassis after cutting off the bolt tags.

The tags on the switch are cut off short, and short pieces of wire are soldered on to the tags that will be used. This must be done before fitting the switch, as it will not be possible to do this later, due to I.F. T.I being mounted so near to this switch.

The loudspeaker is bolted to the chassis with a piece of brass gauze in between to form the grille, and the speaker tags face away from the switch.

The output transformer is bolted on, and also the tag strip soldered on to the chassis by V4 holder.

---

**Fig. 2.** Layout of the receiver and identification of components. The circuit is on page 382.
Fig. 1.—Theoretical circuit of the Portable Four.

COMPONENT LIST

- R1 — 47 K.
- R2 — 10 K.
- R3 — 10 K.
- R4 — 2.2 M.
- R5 — 680 K.
- R6 — 47 K.
- R7 — 3.3 M.
- R8 — 3.3 M.
- R9 — 1 M.
- R10 — 1 M.
- R11 — 470 ohms.

All midget ½ watt components are not shown.

- C1 — 100 pF (Radio Spares).
- C2 — 100 pF (Radio Spares).
- C3 — 175 pF (Radio Spares).
- C4 — 0.1 µF (Hunts).
- C5 — 0.1 µF (Hunts).
- C6 — 0.1 µF (Hunts).
- C7 — 50 pF (Radio Spares).
- C8 — 50 pF (Radio Spares).
- C9 — 0.01 µF (Hunts).
- C10 — 0.01 µF (Hunts).
- C11 — 0.005 µF (Hunts).
- C12 — 0.01 µF (Hunts).
- C13 — 2 µF (Electrolytic TCC Picopack).
- C14 — 2 µF (Electrolytic TCC Picopack).
- C15 — 300 pF (Radio Spares).

H.T. Battery—the H.T. section removed from B114.

- L1 — Long wave frame aerial, two layers of 36 turns 38 S.W.G. enamelled wire.
- L2 — Medium wave frame aerial, one layer of 30 turns 32 S.W.G. silk wire.
- Loudspeaker—2½ in. M.C. P.M. Celestion.

TC1 — 100 pF trimmer.
TC2 — Weyrad P6 2.
TC3 — Weyrad Ho3.
T1 — Personal portable output transformer.

- S1 — 4 pole 3 way switch (ignore one pole).
- S2 — 4 pole 3 way switch (ignore one pole).

Valves—DK96, DF96, DAF96, DL96 (Mullard).

4 valveholders—B7G moulded bakelite.

L.T. is 1.5 v. Baby Cell. It is the next size above No. 8 cell.
Wiring

The wiring of the set is now carried out, except for the oscillator coil and trimmers, using 22 s.w.g. tinned copper wire, and 1 mm sleeving.

The connection from I.F.T.s to the grid of the DF96 is in very thin screened cable.

The oscillator coil as purchased is too long, so the brass mounting nut is removed from inside the coil and 3/16" cut off the coil former and the nut replaced. The coil wires soldered to the tags are removed, the tags cut short, and the wire resoldered. Make a note of the colours before doing this as most of the colour will be removed. The coil is then mounted and wired in circuit.

Before mounting the trimmers, the adjusting screws are fully tightened down and the surplus thread cut off. The tags are allowed as sketch, and are mounted by forcing the earth tag of each between the two I.F.T.s. The other tag is also cut and soldered direct to the switch contacts.

The DK96 valve is screened by bending a thin piece of tin round the valve and soldering the joint: it is insulated by self-adhesive plastic tape (as used by cyclists to put round the handlebars) to prevent the screen from touching the contacts of the I.F.T.s. The screen is then soldered to the valveholder and the valve fitted at the same time.

All earths are soldered direct to the chassis.

Batteries

The H.T. battery, which is soldered in, is the H.T. section removed from the Ever Ready H.T. and L.T. battery number B114. This, too, is taped up.

Death of a Radio Scientist

The recent announcement of the death of Mr. K. W. Tremellen at his home in London records the passing of a pioneer radio scientist whose researches were of immense benefit to this country and, indeed, to the world in general. Mr. Tremellen, who was 68 years of age, had retired from the service of Marconi's Wireless Telegraph Co. Ltd. at the end of 1952.

In his early career he became closely associated with Marconi in many of his early experiments in wireless telephony both in this country and with the Italian Navy between 1912 and 1914.

In 1915, as a Captain in R.F. Signals Branch, Mr. Tremellen was in charge of the establishment and operation of a chain of D.F. stations in France. After the war, in association with Captain H. J. Reardon and Mr. T. L. Dickson, he engaged in the study of long wave propagation and made a world cruise lasting twelve months for the purpose of assessing the possibilities of engineering a projected chain of long wave stations to link the countries of the Empire by wireless.

The L.T. is one cell from Baby torch, number 1839, and although small will be found to have an amazingly long life.

The Case

The case is the next job and is made from very thin three-ply wood, obtainable from the model shops, and is held together by glue and the resin covering. Before covering the case the frame aerials will have to be wound.

The Frame Aerial

One layer of 30 turns of 32 s.w.g. silk-covered wire is used and the ends passed through holes in the wood by the DK96 valveholder. This forms the medium wave section. For long waves, two layers of 38 s.w.g. enamel wire are wound one on top of the other with a layer of Selotape in between and the wires also passed through holes in the case. One end of each frame aerial is earthed to chassis. The resin is not put on the case until the set has been completed as turns may need to be added or removed from the frame aerial.

Testing

Once the wiring of the set has been completed and checked the valves are inserted and the batteries connected, and on switching on some noise should be heard and the oscillator coil adjusted to receive the local Home Service and then adjust TC1. The I.F.T.s can then be aligned on the signal.

The Light programme is next set by adjusting TC3 and TC2. It must be pointed out that any adjustment on the oscillator coil for medium waves will make it necessary for the trimmer TC3 to need adjustment for long waves.

The values of C1, C3 and C4 may need altering to suit different sets and Home programmes. The case can finally be covered with resin or similar material.

Birmingham Jamboree

A MATEUR radio enthusiasts all over the world will be hearing unusual messages coming over the air during August this year.

That is the month when 37,000 scouts from 86 different countries, including Russia and Hungary, meet at Sutton Park, near Birmingham, for the World Scout Jamboree. The Jamboree celebrates both the Golden Jubilee of the movement, and also the birthday centenary of its founder, Baden-Powell.

The unusual messages that will be heard will come from a special amateur radio station which the Sidec Radio Society, of Erdington, Birmingham, are setting up at the Jamboree. During the Jamboree the radio station will transmit goodwill messages to owners of shortwave sets throughout the globe.

One of the men who will be operating the station is Mr. Arthur Goble, of 150, Trinity Road, Aston, Birmingham, who works for British Oxygen Gases Ltd. Says Mr. Goble: "We hope to man the station day and night and we want to contact as many people as possible over the air to tell them about the Jamboree."
The BBC Staff

In the May issue I criticised the tendency of the BBC to alter the standard pronunciation of words and place names. I said that the Director General should really put some period to those snobbish Chelsea types who wish to give Kensington drawing-room type of pronunciation to words and place names, and I went on to criticise the sartorial accoutrements of some of the staff. My remarks were, of course, written in a humorous vein. The Secretary of the Association of Broadcasting Staff in a letter says that his attention has been called to my remarks, which are resented by the members of his union. He tells me that the general impression amongst his "engineering members" is that this journal is waging some kind of a campaign of denigration which they resent. I am sorry that he takes this view, for not one member of the BBC staff has told me on the matter, and I should be glad to have from the Secretary the names and addresses of these objecting members. Does Mr. Littlewood really think that his union controls not only its members, but Press criticism? I have been associated with the BBC for rather more years than some of his members are old, and certainly for very many years longer than this comparatively small and new union. I have the highest respect for the BBC technicians. I was not referring to the technical side at all, but to the programme side—producers, announcers and to some extent those who broadcast. I seem to be far better informed about this matter than Mr. Littlewood. It may come as a surprise to him to know that many of the BBC technical personnel regularly contribute to this journal, and those who read my paragraph chuckled when they read it, but agreed with the general tenor of my comments. This journal is not waging a campaign of denigration against the technicians. It is, however, waging a campaign against the usurpation by the BBC of the right to set all dictionary pronunciations aside and adopt their own. As an Englishman I resent English pronunciations being changed capriciously. Mr. Littlewood also seems singularly unaware of criticisms similar to mine which have been going on for years. In the Observer, the other Sunday, there were quoted some comments of Sir Ernest Gowers in his presidential address to the English Association: "Today the word incidentally has become a vague word seemingly indispensable to BBC announcers. Fowler (author of Modern English Usage) had no patience with those who rejected the anglicised pronunciation of foreign words or place names and insisted on speaking them with the accent of a native of their country or origin. If he were alive today he would, no doubt, be disappointed that the BBC announcers evidently hold the opposite opinion."...Fowler had fought affected or gentle pronunciations. The conviction seems now to be that when one is before a microphone the dignity of one's position demands, for example, the articulation of the 't' in often... People are influenced by what they hear over the air. It would not be surprising if by the end of the century English and American pronunciation had become indistinguishable. The Americans have always found difficulty with their vowel sounds and have never really learned to speak English.

Any criticism of BBC programmes is always met with the rejoinder that the BBC is really understaffed to provide a national service for seven days a week. Then why try? We are also told that there is one broadcasting employee to every 5,000 population. This proves precisely nothing, except to indicate that the BBC is overstuffed. By the same argument, at a particular moment, there is only one announcer to 50 million people in this country. These sort of figures mean nothing.

Music and Movement

As a particular case in point, can anyone see what good purpose is served by that thoroughly inane service to the schools in the morning "Music and Movement." It occupies class time which would be better used to teaching the children how to read and write, in view of the great amount of illiteracy in this country. Some thousands of teenagers cannot read or write today. Of course, if a census were taken at the schools the children will be all in favour of the programme, and I am certain that the teachers who tap this programme will also be in favour of it. They have nothing to do whilst the programme is on, and the children will naturally prefer it to some dry history lesson. The programme itself is imbecile in its conception and certainly stupid in the way it is carried out. "Now, children! Spread yourselves all over the room. We are now going to hear some hopping music," etc., etc. What on earth is it intended to teach them? It will not teach them to dance. They will learn that soon enough from their local skiffle rock 'n' roll club. I seriously suggest to the BBC that they drop this nonsensical programme, which merely wastes school time. It is quite laughable to listen to. One wonders what sort of a person it is in the programme planning department who could be persuaded to put on such utter tripe.

**On Your Wavelength**

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By F. G. Rayer

(Concluded from page 308 July issue)

The second wafer of the switch goes to the rear gang of tuning condenser, the top tag of which goes to R.F. valve grid. It is also connected to the fixed plates of the aerial trimmer.

Wafer 3 switches the R.F. valve anode to any of the five H.F. coil primaries. Wafer 4 switches the secondaries of these coils, and is also connected to mixer trimmer (Fig. 5) and the centre section of the tuning condenser. The top tag of the latter is taken to the 6L7 top can.

The two remaining wafers switch the oscillator coils, wafer 7 being connected to the front section of the gang condenser. To wire in the M.W. coils it is only necessary to set the switch to its second position and connect the various coils to the appropriate tags throughout the switch sections. Fig. 5 shows the positions of the coils, these being arranged to avoid interaction and secure short wiring in the H.F. ranges. If the coils in each circuit position are located as far as possible with tags similarly placed, then the wiring of other ranges will be merely repetitive of that in the M.W. range. To secure additional screening on the L.W. and M.W. bands, the aerial coils of these are above the chassis.

The smaller oscillator coils have two separate windings in the type listed, but those for M.W. and L.W. have a single tapped winding, so that there are only three connections. Where two windings are provided the fourth tag is earthed. With the tapped coils this is not necessary since the tapping forms a common earthing point (via padders) for both sections. It will have been realised that the bands can easily be chosen to suit individual needs, and the Astral coils actually employed were those numbered 1, 2, 3, 5 and 6 in the following list:

<table>
<thead>
<tr>
<th>Coil band</th>
<th>Approx. waveband</th>
<th>Required padders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in metres</td>
<td>capacity</td>
</tr>
<tr>
<td>1</td>
<td>750-2,000</td>
<td>150 pF</td>
</tr>
<tr>
<td>2</td>
<td>190-570</td>
<td>500 pF</td>
</tr>
<tr>
<td>3</td>
<td>16-48</td>
<td>5,000 pF (0.005 mF)</td>
</tr>
<tr>
<td>4</td>
<td>12-36</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>34-100</td>
<td>2,400 pF</td>
</tr>
<tr>
<td>6</td>
<td>90-270</td>
<td>900 pF</td>
</tr>
<tr>
<td>7</td>
<td>250-750</td>
<td>350 pF</td>
</tr>
</tbody>
</table>

In some cases the L.W. band may not be required, though it does increase the general utility of the receiver. The coils used (1, 2, 3, 5 and 6) give continuous tuning from 16 to 2,000 metres, except for the band between 570 and 750 metres, and are probably as suitable as any. Coil 7 would cover this band, if wanted. The No. 4 coil would also cover up to the lower limit of the No. 5 coil, but the L/C ratio grows rather poor, so that the 16-48 metre coil is preferable.

As already mentioned, comparable coil types of other make can be used. In all cases it is essential to follow the maker's tag connecting data and recommendations upon padders values. In a few instances the latter may need to be obtained by wiring two condensers in parallel, e.g. 2,000 pF and 400 pF for 2,400 pF.

Operational Notes

It will be realised that a little care in operation is required if the maximum efficiency is to be obtained, when selectivity and sensitivity will very considerably exceed that of the average domestic superhet. This does not mean that tuning is difficult, since on a great number of stations there will be no need to touch trimmers or the R.F. and I.F. gain controls.

With the transformer set to suit the mains voltage, and valves in position, it is best to place the I.F. switch in the "Low" setting at first, to ensure some signal will be obtained, even under conditions of bad mis-alignment. It should then be possible to tune in the local station. The first and final I.F. transformers are now adjusted, with an insulated tool, to secure maximum indication on the tuning meter (minimum anode current). A metal tool must not be used, as its presence especially in coils, influences resonance. If there is any tendency for any core or trimmer to come near the limit of its travel in either direction, then the other cores or trimmers are all adjusted a little and alignment repeated.

The switch is then turned to the "High" position and the other two transformers similarly adjusted for maximum signal on the meter. Their setting will be very critical. Due to the change in stray capacity in the switch positions, all transformers are then gone over again. When adjustment of any only serves to reduce signal strength, I.F. alignment is complete. When the switch is in the "Low" position one transformer circuit is slightly off peak, due to the extra capacity of the second I.F. valve, but this is no disadvantage.

In some coastal areas it may be desirable to peak the I.F.'s at some frequency other than 465 kc, to avoid local Morse, and a variation of 5 kc is quite feasible.

When the I.F.'s are aligned, the aerial, mixer and oscillator circuits can be dealt with. This will prove relatively easy if the coils are correctly wired, with
the correct padder values, and each band is treated separately.

The 30 pF oscillator pre-set is left at about mid-way position and should not need further adjustment. A station of low wavelength on the band is tuned in, and the two panel trimmers are turned for maximum signal on the meter. They should come to rest at roughly mid-way position, if undue stray capacity between coil connections, etc., and chassis has been avoided. Should one or both trimmers tend to peak near the fully open position, then the 30 pF pre-set can be screwed down a little. With the panel trimmers untouched, a high wavelength station is tuned in and the coil cores adjusted for maximum signal. The procedure is then repeated—e.g., trim at low wavelength, then adjust cores at a high wavelength. Alignment of the band will then be complete and tuning throughout can be with the main control. However, with weak stations it will be found that adjustment of the panel trimmers will often improve signal strength considerably, since even with good quality components exact alignment throughout the swing of the condenser is not achieved.

If the aerial is other than a very short wire, a 25 pF fixed condenser should be included at the aerial socket so that the R.F. stage may tune sharply.

All other wavebands are then aligned in exactly the same way, the i.F. circuits not being touched again, however. On the S.W. bands, wrong core positioning may result in no signals being heard at first. If so, careful tuning should locate some station near the lower end of the band. The coil cores can then be adjusted, when tuning further up the band will be possible, with final alignment at a high wavelength. If it becomes increasingly necessary to close the panel trimmers as the receiver is tuned to higher wavelengths, this shows that the aerial and mixer coil cores need screwing in. The reverse effect shows they need withdrawing.

Should instability arise as either gain control is turned towards maximum, this shows that the circuit in question has long grid or anode leads, or that the valves are insufficiently screened. This test should be made with no signal, since any signal reduces gain, so that the set may only be unstable when tuned away from a station. Inaudible oscillation will be shown by a sudden drop in meter reading.

With the coils mentioned oscillation became a little fierce at the bottom of the S.W. bands. If this arises it can be cured by wiring a resistor in series with the oscillator winding of the coil or coils responsible. The resistor should be of quite low value (usually 30 to 100 ohms) as large values will prevent oscillation completely, so that reception ceases.

Aerials

A final word on the question of aerials. Do not imagine that the larger the aerial the better the results. Many users of communication equipment find that best results are obtained by a short vertical wire. A heavy gauge or two lengths of 7/22 twisted may be supported from a length of wood sticking out from the side of the house, and the wire stretched from the top to bottom.

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A Simple Test Probe

INSTRUCTIONS FOR MAKING A TEST PROBE FOR USE WITH MOST AMPLIFIERS TO FORM A VERY USEFUL AND INEXPENSIVE SIGNAL TRACER

By M. W. Kirby

OFTEN in the course of radio and television servicing and construction it becomes desirable to test each stage in turn for signal continuity and also to get a rough idea of the quality and gain that each stage is giving. It is also useful, particularly in service work, to be able to test for hum pick-up and the efficiency of the smoothing circuits. The most convenient way of testing for the above is by signal tracer, but not every experimenter has one of these, nor does he have enough work to justify the cost of obtaining one.

The test probe described herein makes no pretense of being new or comprehensive, but it does have the advantage of extreme simplicity and fulfills quite efficiently the functions described above, although it can be built in a few minutes out of materials from the spares box. Any high impedance amplifier may be used, or even the amplifier of the set under test, if the audio stages are not at fault. If desired a simple amplifier can be built for use with the probe and Fig. 2 shows a circuit which has given good results on test.

The circuit of the probe is shown in Fig. 1, an EA50 diode being used in preference to a germanium diode on account of its robustness. A length of 16 s.w.g. wire about 2in. long is soldered to the anode pin of the diode and a piece of sleeving pushed over this so that it leaves about 1in. of wire showing at the end. (Remember to use long-nosed pliers when soldering the diode pins, or the heat will damage the glass: this is shown in the illustration.) Then two 3ft. lengths of wire are connected on to the heater pins, the .01-F condensers soldered in place, and a short piece of sleeving pushed up to cover the pins. Next cut a piece of co-axial cable or screened lead about 3ft. long, push back the outer braid and strip 1in. of the inner lead and solder this to the cathode pin. The outer braid is the earth terminal for the two condensers, and also a 1ft. length of wire stripped for 1in., which will be the earthing strap to the case and form the earthing fly-lead for the probe. The case can conveniently be made out of a through-chassis electrolytic condenser sawn off at the base, the contents cleaned out and a hole drilled in the end to take the probe and sleeving.

The open end should then be filled smooth and two cuts made 1in. long and 1in. apart down the tube. The centre piece is lifted up to form a tag to which the earth wire may be connected. Now slide the assembly into the can and connect the earth wire to the tag. Fill with pitch or Chatterton's compound and mould the end so that it forms a support for the wires. The base of the can may then be bound with tape to make a neat job. How the other ends of the wires are connected will depend upon the apparatus with which it is to be used, but if this will vary it will be a good idea to fit crocodile clips on all leads.

To test the probe, connect the heater leads A and B to a 6.3 volt supply and earth lead C to the earth of the amplifier and lead D to the input. Switch on the amplifier, and increase volume until there is a
Slight hum present. When the probe tip is touched with the finger a loud A.C. hum should be heard. Then connect the fly lead F to the chassis of a radio set and, without switching on, place the probe on the aerial tuning condenser, when the stations should be heard as the condenser is rotated. Next switch on, and trace the signal from the grid to the anode of each valve in turn and notice that as the output stage is approached it will become necessary to reduce the volume control of the amplifier. So much has already been written on the use of a signal tracer that there is no point in elaborating further, as instructions can be found in most books on radio and television servicing. A word of warning: if the amplifier is not isolated from the mains and an A.C./D.C. set is being tested, make sure that the mains are connected in correct polarity or a short will result.

New Versatile Tape Recorder

The new Selectophon T-5 recording machine is believed to be the most versatile machine of its kind on the market. It can be used in the home or in the office. This is because the length of the tape it uses can be varied to suit the application—whether it be for recording long-playing records or for office dictation. Its application includes, apart from these, recording conferences; “music-while-you-work” in factories and canteens; background music in shops, hotels and at exhibitions, etc.

It will reproduce through a microphone or from a radio. An attachment enables it to play and record gramophone records. Radio or disc recording can be done silently or otherwise.

The tape is housed in a book-shaped case, which can be stored in a library like a real book. This is known as a Tone-Book.

There are four Tone-Books, each housing different lengths of tape. As the machine has three speeds, the amount of recording depends on the book used and the speed. The books are known as Dictation, A, B and C. The dictation book (for office use) will record for 30 minutes at fast speed. Book C, on the other hand, will record for six hours at the same speed—making it ideal for recording long orchestral works and conferences. Fitted to each book is a register card, enabling a check to be kept of everything recorded.

The tape, 35mm. wide, has 70 tracks, each 0.3mm. wide. They are connected to form one uninterrupted sound track. When recording or play-back reaches the end of a track, it automatically carries on to the next, without any audible brake. A track-selector, controlled by a knob, enables any track to be chosen within a few seconds.
The modified unit.

**Conversion Cost.** This is kept as low as possible by the following: winding coils and I.F. transformers, using low-priced valves which can be bought as type CV138 for as low as 5s. each, and by using the lowest possible number of components.

**Circuit Description (see Figs. 2a & 2b)**

The signal from the aerial is stepped up by the R.F. transformer I1, L2 and applied to the grid of V1 which is operating as a wide band R.F. amplifier. The signal from the anode of this valve is then passed on via C7 to the grid of V2 and its tuned circuit L3, VC2. V3 acts as an inverted Hartley coaxial oscillator of high stability, the output of which is fed through the capacitor C10 to the grid of V2. Additive mixing takes place within V2 and the resultant I.F. of 10.7 Mc/s appears at the anode. This signal is then transferred via coaxial cable to the primary of the first I.F. transformer. From the secondary of I.F.1 the signal...
is applied to the grid of the first I.F. amplifier V4. Here the signal is amplified in the usual way and the amplified signal is then fed via T2 to the grid of V5. V5 is operated as a saturated R.F. amplifier. The purpose of this stage is to limit, not the F.M. signal, but electrical interference which is in most cases amplitude modulated (it also to a certain extent limits the voltage which appears across D1 and D2, as too high a voltage here will ruin the germanium diodes). The signal from the anode of V5 is now applied to the ratio detector, a description of which follows.

The Ratio Detector (Figs. 2b & 2c)
The ratio detector is essentially a phase discriminator, the coupling coil Lc taking place of the usual capacitor. When the F.M. carrier is at rest frequency, i.e. unmodulated, the following conditions exist: the voltage across the ends of the primary of T3 is 180 deg. out of phase. The voltage across the ends of the secondary is also 180 deg. out of phase, and the voltage injected by the centre tap is 90 deg. out of phase with reference to the ends of the primary: a state of balance therefore exists in the ratio detector. When the F.M. carrier is deviated, i.e. modulated, in one direction, the balance of phase across T3 secondary, with reference to the centre tap which remains at 90 deg., is upset. Vector addition of the voltage across T3 secondary will now show that the voltage across one half is greater than that of the voltage appearing across the other half; therefore on one half cycle a current will flow through one half of T3 secondary, through Lc, R20, C37, the A.F. load, earth and back via D2. On the next half cycle the current will flow from the other half of the secondary, via D1, R21 and C39 in parallel, earth, the A.F. load, C37 and R20, then through Lc and so back to the secondary; the current flowing round this part of the circuit is at audio frequency due to the rectifying action of D1 and D2, C38 being the R.F. by-pass capacitor.

There is also a direct current flowing round the ratio detector circuit, through D2, T3 secondary, D1 and R21. The current flowing through R21 causes a voltage drop R21 which charges up C39 to the D.C. level of the signal. The time constant of R21 and C39 is such that it will allow slow carrier height variations but will absorb rapid carrier height variations, which are usually due to electrical interference or amplitude modulation. C36 and R20 form the deemphasis network and C37 is the isolation capacitor.

Modifications to the R.F.27 Unit
Fig. 1 shows the components which are omitted from the modified circuit. First remove the valves, then referring to Fig. 1, disconnect L1 from the aerial socket and unwind it from about L2, unsolder the leads to L2, L3 L4 and L5 and remove these coils from the unit. Now unsolder and remove all the ceramic trimmers with the exception of T6 in the oscillator section. Also remove the parallel resistors, R1, R8 and R10; the aerial trimmer capacitor VC4 is also removed. The dial is now removed, the moving part of which is released by a grub screw located at the bottom right hand side and a grub screw which is accessible when the bulb holder is removed. When the rotor is removed the four bolts holding the stator are exposed, remove this after first unsoldering the wire to the dial bulb. To remove the tuning gang, VC1, VC2 and VC3, unsolder the earth wires from the chassis end and take out the four bolts holding the gang; it may be found that packing pieces are used under some of these capacitors. These are used to keep the spindle in alignment and must be replaced in exactly the same positions when remounting the tuning capacitors. The screened cable and C11, which are connected between

COMPONENTS
C25, 30, 31, 34—10 pf 2 per cent. silvered mica L.E.M.
C26, 27, 28—2,200 pf miniature ceramic. T.C.K.
C29, 33—0.01 pf 200 v. D.C. T.C.C. CP112
C32, 35—47 pf 2 per cent. silvered mica L.E.M.
C36—500 pf mica. Dubilier (C20 from R.F. unit)
C37—0.02 pf 500 v. D.C. T.C.C. CP34 S.
C38—330 pf ceramic. T.C.C. Hi-K.
C1—4 pf 275 v. B.E.C. CE550 (with horizontal mounting clips).
R16—1 K ! w. Dubilier.
R17—150 ! w. Dubilier.
R18—47 K ! w. Dubilier.
pin 7 on the Jones plug and pin 2 of V2, are removed and also the resistor and capacitor from the cathode circuit of V3, R15 and C20. R14 and C16 are now removed and the junction of R13 and C2 are taken directly to pin 4 on V3 as shown in Fig. 2a.

From the components removed only the following are re-used: the valves, the coilformers without cores, the tuning assembly and C20. The inductance of the coils is too high for the F.M. band, so they are stripped and rewound as shown in the coil table. The capacitors VC1, VC2 and VC3 are all reduced to approximately 27 pF by removing all but three rotor vanes on each; the rotor vanes are held to the spindle by a clamp construction method and can be easily removed by prising out with a pair of long-nosed pliers. Care should be taken not to damage the remaining plates and on completion of this operation each capacitor should be checked for short circuits. These components should now be placed in a safe place whilst the redrilling of the chassis takes place.

Drilling Details
The drilling details are given in Fig. 3, to enable the unit to be laid flat it is necessary first to remove the front panel: this is held on by two bolts at the left-hand side and the two handles securing the bolts at the other side: also by two bolts holding the tag panel, containing C18 and R12, and the coaxial aerial socket. It will be noticed that no tag strip drilling details are given in Fig. 3. This is because of the various types of tag strips which are available. The height of the tag strips must not, however, exceed half-an-inch, otherwise they will not fit in the space available.

The approximate positions of these are shown in Fig. 6.

Details of a new front panel are given in Fig. 4, and when completed this can be used as a template for drilling the front of the unit. Only the following holes should need drilling: Two front panel fixing holes; a hole for the output jack, two holes for fixing the coaxial socket; and fixing holes for the dial. If the original dial is used then turn it through 90 deg. and redrill holes for it. When the dial is remounted it will project about 1in. above the new front panel, which, in the author's opinion, does not mar the appearance of the unit. The author used a different dial here, the original one being used on a piece of test equipment. Holes for mounting the tag panel (containing C18 and R12) if required, can easily be marked on to the front panel from the rear side and should be countersunk.

Wiring and Mounting Components
The I.F. transformers are now constructed as shown in the table. Readers may find it easier if first the coils are wound and fixed with Durafix. Then take 13 pieces of bare connecting wire about 7in. long and put a small blob of solder on the end of each, then pass these wires down through the holes in the top and base supports of the coil and pull each wire tight whilst soldering to the base, the ends of the coils are then wrapped around and soldered to the appropriate supports, and the capacitors mounted as shown, care being taken to ensure that no short circuits will appear between the coils and cans.

The I.F. transformers are now mounted together with the valveholders and C39. The tuning gang VC1, VC2 and VC3, and the inductors L2 and L3 are then replaced and soldered into the unit, as shown in Fig. 2a, keeping connecting wires as short as possible; the remainder of the unit, including metalwork and tag strips, is now bolted on.

- C. R21—22 KΩ w. Dubilier.
- H. D1, D2—G.E.X. 44, G.E.X. 34, etc.
- I. J1—Jack socket.
- M. 1j. 2 B7G Valveholders with cans.
- N. C. 3 Aladdin coil formers with cans and cores. 2½in. high x 1½in. sq. (R.C.S.)
- O. Miscellaneous
- b. 3-way flat mounting tag strips.
- c. Grommets, nuts, bolts, tags, etc.

Fig. 2(b).—The additional unit to make up the feeder.
The coaxial cable in the oscillator stage, 1.4. Fig. 2a, is made up as follows: Take 7in. or 75 Ω ¼ in. diameter coaxial cable and cut into two lengths of 3in. and 4in., cut off ½ in. of outer sheath on each end and splay out the braiding; then lay the braiding back along the cable sheath, bind with connecting wire long earth leads, sharp bends in the cable, and too much heat as polythene melts very easily.

The next operation worthy of mention is the coaxial cable between V2 anode and H.T., and the primary of T1. The author used thin 50Ω TV cable, and lightly solder. After completing each soldering operation lay the coax to one side to allow the polythene to reset. When wiring into the unit avoid but almost any type of coaxial cable will be found suitable here.

(To be continued)

Fig. 2a. How the detector works.
ALL-WAVE RADIOGRAM CHASSIS

3 WAYS 3 SLOTS

3 1F V. 30 m "- 30 m

LATENT MERCURY

B.Y.A.

M.W. 500 m - 500 m

R.F.

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A TELESCOPIC aerial is mounted on the top of the offside wing just forward of the windscreen pillar and the coaxial cable is fed through the bulkhead to the R.H. end of the shelf, behind the instrument cluster, and so to the back of the set. The corresponding socket on the back of the chassis is turned through 90 deg. on a small block, to avoid an unnecessary and severe kink in the coaxial cable. If, for any reason, the aerial is mounted on the nearside of the car, it will be necessary to move this block slightly in a nearside direction and point the socket accordingly.

Power Supply

The use of a vibrator or a rotary converter can best be determined by the constructor. As there is very little space below the bonnet of a Consul, particularly when a heater has been fitted, the writer decided to install an ex-W.D. vibrator unit of Pye make in the boot, in the otherwise unused space to the offside of the spare wheel. This is fastened by bolts passing through the floor of the boot.

Heavy screened cables were used for L.T. feed and H.T. return and these were pulled through the appropriate channel in the roof, using a length of expanding curtain wire as a "fish." At the forward end they appeared on the shelf, close to the offside windscreen pillar, and were passed over the steering column, behind the instrument cluster, to the centre of the shelf, at which point the seven-pin plug was attached.

The L.T. feed from the voltage regulator terminal block and the earth connection are taken to the same point through an existing hole in the bulkhead to the right of the voltage regulator.

Installation

The installation of the set is extremely simple if the following sequence is observed. Remove the single Philips-head setscrew and nut securing the front edge of the shelf at the nearside end. This corner of the shelf should now be pressed downwards and a distance piece such as a screwdriver handle inserted to keep it down to increase the gap through which the set must be inserted. There is neither danger nor
The prototype is fastened down by two unobtrusive external angle pieces on the sides at the front with small bolts passing downwards through the shelf thickness. These must be located clear of the heater and handbrake controls. In addition it is held down by a piece of eraser rubber wedged between the top.

(Continued on page 401)

Fig. 7.—Details of the metal containing cabinet.

Fig. 4.—Details of the plywood panel, 3 in. thick, viewed from rear. Shaped area to be cut away to depth of 1 ply.
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of the casing and the underside of the windscreen wiper housing. The location of this is readily visible once the central ashtray has been removed.

**Suppression of Interference**

Very little suppression has been found necessary. Most interference will come from the sparking plug leads, and this will be in the form of a "plop" at every firing stroke. The simplest cure is to fit a suppressor of the TV type to the centre connection (i.e., the coil lead) of the distributor head. Incidentally, if the car is a late model, this type of suppressor will already have been fitted by the makers. If ignition interference should still be troublesome, separate suppressors should be fitted to the individual plug leads, as close as possible to the plugs themselves. "Cut-lead" types can be used here, but a more satisfactory job will be obtained by installing shrouded models.

The second principal source of trouble is the dynamo which emits a whine rising in pitch as engine revs. are increased. This can be eliminated by fitting a 1 μF 150-volt condenser across the "D" terminal and earth, preferably directly on the dynamo itself. A suitable type—much more robust than the normal radio by-pass condenser—is marketed by Radiospares.

The voltage regulator will normally already have been suppressed by the makers, as will also the

---

**Fig. 7(a).—An extension of the case in Fig. 7.**

**Fig. 6.**—Sub-chassis wiring. "A", second stage, indicates earthing points.
blower motor, if a heater has been fitted. A number of minor sources of interference remain, but as their effect is only of a transient or temporary nature, suppression has been ignored. The starter motor

will produce a healthy crackle when in use and "blinking" indicators will produce a rhythmical clicking. The stop-light switch will be responsible for a click when the brake pedal is depressed, and braking may result in a slight hiss, presumably from the generation of static electricity, but this seems to be a freak effect and may be dependent on weather conditions.

General

All trimmer screwheads were liberally coated with beeswax after final adjustments had been made, and after continuous service over nearly a year no troubles have been experienced from vibration. Very little suppression has been found necessary, suppressors having been fitted only to the sparking plugs and the generator.

Fig. 5.—Sub-chassis wiring, first stage. "X" indicates earth points.
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THE "ultimate" in aerial systems for the average amateur, and indeed the keen S.W.L., is some form of directive beam array. At any rate, where space does not permit of unlimited long wires and rhombic arrays, but where space is available for some form of beam, the "dream" of the ham is a beam aerial. While on the subject of "long wire" aerials, however, it should not be forgotten that the "long wire" array is used at many stations consistently working DX in many directions, as apart from the main lobes, the long wire has good general coverage in many other directions as well. However, the long wire does have sharp "nulls" in some directions. This fact was brought home at G3BHJ very recently, when a long wire aerial was lengthened and shifted in direction by a mere 15 to 20 degrees. This reduced the 21 Mc/s signals at a local nearby amateur's QTH, a mere half mile or so, from a S9 plus 30 db to a mere S5 to S7 varying according to wind swaying the aerial from exact null position! Signals on the long wire in that particular direction, in fact, were three S points approximately down on the signal radiated from an odd length of wire lying on the shack floor and tuned up "for laughs" in local tests on the "null" properties of this particular long wire main aerial. This "null" effect was put to good use on reception, as the powerful local ground wave of the other station on reception on the long wire was reduced from an ear-splitting receiver-paralysing signal to a comfortably moderate loudness, thus greatly facilitating mutual DX chasing activities on 21 Mc/s.

The twin points of directivity and reception serve to emphasise two of the important aspects of beam arrays. First there is the directional peaking of the radiated signal, a factor usually regarded as the only function of a beam. However, the directionality on reception serves a dual purpose, for not only are signals enhanced in the forward direction, but QRM arriving from the rear is greatly attenuated. Thus the attenuation of European signals on reception was a much valued aspect of the writer's 20 metre DX chasing with a three-element rotary. Further, of course, the attenuation of noise and even "jammer" QRM is a further boon of the "back to front" discrimination of a beam array. The combination of forward directivity on reception coupled with discrimination against rearward noise and QRM generally, thus effects a double advantage on reception. Coupled with the enhanced signal from one's own transmitter in the forward direction, a threefold gain is thus achieved in increasing solid DX QSOs. To drive home this point, consider two stations, each using simple two-element beams on both reception and transmission. A simple two-element beam may thus give a 5 db gain on transmission to the receiving point. If the receiving point also uses a simple beam giving a 5 db gain, the total "transmission path gain" is thus 10 db over the use of simple dipoles. This alone is equivalent to a tenfold increase in power of the transmitters, and points the moral that a relatively cheap aerial system goes at low cost the benefits otherwise derived only by a high cost increase in transmitter power, a change, say, whom 100 watts to 1 kilowatt—a very expensive change! Furthermore, QRM arriving from the rear may be attenuated by ten or more dbs. This possible 20 db gain on reception gives a "communication effectiveness" equivalent to a hundredfold increase in transmitter power as far as rearward QRM is concerned! This, of course, is old stuff to the hardened amateur, who is asked to bear with us, because we are primarily considering the beginner and tyro in this present article.
Word of Caution

Before the beginner fired with enthusiasm and thirsting for a 20 db increase in "communication effectiveness" rushes out and hangs a reflector wire behind his halfwave dipole, it is necessary to sound a note of caution. Even with the simplest beam, optimum results are not to be obtained without some care and attention to detail. Thus a "simple two-element beam" may produce some surprises. One surprise is that it can have gain, a little gain, in both directions at once, and thus give very little apparent boost in signals and show little, if any, "back to front" ratio. The "simple two-element beam," therefore needs a little further discussion and clarification if good results are to be obtained.

For a "two element" beam, there is a choice between a "radiator and reflector" array and a "reflector and director" array. As is widely known, a "radiator and director" two-element array can give slightly higher gain than a radiator and reflector array. However, there is a price to be paid for this slight increase in gain, as a director-reflector array is liable to have a sharper and more critical tuning adjustment plus a lower radiation resistance than a reflector-radiator array. Thus practically there is little to choose between the two, especially as less than a db of gain is involved. However, a director array is a closer spaced and therefore a compact airfoil than a radiator-reflector combination two-element beam. In fact, a spacing of a tenth of a wavelength may be employed with a director plus radiator beam, whereas a spacing of .15 to .20 might be employed with a radiator-reflector array. However, this leads to the fact that variations in spacing of the elements in a two-element array may be compensated for by tuning adjustments of the parasitic radiator length. Thus both types of two-element array may be operated with wide variations in element spacings, provided the beam is "tuned up" for optimum results. The wider spaced arrangements will be far less critical than the closely spaced arrays. Generally, spacings of .1 to .15 of wavelength are "close" spacings, while spacings of .2 or .25 or more are "wide" spacings. Unless compactness is a "must," therefore, the recommended "simple two-element beam" is a radiator plus reflector as shown in Fig. 1. No exact element lengths are laid down, however, as these will be subject to many varying factors. The old "cut-and-try" method is unbeatable in beam adjustment. Thus, if wire elements are used a pair of clippers will effect adjustment on trial beam before constructing the final version.

If aluminium or similar metal tube construction is used for the elements, a telescoping end portion of tube will enable "tuning-up" adjustments to be readily effected. In any case it should be stressed that dipole resonant lengths and parasitic element lengths also depend upon the diameter of the element used, so that specification of "exact" lengths would require a specification of the element diameter as well. For a two-element beam, resonating the dipole, and then adding the parasitic element and making a first trial adjustment for optimum forward gain is simple enough. The radiating dipole may then be trimmed to resonance at the centre frequency required, and the parasitic element adjusted for optimum back-to-front ratio consistent with reasonable gain. Such tests, while facilitated by a simple field strength indicator, such as a germanium crystal rectifier and milliammeter, may be carried out on reception at a pinch. Even the crudest but very serviceable indication given by a flash lamp bulb at the centre of a halfwave length of wire may be employed. In all cases, however, the "field strength indicator" should be as far away from the array as feasible, a full wavelength or more being satisfactory.

Feeding the Aerial

Having decided upon a simple but two-element beam for initial tentative experiments, the question of "feeding the brute" rears its ugly head. Unfortunately, the feed impedance of the radiator may vary widely with the spacing, and to a lesser extent the tuning of the parasitic element. Thus a close spaced director plus radiator array may have a feed impedance of some 12 to 15 ohms, while a wide spaced array may have a feed point impedance of around 50 ohms. While the wide spaced array could be fed with twin low-impedance feeder without much harm, the close spaced array might be troublesome. Therefore, for a close spaced array, the recommended feed is via a quarterwave matching transformer of 75 ohm twin feeder cable. This will give a tolerable match up to a 300 ohm moulded twin feeder line. The propagation constant of the 75 ohm twin cable should be obtained from the makers, and the length of a quarter wavelength in free space multiplied by this to give the length to which the feeder should be cut. The propagation constant varies slightly from maker to maker, but in an emergency a value of 0.70 is close enough. Thus a length of 0.175 of a free-space wavelength should serve adequately. A "director plus radiator" beam might thus be as illustrated in Fig. 2. A further solution is to use a folded radiator element. If the folded element is made of the same diameter wire or tubing for both upper and lower limbs, this will quadruple the feed point impedance. Thus a two-element close spaced array might be fed by 75 ohm moulded twin feeder as in Fig. 3, while a wide spaced beam could be fed with 150 ohm twin feeder as shown in Fig. 4.

Compact Arrays

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(Continued on page 409)
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arises. All but the most confined gardens will accommodate a ten-metre beam. The writer has even had a fixed ten-metre beam indoors with three elements. However, twenty-metre rotaries are a different proposition for indoor use, or even for many gardens or open spaces in city sites. The “loading coil” method may be employed to “cut down to size” a beam array for use in restricted sites. Element spacings may NOT be cut down, and due to the reduction of feed impedance a spacing of 0.15 wavelengths is suggested. Moreover, the element lengths should not be reduced to less than a quarter of a wavelength, and preferably a third of a wavelength or so should be used. For initial trials experimental loading coils should be used first to resonate the radiator, and then to resonate the reflector. It is suggested that a reflector type two-element beam be tried for a “compacted” array. When initial tests have indicated the coil size required, they should then be made up. Heavy copper tube coils, self-supported, are recommended. Final tuning adjustments are best made by telescoping end pieces on tubular elements. Tube elements are in any case virtually necessary for “compacted” coil loaded arrays, to assist in keeping the bandwidth of operation wide even with the reduced element lengths which tend to produce a low radiation resistance, and hence a sharper tuning beam of reduced bandwidth. Thick elements help to broaden the bandwidth of the beam, and reduce losses which may be quite high in beams of close spacing plus loaded “compacted” elements. The use of a centre loading coil in the radiator has one feature that is an advantage, as it enables the feeder to be matched in by tapping across the centre turns of the coil (Fig. 5), or by using a link winding as in Fig. 6. The efficiency of the famous Moseley beams marketed by the American Moseley Electronics Corporation is greatly assisted by the use of this link coil centre-feeding system. The U.S.A. satellite project is in fact using many of these Moseley beams for timing signal and other communication links, a tribute to their efficiency.

A further method of broad banding a compacted beam is to use “skeleton” forms of “fat” elements, somewhat on the lines of the “fat” groundplanes previously described. While there is no space to describe the innumerable variants possible upon this theme of fattened elements, one typical illustration is shown in Fig. 7. This is coil loaded, and resonated by squeezing or pulling the coil turns. A radiator of this type may be fed by the link coil system referred to above, and a reflector of similar construction may be suitably spaced to provide a simple two-element compacted beam. Such an aerial should be docile and easy to load up on frequency. Due to the “broad-banding” effect of the skeleton “fat” elements, operation over a good bandwidth is feasible.

A beam of high gain and directivity is of little use if it cannot be operated over more than a narrow band frequency. Tubing elements rather than wire,

![Fig. 5: Compact coil loaded dipoles may be fed by tapping the feeder into the centre of the loading coil.](image)

and tunings which will provide approximately the same gain, but often with marked variations of the dipole radiator feed impedance. Here again the use of two close spacing is to be avoided if possible. A close-spaced three-element beam may have little or no gain over a wide-spaced two-element beam that occupies about the same physical area. Moreover “compacting” techniques should also be applied with caution, as these become very tricky with close-spaced multiple-element beams. Indeed, a wide-spaced full-length element beam would probably perform about as well as a multiple-element beam with compacted elements and close spacing between elements. For a three-element beam a reflector spacing of around .15 wavelength plus a director spacing of .20 to .25 wavelengths is a good compromise.

![Fig. 6: Coax loaded elements enable coaxial cables to be matched in by a small, tightly coupled link winding wound over the loading coil, a very efficient and handy method of feeding “compacted dipole” elements.](image)

or skeleton “fat” elements bent from number 10 gauge wire or thin tubing are the solution to broadbanding requirements, providing that the beam elements are not spaced too closely. For simple two-element beams the .10 to .20 spacing will be found satisfactory.

A More Complex Problem

In the case of three or more element beams the situation becomes more complex, as there is an almost unlimited number of combinations of element spacings

![Fig. 7: A loaded element may be broad-banded by skeleton “Fat” construction from bent wire.](image)

![Fig. 8: One form of “gamma match” for feeding the radiator from coaxial. The variable condenser assists in the final loading adjustments to give a low S.W.R. on the coaxial.](image)
between gain and compactness. A reflector spacing of around .20 plus a director spacing of around .25 to .30 wavelengths will give slightly more gain.

A three-element wide-spaced beam will have a feed impedance of around 20 ohms, and folding the radiator element will provide a very good match into possibility several amateurs are interested in at the present time, including the writer! Yes, we mention reception, for the really keen SWL types who are the future "hams" of to-morrow will obtain pleasure from experiments with beams... even if only simple haywire "wire" affairs... in their searching of the

Fig. 9.—A "Flip-over" wire element beam supported on bamboo spreaders.

75-ohm twin cable. Despite the craze for coaxial cable, twin feeder is preferable for beam feeding, as the feed is symmetrical, and avoids the necessity for baluns, bazookas or Gamma Match feeds that are desirable with coaxial cable to avoid parasitic current effects to the coax outer sheath. The Gamma match is sketched in Fig. 8, as some may wish to try it. However, a variable condenser for cancelling residual inductive reactance at the "match" point is advisable to obtain the best transfer of power with a "flat" coaxial line.

A further idea for those in restricted locations, or those who cannot erect rotary beams, is the use of fixed or semi-fixed wire element beams. Thus a two-element "flip-over" beam strategically erected between spreaders, as shown in Fig. 9, would enable the beam to be turned over to cover two directions. Thus, in one direction W and VE: might be covered in a N.W. direction, and ZB, ZS, CN8 and MP4 in a S.E. direction by flipping the beam over so that the director and radiator were changed over for the second direction to the rear. An even simpler and less energetic solution would be to clip on or off a short extra length of wire so that the director became a reflector. Providing the wire and clip were kept conveniently to hand, this would enable an all "electronic" switch of direction to be effected by the simple alteration of the effective length of the parasitic element by adding the experimentally determined length. It is a simple extension to this to devise a three-element fixed beam, the direction of which could be reversed by removing the additional wire length from the reflector which would thus become a director, and attaching it to the erstwhile director to convert it to a reflector, thus again "electronically" reversing the direction of "fire" of the fixed beam array. Indeed, with some ingenuity, the resources of even a small garden, particularly on ten, could be exploited in turn with temporary "fixed reversible" wire beams to sample the DX possibilities of several different directions. Moreover, for some special feat, such as receiving or contacting a "rare DXpedition," a multiple-element fixed beam of high gain could be erected for the occasion, a

Fig. 10.—"Buck-folding" of beam elements permits of compact arrays without use of loading coils. short-wave bands. A "beam" array of some kind in fact need not be an expensive and elaborate rotary affair mounted on a 60ft. tower, and experiments with beams, even with three- and four-element beams, need not cost more than the cost of the wire and insulators involved. In fact, the writer some 10 years ago had a very nice three-element indoor 10-metre beam made from wire elements. Try it sometime and remember that like other forms of "compacted" arials, the ends of the elements, wire or tube, may be bent hanging down, or even doubled back (Fig. 10) to conserve space, even to halving the lateral spread of the beam elements. Let your motto be not to sigh for the unobtainable, but to obtain it in some form or other. You may not work or hear all the DX, but you will have fun and improved results over plain dipoles or lengths of wire. Assuming you have a restricted space you will not have a long wire, and even if you have, you might fill in the "nolls" earlier referred to, by a simple "wire element" two- or three-element beam.

PRACTICAL TELEVISION JULY ISSUE NOW ON SALE PRICE 1s. 3d.

The current issue of our companion paper, PRACTICAL TELEVISION, now on sale, contains a constructive article on a form of aerial which is very popular in America but which is not seen much in this country. Known as the Rhombic this type of aerial is very good for fringe areas, but occupies a fair amount of space. Those who are interested in aerial experiments will find this article full of valuable information.

Another article containing information which hitherto has been lacking is "TV without mains," a service engineer's account of methods of operating a TV receiver in districts which have no mains facilities. A new frame pulse separator is also described, together with two separate articles on fault finding. One deals with A.G.C. circuits only, and the other with Fault Finding without Instruments. A further explanation is given of Colour TV, together with details of a new test instrument which has been developed to test the "phase of colour" signals, whilst other articles deal with a Surplus Valve (the EF54), Smaller Picture Tubes, the Scottish TV Centre, and the usual features.
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Radio and Automation

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

(Continued from page 344, July issue)

As stated in the previous article, automation, as we know it in the present day, would not be possible unless the electronic valve had been discovered. I will now go further and state that automation could not progress except for the invention of the electronic computer.

The Computer

This is an electronic machine, constructed to be able to perform everything that can be done by a human operator equipped with a desk calculating machine, a set of volumes of tables, pencil and paper for recording intermediate results, and noting the required sequence of operations. Then he has to use his own brain for controlling these sequences until he gets a final result.

An electronic computer, if it is to be completely automatic, must be able to achieve this. Therefore, we may say that it must be able to perform the following operations:—

1. Arithmetical operations +, −, ×, ÷, \(^\frac{\pi}{\lambda}\).
2. Storage or memory.
3. Transfer data from one section to another.
4. Reception of data (incoming).
5. Supply of results.
6. Control.

Arithmetical Operations

Computers may be constructed to be binary or decimal, or both, by means of a binary/decimal matrix or vice versa. By binary is meant that numbers are represented in the scale of 2, and decimal in the scale of 10. For instance, in the binary scale the number 1011 would be \(1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1\) and the number 7601 in the decimal scale would be \(7 \times 10^3 + 6 \times 10^2 + 0 \times 10^1 + 1\). Generally the binary system is used, as components and circuits are fewer than in the decimal scale. In the case of a computer acting as a control for a machine tool it is necessary to use the decimal scale as the measurements of the various jobs to be done are practically always to a decimal place.

Memory or Storage

It often becomes necessary when a complex operation is being carried out by the computer, that results of one stage of the operation be stored for a short time, until another stage has been worked out. Then the two results are integrated and the machine carries on with the operation. This can be achieved in several ways.

Firstly, a delay line may be used. A simple form is shown in Fig. 1. Here the electric pulse is converted into an acoustic pulse in the mercury and reconverted at the other end into an electric pulse. If the electric pulse has a spacing of 1 micro second, 150 cms. of mercury would hold 1,000 pulses, which is enough, in a binary system, to represent 30 numbers of 10 decimal digits each, and the information thus becomes available one each milli second. As a pulse group may be required to circulate many thousands or more, before being used, the pulse shape may deteriorate to such an extent as to be unrecognisable; therefore the amplified pulse itself is not transmitted, but is used to open the crystal gate so as to allow a new pulse from the pulse generator to reach the end of the delay line.

![Image of a computer and a diagram of a delay circuit.](Image)
Magnetic Storage

This is the method generally used. A magnetic tape or magnetic drum is used. These pass under a head which produces a magnetic field and magnetises the material with the data to be stored. There may be several writing heads and reading heads differently spaced so as to read or write at different positions on the tape or drum.

Some computers have two systems of storage. One, a high-speed storage of small capacity, mostly for arithmetical work, and a slow storage of much greater capacity with facilities for transfer between the two forms of storage.

The Pulse Generator

This is the heart of a computer, and here we go back to the thermionic valve as first used for radio.

![Diagram](https://example.com/diagram.png)

Fig. 2.—The operation of an arithmetical section.

The average pulse generator is generally a multivibrator circuit, although in small machines a squiggling type oscillator is often used. An amplifier is also required to ensure a pulse of sufficient amplitude is transmitted. Pulses are produced at a rate of about 100,000 per second. (Different makes and types, of course, vary.) These pulses are routed by gates. If a standard pattern of pulses is repeated every 20 pulse periods, that is, 0.2 milliseconds.

Operation (Arithmetical)

See Fig. 2. Here we see that the control opens or closes a gate according to the data supplied to it, and the pulses from the pulse generator then go to the electronic counter according to plan from control.

Control (Machine Tools)

Here we have automation doing a real job of work. Generally speaking the system used is as follows. A small computer is fed with the necessary data, as to measurements, in three dimensions. This is then transferred to a magnetic tape which is fed to the control box fitted to the machine tool. This control box is connected to an electronic servo-mechanism, which has absolute control over the work the tool has to do. It will keep it accurate to the data supplied by means of its error indicator (see Fig. 3). Under this method of control great accuracy and a definite saving in time and labour are achieved. Of course, in preparing the data for the machine a period of time is taken, but as this tape can be used time and time again, this period is reduced considerably.

Other Uses of Automation

Many other industries are now using automatic devices which are electronic in character. The railways, for instance, are using valves in track-signalling apparatus, and a new method of traffic control is being tested in which a train, with suitable white markings on it, is scanned as it passes by a control box, the movement of the train acting as the horizontal scan. This is amplified and can be read on a C.R.T.

Office Equipment

There are now many firms making this type of equipment. One that has just come into use is the electronic calculator. This is similar to a computer, but it only deals with the four basic arithmetical operations in controlled sequences as desired. The results are produced in punched card form. There is also the large computer, which can nearly be considered as the automatic office. It consists of an integrated system of units. Information can be stored on magnetic files and daily information added. Statistics and reports can be prepared in accordance with a preset programme.
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A High-cycle Transformer

Sir,—Readers who are interested in using the high-cycle transformer described in the June issue by Mr. Stebbings may like to know that the transformer can easily be converted to an efficient heater transformer.

Only 23 turns are needed and there is ample room to accommodate them. These should be connected in series with the original 6.3 and 5 volt windings so that the voltages add up. This arrangement will give 6.3 volts when the H.T. winding is used as a primary as described in the article. If an output of 4 volts is also needed, then the new winding alone should be used. The gauge of the wire depends on the current required: 18 s.w.g. wire is sufficient for 3 amp consumption.—M. H. Kubra (W.9).

SIR,—In reply to many letters asking for a design for a power pack for the tape recorder with isolating transformer, a circuit diagram is given above for a suitable unit.

The transformer should have a secondary winding of 350-0-350 volts at 150 mA, and a 6.3 volts 3-4 amps for heaters, and 5 volt 2 amp rectifier supply. The valve is a 524G. No other extra components are required.—B. L. Phillips (Preston).

The power pack for the tape recorder.

BBC Staff

SIR,—My attention has been called to the editorial in your June issue, to which members of this Association take very great exception. On the question of programme content, and the desirability or otherwise of broadcasting matter not specifically directed at the Lowest Common Multiple of popular intelligence, it is a job rather of the British Broadcasting Corporation than myself to reply to your strictures. One would have thought that the Corporation’s many years’ experience, and the high reputation which it has established among civilised people for the quality of its programmes, would, however, be sufficient answer to criticisms of this kind.

Your criticisms of the quality of BBC staff, who are members of this Association, cannot so easily be disregarded. Let me assure you that the standard of appearance, whether sartorial or tonsorial, of the people who work in broadcasting is fully in keeping with their status as public servants. They include “people of ripe experience in the entertainment field and in the realms of literature,” who in addition to these qualities combine a profound knowledge of broadcasting. Excluding staff employed on Britain’s broadcasts abroad, a national service, available for practically three-quarters of the day, seven days a week, is accomplished on a statistical basis of one broadcasting employee to every 5,000 population. —T. L. Littlewood (General Secretary).

R1155—Power Pack

SIR,—I should like to draw your attention to the power supply connections for the R1155 as given in the September, 1956, issue of your magazine. The heater should be 6.3 volts not 5.3 volts.

If the H.T. is connected to pin seven, then the D.F. stages are brought into operation. I suggest, however, that all connections are traced as various manufacturers have their own ideas about these connections.—N. A. Curney (Bishop Auckland).
For those readers who are interested in classical music, "The Fifteenth Variation" was a tribute to Figaro on the occasion of the centenary of his birth. The analogy in the title lies in the finale of the immortal "Figaro Variations," the last of which is a self-portrait. Revised and introduced by Alex Robertson and produced by Charles Parker, it consisted of eulogies by a galaxy of musicians who knew him, and who filled an hour with their personal reminiscences of the master. It was done in the standard BBC formula of such programmes, and was one of the best of them that I can recall.

Should such a programme contain adverse as well as laudatory comment? Doubtless, this problem has been well thrashed out. Setting out as a "tribute," and not a "criticism," the answer would seem to be "no." The trouble is that it makes the programme very lopsided and mambypamby. Although Figaro, when he chose, could be an overwhelming genius, he had many detractors among practising musicians. Wouldn't their opinions, concluding with the defence, give such a programme much more bite and fillip, add zest to the desire to discuss it among listeners, and raise generally its level both as entertainment and instruction?

It is the same with their private lives. How cheering and comforting it would be to learn that these great men sometimes did as we ourselves do: arrived home, a little bit "muddled," lose our temper over some trifles or other, or to be real human on occasion - as it is certain they were. But no, they must always be drawn as paragons of perfection, just as they must always be supremely great in everything they do in their particular line of work.

"The Critics"

I was surprised to hear "The Critics," one and all, fairly "lay in" to the new panel game, "My Word," which I had praised on this page. I thought they passed a harsh judgment. One of them said she could not hear a word chairman John Arlott said. This fairly staggered me.

Documentary

Another meritorious documentary was "The Fabulous Videoq," with script by Eric Ewens, based on material supplied by P. J. Stead. Videoq was the first chief of the modern Sûreté Nationale, having started his career in Napoleon's day as a spy and a detective. He was originally a convict. With Donald Wolfitt in the title role, an interesting and, at times, exciting narrative was assured.

"Any Answers?" is advertised as "a radio correspondence column in which listeners add their comments to the views expressed in last Friday's "Any Questions?"

I wonder if it is really necessary? Granted that it is fairly amusing and entertaining, are not the questions sufficiently thrashed out by the four experts who, in their chairman's frequently reiterated words, seldom agree, and whose wanderings from the original starting point "just aren't true?" What it really sets out to do is to animate the correspondence columns of a daily paper. The result, however, is to bring Mr. and Mrs. Muggins into our programmes, instead of leaving them quietly listening-in in their homes. The person who would read the paper at home aloud, would soon be "told off," by those he was hoping vainly to entertain.

Music

An anthology of words and music, inspired by that most romantic and appealing of birds, the lark, made it a pleasant half hour. Selected and presented by James Fisher and Geoffrey Grigson, it brought back nostalgic memories of summer evenings, the river and harvesting. It concluded, almost inevitably I suppose, with a bit of Vaughan Williams's "The Lark Ascending," for violin; a work I find boring and repetitive. So is the lark repetitive, you may well say. But, whereas the one has an ethereal and quite incomparable charm, the other is its naked bones.

The Bristol Old Vic Company gave Miles Malleson's translation of Molière's masterpiece, "Le Misanthrope," under the title "The Slave of Truth." Mr. Malleson compared. His translations are always diamond-bright and the original French atmosphere considerably anglicised. The Bristol players did it full justice, except that Rachel Robert's Célimène seemed a bit underplayed.

A new series has started of the panel game, "Call the Tune," under its old chairman, Joseph Cooper. The panel was made up of Joyce Grenfell, Stephan Potter and Wynford Vaughan-Thomas. Although specially designed on rather unsophisticated lines, no one among the three seemed to have an undue share of musical perception; not even Mendelssohn's "Fingal's Cave" overture was recognised. Mr. Cooper, as I remarked last season, makes a genial and hospitable chairman, though on this occasion his presiding remarks lacked spontaneity, and sounded as though read from a script. Dennis Brain was the guest.

The Proms will be with us again before this article is in print. One talks glibly, as a rule, of how life has changed since two world wars took a hand at changing it. But few things I can recall, mark those new shapes so completely as the massive, hippopotomium-dinosaur symphony concerts, that rightly draw the musically moronic to Kensington every late summer.
OSCILLATOR COILS, as specified for the "P.W." Hi-Fi recorder, the Hatfield Oscillator coil is the only one sold with a guarantee of "less than 0.03 of 1 per cent. distortion" using only one valve, and backed by an N.P.L. report, 10/6 post free. Patent app. for.

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We stock all the components for the Mullard Tape Amplifiers as described in the Mullard Tape Amplifiers Booklet.

RESISTOR KITS. LAB. All fixed and variable resistors as specified in Model A.

CONDENSER KITS. Model A. 33: Model B. 35. These kits are made up for the Brelent and Collaro Decks. If Lane or Truvox Decks are being used this must be stated when ordering.

CABLES. SUPPLIED. — Gilbert OPT-767, 25 ft. Eiseone OT/3, 21 ft., Partridge SVO 1, 60 ft.

ELCOS PLUGS AND SOCKETS. PO4 Chassis Plug, 3.5 ft. PO4 Socket A.

IGRANIC JACK SOCKETS. P71 3 J., P72 3 J., Bulgen Jack Plugs to fit 3.5. BELLING LEE PLUGS AND SOCKETS. Speaker Socket, L19. Red and Black, Latch, L79. Plugs to fit 106. each, Co-Ax Socket 8754, 1s. L6054, 1s. L737 Plugs to fit 1 J. Each.
News from the Trade

COSMOCORD POLYSTYRENE MICROPHONE

A NEW type of microphone is now being manufactured by Cosmocord, Ltd., using Styron 475 polystyrene. These microphones are of unique style and are extremely compact and attractive in appearance. They have excellent tonal qualities, and are particularly suitable for use in conjunction with most tape recorders.—Cosmocord, Ltd., Waltham Cross, Herts.

ELECTRONIC MIXER UNIT

THE latest thing for the tape-recording enthusiast is a four-channel electronic mixer unit incorporating a pre-amplifier. This device will extend the field of tape recording enormously, enabling the user independently to fade in or fade out up to three microphone inputs plus one additional channel. Under certain circumstances it is possible to control a total number of six microphones simultaneously. This compact, self-contained unit can be put to a number of uses in conjunction with a tape recorder. For example, if you are recording a produced play at home you can use two microphones for the actors’ voices, one microphone for manual sound effects, and the additional channel for incidental music or recorded sound effects. Each control works independently and the user is thus able to fade the sound from any particular source at will. The Grundig GMU3 Electronic Mixer Unit also has the facility for monitoring by a pair of headphones and the built-in magic eye ensures that the recording is being made at the correct level.

These mixer units will operate with any past or present Grundig tape recorders and are suitable for use with most types of microphone. The complete unit costs 16 gns. and is obtainable from Grundig agents all over the country.—Grundig (Great Britain) Ltd., 39-41, New Oxford Street, London, W.C.1.

NEW R.C.A. VALVE

THE R.C.A. Electron Tube Division has recently announced a medium-mu twin triode designated as the 6350. It is a 9-pin miniature type designed for use in a wide variety of applications in electronic computers particularly of the high-speed digital type, and in other “on-off” control equipment.

In such service, the 6350 maintains its emission capabilities even after long periods of operation under cut-off conditions, and, therefore, provides good consistency of plate current during its “on” cycles. Furthermore, balance of cut-off bias between the two units is closely controlled during manufacture. Production controls correlated with typical electronic computer operating conditions as well as rigorous tests for inter-electrode leakage, high-resistance and intermittent shorts, and cathode inter-face, insure long dependable performance from the 6350.

The 6350 has separate terminals for each cathode to facilitate flexibility of circuit arrangement, and a mid-tapped heater to permit operation from either a 6.3-volt or a 12.6-volt supply.

Technical bulletin for the 6350 is available upon request.—R.C.A., Gt. Britain, Ltd., Lincoln Way, Windmill Road, Sunbury-on-Thames, Middlesex.

NEW LOW-PRICED EKCO CAR RADIO

A NEW Ekco quality car radio receiver which, together with a styled installation kit, sells at only 20 gns. (tax paid), and can easily be fitted in practically any make or year of car, is announced by E. K. Cole, Ltd.

Exceptionally neat and compact, this new receiver, Model CR280, combines the receiver and power units in one assembly occupying no more space than the majority of receiver units alone.

The four-valve superhet receiver unit covers long and medium wavebands with excellent sensitivity and selectivity, while the high standard of reproduction is assisted by negative feed-back. Other features of the receiver unit include a self-rectifying synchronous vibrator, a glare-free floodlit scale, a single slide-action wavechange and easy-to-handle controls.

The standard receiver, finished in dove-grey with a chromium escutcheon, black scale with white figures and black control knobs, is attractively designed to blend with any fascia panel and interior.

Dimensions : 2in. high by 7in. wide by 7in. deep.

A choice of four speaker assemblies is available, together with a wide range of aerials.

Price : 20 gns. tax paid (including receiver and power unit together with installation kit styled for practically any type of car).—E. K. Cole, Ltd., Southend-on-Sea, Essex.
MATCH TEST INDICATOR

A USEFUL type of symmetrical directional coupler employs coupled transmission lines. One physical form of the device employs lead-covered cable. The manufacture of such a coupler entails accurate milling of the flats on the cable, a great care in soldering lest the polythene insulant should melt.

By employing strip-line instead of cable, a printed circuit equivalent is possible and an actual coupler, comprising a through line and two auxiliary lines, has been manufactured. The instrument serves as a match indicator, reflectometer, and true output power monitor over the frequency range 150-500 Mc/s. Standing-wave ratios down to 1:2 to 1 can be measured at 500 Mc/s with an accuracy of 20 per cent. It is simple, compact and robust.

The printed circuit is made from a laminated paper board copper clad on both sides. One side of the board consists of three short sections of transmission line, each having a characteristic impedance of 75 ohms. On the other side of the board the copper is retained. The transmission lines are therefore single strip above an earth-plane type, with laminated-paper dielectric.

The middle strip-line carries the radio-frequency energy and the two auxiliary strip-lines, one on each side of the main line, are coupled to it by virtue of their mutual capacitances and inductances. The direction of the current so induced in each auxiliary line due to the couplings is such that the two components will tend to cancel in one direction and add in the opposite direction. The resulting voltages obtained across the auxiliary line terminations are, therefore, dependent on the direction of power flow in the main line, i.e., the unit will exhibit directional properties.

— Millett, Levens Group, Stirling Corner, Barnet By-Pass, Borehamwood, Herts.

HIGH FIDELITY FABRICS

SIMPSON & GODLEE of Manchester, long established as producers in the textile industry, recently appointed Austin W. Farrell to institute their New Fibres Development Division.

Under the family brand name of "Simplan," Farrell is designing "engineered" fabrics for the radio, television, furniture, motorcar and other industries, specifically to meet each industry's needs.

First into production after six months of preparatory work is a brand new radio and television high-fidelity fret fabric, featuring a combination of excellent acoustical and technical qualities with outstanding artistic design created in Simpson and Godlee's own studies. The designs now available present new possibilities to the cabinet designer, with refreshingly novel styling and textures, but Simpson & Godlee welcome invitations to design fabrics exclusively to meet individual requirements.

"MY LADY CATHERINE" BATTERY PORTABLE

VIDOR announce an additional bright new colour combination for their very popular portable receiver "My Lady Catherine," which has enjoyed sensational sales.

The new colour is in Cambridge blue and light grey with attractive primrose yellow scales and trim. The price remains at 11½ guineas, deliveries to commence immediately.—Vidor Ltd., Erith, Kent.

PHILIPS A.M. F.M. CAR RADIO

WHAT is believed to be the first A.M. F.M. car radio to be launched in this country by a leading manufacturer was introduced by Philips Electrical Ltd. on 1st June, 1957.

Known as Model X61V this new high quality receiver sells at a retail price of 49 gns. (list £37.16s. 8d. (including £2 9s. 6d. for Suppression Equipment) plus P.T. £13 12s. 4d.). It employs seven valves and rectifier and covers long, medium and F.M. wave-bands. There are push buttons for station and waveband selection. An outlet socket for operating the "Philishave" dry shaver is incorporated.

A separate power supply unit is provided and the set can be adapted for 6-volt or 12-volt operation.

**Specification**

<table>
<thead>
<tr>
<th>Valve</th>
<th>A.M.</th>
<th>F.M.</th>
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<tr>
<td>R.F. Amplifier</td>
<td>EF89</td>
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<td>Frequency Changer</td>
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<td>1st I.F. Amplifier</td>
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<td>2nd I.F. Amplifier</td>
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<td>3rd I.F. Amplifier</td>
<td>EF85</td>
<td>EF42</td>
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<td>Detector and A.F. Amplifier</td>
<td>EABC80</td>
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<td>A.F. Output</td>
<td>EL84</td>
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<tr>
<td>Rectifier</td>
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**Harmonics**—Long 1,053-2,000 m. Medium 186-583 m. F.M. 87-100 Mc/s.

**Controls**—On/off and volume. Tuning. Tone (continuously variable). Five push buttons for station and waveband selection.

**Power Supply**—6 v. or 12 v.

**Consumption**—55 watts.

**Cabinet**—Metal, dark grey lacquer. Chrome plated escutcheon.

**Dimensions**—Control Unit, 6½ in. x 2½ in. x 5½ in.

**Power supply unit, 8½ in. x 3½ in. x 5½ in.**

**Features**—High Sensitivity: Small dimensions for easy mounting. Push button operation for station and waveband selection. Speaker—7 in. complete with baffle and "Philite" housing.

**Price**—49 gns. (Tax paid).

—Philips Electrical Ltd., Century House, Shaftesbury Avenue, W.C.2.

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<table>
<thead>
<tr>
<th>VALVES</th>
<th>6S17</th>
<th>7A2</th>
<th>687M</th>
<th>VR36</th>
<th>VT501</th>
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EPF 3.6 6EZ 4 11 6F 62 8.5 6D 5

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11 8A6K 7 8 8D 6B 8B

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<th>No. of Blueprint</th>
<th>battery operated</th>
<th>one-valve : 2/6 each</th>
<th>Two-valve : 2/6 each</th>
<th>Three-valve : 2/6 each</th>
<th>Four-valve : 2/6 each</th>
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<tr>
<td>2/- each</td>
<td>1937 crystal receiver ...</td>
<td>PW71*</td>
<td>PW94*</td>
<td>PW95*</td>
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<td></td>
<td>the &quot;pyramid&quot; one-valver (HF pen) ...</td>
<td>PW93*</td>
<td>PW96*</td>
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<td>the modern one-valver ...</td>
<td>PW76*</td>
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<tr>
<td>2/6 each</td>
<td>DUAL-WAVE &quot;CRYSTAL DIODE&quot; ...</td>
<td>PW77*</td>
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### Straight Sets

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<th>battery operated</th>
<th>one-valve : 2/6 each</th>
<th>Two-valve : 2/6 each</th>
<th>Three-valve : 2/6 each</th>
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<tr>
<td>2/- each</td>
<td>W.F.J. camm's 2-valve ...</td>
<td>PW88*</td>
<td>PW38A*</td>
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<td></td>
<td>W.F.J. camm's 4-valve ...</td>
<td>PW30A*</td>
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<tr>
<td>2/6 each</td>
<td>HW3A*</td>
<td>HW63*</td>
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### Shorts-Wave Sets

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<tr>
<th>battery operated</th>
<th>one-valve : 2/6 each</th>
<th>Two-valve : 2/6 each</th>
<th>Midget Short-Wave Two ...</th>
<th>Three-valve : 2/6 each</th>
<th>EXPERIMENTER'S SHORT-WAVE THREE (SG, D, Pow) ...</th>
<th>THE BAND-SPREAD S.W. THREE (11F, Pen, D, Pen) ...</th>
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<tbody>
<tr>
<td>2/- each</td>
<td>HW3A*</td>
<td>HW63*</td>
<td>PW76*</td>
<td>PW38A*</td>
<td>PW30A*</td>
<td>PW68*</td>
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### Portables

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<tr>
<th>battery operated</th>
<th>one-valve : 2/6 each</th>
<th>Two-valve : 2/6 each</th>
<th>STANDARD FOUR-VALVEER</th>
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<tbody>
<tr>
<td>2/- each</td>
<td>HW3A*</td>
<td>HW63*</td>
<td>HW76*</td>
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### Miscellaneous

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<tr>
<th>battery operated</th>
<th>one-valve : 2/6 each</th>
<th>Two-valve : 2/6 each</th>
<th>short-wave set (SG, D, LF, P) ...</th>
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<tr>
<td>2/6 each</td>
<td>HW3A*</td>
<td>HW63*</td>
<td>WM383*</td>
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### Television

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<th>Two-valve : 2/6 each</th>
<th>four-valve: 2/6 each</th>
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<tbody>
<tr>
<td>2/6 each</td>
<td>HW3A*</td>
<td>HW63*</td>
<td>HW34C*</td>
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### Amateur Wireless and Wireless Magazine

### Straight Sets

<table>
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<th>one-valve : 2/6 each</th>
<th>two-valve: 2/6 each</th>
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<tbody>
<tr>
<td>2/6 each</td>
<td>HW3A*</td>
<td>HW63*</td>
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### Superhets

<table>
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<tr>
<th>Battery Sets : 2/6 each</th>
<th>F.J. camm's 2-valve Superhet ...</th>
<th>PW52*</th>
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</thead>
<tbody>
<tr>
<td>&quot; Coronet &quot; A.C.4 ...</td>
<td>PW100*</td>
<td></td>
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<tr>
<td>AC/DC &quot; Coronet &quot; Four PW101*</td>
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**Special Note**

These blueprints are drawn full size. The issues containing descriptions of these sets are now out of print, but an accurist denotes that constructional details are available, free with the blueprint.

The index letters which precede the blueprint number indicate the periodical in which the description appears. Thus P.W. refers to PRACTICAL WIRELESS, A.W. to Amateur Wireless, W.M. to Wireless Magazine.

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