COMPONENTS AND CHASSIS MANUFACTURED FOR "MULLARD" AMPLIFIERS, TAPE RECORDER AND F.M. TUNERS...


F.M. TUNER, I.F. Transformers, Ref. 510/IFT, 2/6, Aerial Coil, L1/L2, Ref. 510/A, 4/-, Choke L3, Ref. 510/RFC, 2/-, R.F. Coil L4, Ref. 510/RF, 2/6, Oscillator Coil L5/L6, Ref. 510/OFC, 4/6, I.F. Transformer, L1/L2, Ref. 510/IFT, 1/6, 2nd I.F. Transformer, 1/6, Ratio Detector Transformer, L1/L2/12/3, Ref. 510/RDT, 12/6.

Aluminium Chassis, punched, 14/6, Chassis Base Plate, 4/-. DENCO (CLACTON) LTD., 357/9 Old Road, Clacton-on-Sea, Essex

STOP PRESS: MAXI-Q F.M. TUNERS COMPLETELY ASSEMBLED—PRE-SET, £8/7/5 PLUS £3/8/7 P.T.—£12/-. VARIABLE, £7/17/2 PLUS £3/2/10 P.T.—£11/-. (Note price correction.)

MULLARD TAPE AMPLIFIERS

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

RESISTOR KITS. LAB. All fixed and variable resistors as specified. Model A, 33/-, Model B, 31/9.

CONDENSER KITS. Model A, 33/-, Model B, 35/-.

These kits are made up for the Brenell and Collaro Decks. If Lane or Truvox Decks are being used this must be stated when ordering.


ELCOM PLUGS AND SOCKETS. P04 Chassis Plug, 3/6, S04T Flex Socket, 5/3.

IGRANIC JACK SOCKETS. P71, 3/4, P72, 3/10, Bulgin Jack Plugs to fit, 3/-.

BELLING LEE PLUGS AND SOCKETS. Speaker Sockets, L316 Red and Black, 1/- each, L374 Plugs to fit, 10d. each, Co-Ax Socket L7345, 1/-, L6045, 1/3, L374 Plugs to fit, 1/3 each.

McMURDO VALVE HOLDERS. B9M9U, 10d., XM9/UCI, 1/7, XM9/UGI, 2/3.

SWITCHES. Set of three for Model A, 32/6. One Switch for Model 16/6.

BULGIN TAG BOARDS. C120, 1/3, C125, 2/3,

EQUALISER PLUG AND SOCKET. Plugs 2/3 each, Socket 6d.

CERAMIC STAND OFF PILLAR. 1/- each, OSCILLATOR COILS. Brenell, 8/-, Truvox TR98, 6/-.


VALVES. EF66—Mullard, 24/4; Alternatives, 15/-, ECC83—Mullard, 16/4; Alternatives, EM8/1811, EL84—Mullard, 16/-, Alternatives, 12/-, OA71 Diode, 6/-.

KN0BS. Bulgin K370, 1/6 each. EM5I ESUTCHIEON, 2/6.

SUNDRIES KIT. Contains all nuts, bolts, caps, wire, flex, solder, etc.

FULLY DETAILED LIST is available free upon request. This gives prices for complete kits and details of Power Unit Components.

WATTS RADIO

8, Apple Market, Kingston-on-Thames, Surrey

Telephone: Kingstone 4099
Build this TRANSISTOR POCKET SET FOR ONLY 49/6!

WE'VE DONE IT AGAIN! our design department in response to a great many requests have developed this "SKYPOCKET" Transistor Set. This is a two-stage receiver covering all medium waves, working entirely off of the battery, which costs 6d. The complete case, battery, etc., is only 9/6. As the building up is absolutely "no-brain," it is quite simple to build.

BUILD THIS TRANSISTOR SET FOR ONLY 35/-

THIS BUILDING SET IS FOR ABSOLUTE BEGINNERS. NO EXPERIENCE OF ANY KIND REQUIRED. It is complete and ready to be built, and the complete set is only 1/-.

BUILD THIS "SKYPOCKET" TRANSISTOR SET FOR ONLY 49/6!...

Orders receive prompt attention. Cheques accepted. Cash on delivery 1/- extra. Please print name and address in block letters.

Suppliers to Schools, Universities, Government and Research Establishments. Complete range of components and valves stocked. CALLERS WELCOME. Shop Hours: 9 am to 6 p.m. (1 p.m. Thursdays). Regret no COD, abroad.

CONCORD ELECTRONICS
69, PRESTON STREET, BRIGHTON

PRACTICAL WIRELESS
July, 1957

EASY AS "A.B.C."—CHEAP TO MAKE!

BUILD THIS POCKET RADIO FOR ONLY 37/6

BUILD THIS POCKET RADIO FOR ONLY 107/6

Build this exceptionally sensitive double triode radio. It is a beautifully designed precision set. Nib and easy to build. No knowledge required. SIMPLE, pictorial plans. Buy by the last nut and bolt. No traps. Special offer. Contains "WIRELESS" case 'with 51 in. in. in. x 5 in. x 3 in. in. in. Medium waves—uses only one all-day battery. H.T. consumption only 1/2 to 1/3 A.A. Uses personal phone. Ideal for Bedroom, Garden, Holiday, etc.

LATE! IT'S ORDER TIME!... Only 35/-speed receiver covering all medium waves, working entirely off of a tiny "pen-light" battery, which costs 6d. The complete case, battery, etc., is only 9/6. As the building up is absolutely "no-brain," it is quite simple to build.

FOR ABSOLUTE BEGINNERS, NORTON PACKS. To Send Orders, 1ST P.O. Box 657, Dorset Street, Ely, Cambridge. Price 6d., inc. packing.

WE'VE DONE IT AGAIN!

orders receive prompt attention. Cheques accepted. Cash on delivery 1/- extra. Please print name and address in block letters.

Suppliers to Schools, Universities, Government and Research Establishments. Complete range of components and valves stocked. CALLERS WELCOME. Shop Hours: 9 am to 6 p.m. (1 p.m. Thursdays). Regret no COD, abroad.
LASKY'S TRANSISTOR AMPLIFIER KIT
(200 milliwatts)

Miniature size: 3½in. x 3½in. Height can be under 1in. Uses our hermetically sealed Transistors and operates from 6-volt battery. Output impedance 5 ohms.

COMPLETE KIT including 4 Transistors, all brand new components, latest T.C.C. miniature condensers, PRINTED CIRCUIT and full instructions, Post Free.

FULL DETAILS, circuit diagram and shopping list, 1/-, post free.

Free Demonstrations. All components available separately.

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42, TOTTENHAM COURT ROAD, W.1.
Telephone: MUSEum 2605.
378, HARROW ROAD, PADDINGTON, W.9.
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Very latest 1957 model RC.456, incorporating auto and manual control enabling records to be played singly or up to 10, all sizes mixed, automatically. Complete with Studio crystal pickup and sapphire stylus.

List £13.17.0. LASKY’S PRICE £9.15.0

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B.S.R. 4-SPD. AUTO-CHANGER

Complete with t.o. crystal pickup. Incorporates auto and manual control. Brand new in makers' cartons.

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Type T901. Circular. Gives large black and white picture, 11in. x 14in. Guaranteed by us for 3 months. List £23.9.10. LASKY’S PRICE £8.9.6

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 Rectangular G.R. TUBES


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187 LONDON ROAD, MITCHAM, SURREY

SUMMER DAYS AHEAD—have a gay holiday with the HIWAYMAN All-dry battery portable.

4 valves and high efficiency Ferrite rod aerial. Medium and Long Waves. Full constructional details and price list. PRICE 1/-6. Total building cost approx. £7.10.0.

Immediate delivery. Limited number of the fabulous "QUAD" FM Tuner.

Elliptical Speakers. 7" x 4" brand new units. Price 15/-, plus 1/6 post.

MAGNETIC RECORDING TAPE

A by-return service of all types and sizes. E.M.I., BASF, Scotch Boy, Simon, Ferrovoice, MSS, AGFA, Ferrograph, Puretone, C.O.D. or C.W.O. S.A.E. for full list.

“TSL” HIGH STABILITY FM/VHF TUNER

Magic eye and pre-set audio level. 6 valves in very sensitive circuit giving satisfactory results up to 100 miles from station. Minimum drift and full bandwidth ensures highest quality reception. Self-contained power supply enables this unit to be used with any receiver, radiogram or amplifier. Leaflet giving full technical specification free on request. We are demonstrating this excellent tuner every day. Cabinet available if desired. (37/6 extra.)

PRICE £17-10-0 inc. P.T. and carriage.

Also TSL High Stability amplifier in matching cabinet makes ideal complement to the TSL tuner. Full details on request.

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High-Fidelity Push Pull Amplifier with "Built-In" Tone Control, Pre-amp Stages, Separate Bass and Treble Controls. 200-230-250 v. A.C. inputs. 50-500 cycles. 3db. for 2.5db. at 1kHz. 0.1% distortion at 1kHz. 6x7A.A.A. or 6x7A.E. tubes. 3000 watts. Price with Self-Contained Dipole Speaker System & Amplifier £7-15-0. For full particulars send 1d. to The Radio Supply Co., 32, The Calls, Leeds 2.

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

A highly sensitive Push-Pull high output unit with self-contained Pre-amp, Tone Control Stages. Certified performance figures compare very favourably with other expensive amplifiers available. Iím level 70 db. Frequency response 20-20,000 cycles. Specialised designed sectionally wound ultra linear output transformer is employed with 6x7A.E. output valves. All components are chosen for reliability, Six valves are used. E86, EF15, 807. Bass and Treble Controls are provided. Minimum input required for full output is 2 db. of any kind of MIC 0REPHONE or PICK-UP INSETABLE. Unit suitable for Clubs, Schools, Theatres, Dance Halls or Outdoor Functions, etc. For use with Electronic ORGAN, GUITAR, STRING BASS, etc. For standard or long-playing records OUT, FIDELITY SPEAKERS, etc. The Radio Supply Co., 32, The Calls, Leeds 2. £19.9. TERMS: Deposit £11 and 9 monthly payments of £11.

R.C.A. 20 WATT RE-ENTRANT 1312. 45-50W. For P.A. use. Headphones or Loudspeakers required. For outdoor work only. 8 G. S.P.E.A.K.E.R. 23 ohms, 7/15. Goodmans, 179, 6in. Goodmans, 10in. Goodmans, 12in. £10-9. Goodmans, 14in. £18.9. Lucas, 12in. £19.9. Recommended for use with our A4 amplifier, £4.10.9. £4.19.6. £5.10.9. £6.11.9. £7.12.9. £8.13.9. £9.14.9. £10.15.9. £11.16.9. £12.17.9. £13.18.9. £14.19.9. £15.20.9. £16.21.9. £17.22.9. £18.23.9. £19.24.9. £20.25.9. £21.26.9. £22.27.9. £23.28.9. £24.29.9. £25.30.9. £26.31.9. £27.32.9. £28.33.9. £29.34.9. £30.35.9. £31.36.9. £32.37.9. £33.38.9. £34.39.9. £35.40.9. £36.41.9. £37.42.9. £38.43.9. £39.44.9. £40.45.9. £41.46.9. £42.47.9. £43.48.9. £44.49.9. £45.50.9. £46.51.9. £47.52.9. £48.53.9. £49.54.9. £50.55.9. £51.56.9. £52.57.9. £53.58.9. £54.59.9. £55.60.9. £56.61.9. £57.62.9. £58.63.9. £59.64.9. £60.65.9. £61.66.9. £62.67.9. £63.68.9. £64.69.9. £65.70.9. £66.71.9. £67.72.9. £68.73.9. £69.74.9. £70.75.9. £71.76.9. £72.77.9. £73.78.9. £74.79.9. £75.80.9. £76.81.9. £77.82.9. £78.83.9. £79.84.9. £80.85.9. £81.86.9. £82.87.9. £83.88.9. £84.89.9. £85.90.9. £86.91.9. £87.92.9. £88.93.9. £89.94.9. £90.95.9. £91.96.9. £92.97.9. £93.98.9. £94.99.9. £95.100.9.
The MULLARD 5-10 MAIN AMPLIFIER

This is the very latest complete design and needs no recommendation from us. Our Kit is complete to MULLARD specifications, including the latest GISHION ULTRA LINEAR OUTPUT TRANSFORMER and the entire MULLARD Valve line up. ALL SPECIFIED COMPONENTS are supplied. PRICE OF COMPLETE KIT £11.1.0. & Ins.

The full SPECIFICATION and PRACTICAL BUILDING INSTRUCTIONS for these fully complete kits are supplied for leaflets. H.P. and CREDIT SALE TERMS are available.

The following two RADIOGRAM CHASSIS are very well designed and represent the best quality on the market, but include the very latest MULLARD quality transformers.

**MODEL H.2.A.** A 3 Waveband AM/FM CHASSIS £20.17.0.


**TUNER UNIT CHASSIS**

**MODEL H.1.B.** A combined 3 Waveband AM/FM Tuner incorporating a "Hi-Fi" Preamplifier, which has switching connections for Tune Display, Bass, Treble and all Tuner Controls, etc. PRICE £9.19.0.

**Stern’s 'F.M.' TUNING UNIT**

A 5-valve Tuner incorporating the latest MULLARD Frequency Full wave and Crystal Type Tuner, heart and a Magic Eye Tuning Indicator. PRICE ASSEMBLED READY FOR USE £14.10.0. \( \text{Plus 7/6 and 12 months payments of £1.14.6.} \)

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EXCLUSIVELY DEVELOPED FOR THE HI-FI ENTHUSIAST. THESE KITS ARE AVAILABLE FOR 12V. 10 WATT. HAS FULL SERVICE SUPPLIED FOR THESE KITS. INCLUDING AMPLIFIERS, TUNERS, ETC.

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

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Having supplied and ready for use one of the most popular models new offered to the home constructor. Provides excellent reproduction up to 5,000 watts, employing 6V6's in push-pull, incorporating negative feedback. Provides for use of both 3 and 15 ohm speakers.

WE HAVE THE FULL RANGE OF DULCI'S CHASSIS IN STOCK

**THE MODEL H.4. is illustrated but all Chassis and Tuners are available.** S.A.F. for leaflets. H.P. and CREDIT SALE TERMS are available. The following two RADIOGRAM CHASSIS are very well designed and represent the best quality on the market, but include the very latest MULLARD quality transformers.

**MODEL H.2.A.** A 3 Waveband AM/FM CHASSIS £20.17.0.


**TUNER UNIT CHASSIS**

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

**A NEW 4-SPEED AUTOCHANGER.**

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**THE S.S. EPOX 52 COMPLETE**

**AT GREATLY REDUCED PRICES**

Send S.A.E. for Illustrated leaflet.

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

- Complete with High Fidelity Crystal Type Tuner, Head which incorporates separate Stylus, P. and T. P. and 78 rpm records. A "MIXER" Unit that will accommodate 7 in., 10 in. and 12 in. records of same speed. Incorporates the usual Control position.

**CALLERS ONLY**

We have in stock various designs for CONSULTANTS Including F.M. Detectors, A.M./F.M. Detectors, Midget Battery Portable, Mains Units, etc., etc.

Look at Acos

Acos has recently established a large new factory, and considerably increased its development and manufacturing resources. The results achieved so far include, for instance, new diamond styli, a new consolidated range of cartridges, a new series of microphones. And plans for the future, now on the drawing board, will ensure that Acos products remain a little ahead of their time.

**Replacement Styli**
Quality sapphire and diamond styli, tested at 500 times magnification to ensure optimum shape and polish, giving longer record life and improved reproduction.

**Turnover Cartridges**
There is a specific Acos Cartridge for all applications, for moderate or tropical climates: small record players, large radiograms, high-fidelity installations.

**Gramophone Pick-ups**
A number of high-quality crystal and magnetic pick-ups for amateur and professional users.

**Crystal Microphone**
The widest range of microphones for all applications offered by any manufacturer in this country.

have a good look at the Acos range

COSMOCORD LTD. WALTHAM CROSS HERTS TEL: WALTHAM CROSS 5206
SUN SPOTS

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

THE RADIO SHOW

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

TRACKING THE EARTH SATELLITE

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

Our next issue, dated August, will be published on July 5th.
Atlantic Islands Linked by Radio-telephone

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

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

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

The International Geophysical Year

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

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

Radio System for New Comet IVs

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

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

Type AD704 Receiver for V.H.F. communication.

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

Electronic Computer Exhibition and Symposium Next Year

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

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

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

H.M. The Queen Radio Show Patron

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

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

Apprentice/Technician Brian Young (17), of Bournemouth, repairing an intricate piece of equipment at the R.E.M.E. Apprentices School, Arborfield, where he is training as a tele-communications engineer.
The Queen, as Princess Elizabeth, was also joint patron with Queen Mary in 1951.

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

A Prefabricated Sound Enclosure

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

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

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

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

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

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

French Honour for British Inventor of Printed Circuits

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

R.A.C. Radio Link

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

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

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

Sweden to Establish F.M. Radio Network

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

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

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

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

New Ekco Executive Director

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

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

New Radiotelephone Circuits

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

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

A radiotelephone service has also been opened between Aden and Djibouti (French Somali). A three-minute call costs £1 2s. 6d.
THE maintenance and repair of tape recorders is a job that cannot be taken too seriously. Many of the faults can be remedied, if not cured, by the use of simple gear and patience and time. This article is written in the hope that some reader might find it a helping hand, and it caters for the tape recorder owner who is both mechanically and electrically minded and who has a normal selection of tools. Should any reader lack any of these qualities, he is well advised to seek advice from another man who possibly has had more experience. Some typical faults are given, as well as some remedies. The faults will be dealt with in sections, and therefore we can devote certain separate space to each.

Motors

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

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

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

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

![Fig. 6.—Typical tape deck. When a tape is in playback position the erase head can easily be identified as the head nearest the unplayed or full spool.](image-url)
as clockwise or anti-clockwise. A shaded-pole motor may be easily reversed by changing around the stator (see Fig. 1).

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

Heads

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

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

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

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

If wear is experienced the recorder becomes more

Fig. 2.—Showing the cause of "wow."

Ball bearing has worn a curve in the motor spindle, the nut is not tight, and hence more wow

Fig. 3.—Circuit of a head tester.
we have a 6-volt supply with a pair of test leads in series with a meter to read 6 volts A.C. This can be accomplished by using a meter rectifier and wire-wound potentiometer, so that the meter reads full scale on the 6-volt reading when the leads are shorted. Any reading when the leads are applied to the heads, which are disconnected from the rest of the circuit, should, if the head is intact, give a reading on the meter, dependent on the actual resistance of the head winding. This then caters for the high impedance heads. In position 2 we have the leads for testing in series with the A.C. supply of 6 volts and a 6-volt bulb. When these test leads are placed across the heads, as previously explained, if the winding of the head is O.K. we get a light in the bulb. This is the same as a continuity test with an ohm meter except that we are not damaging the heads by passing A.C. through them. The heads can be easily demagnetised (Fig. 5) by using an old field coil of 2,000 ohms from an energised speaker. Connect the ends of the field coil to the mains and draw the heads through the centre hole, which had previously been occupied by the pole piece of the speaker. These are about the only things that can be said for heads, but in any case of query the makers will be only too pleased to advise or test.

**Amplifier**

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

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

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

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

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

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

No. 5. Head adjustment. The reader will appreciate that for efficient performance the tape must be correctly run on or across the head. The modern tape heads have what is known as azimuth adjusting screws (see Fig. 4). These screws control the path of tape in respect to the heads, as per sketches. This,

*Fig. 4.—Adjusting the heads for correct fault clearer.*

*Fig. 5.—A head demagnetiser.*
A Radio Telescope Assembly at Cambridge.

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

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

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

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

Radio Transmitter

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

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

Satellite Path

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

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

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

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

The output of the signal will be circularly polarised, with the plane of the polarisation being normal to the ascending node. At any given time during its orbit, the satellite will be predictable to within a few degrees of the earth's surface. The satellite will be a beacon for radio amateurs and others interested in radio astronomy, providing an opportunity to study the effects of the earth's atmosphere on electromagnetic waves and to test new theories of radio propagation.
the earth's surface receiving circular polarisation will be most suitable to receive the satellite transmissions because of the rotation of the plane of polarisation through the ionosphere by the Faraday effect. This favourable situation can exist initially at two locations on the earth's surface, at approximately South Africa and Hawaii. These optimum locations will shift because of the earth's rotation and also because of the rotation of the elliptical satellite orbit resulting from the earth's equatorial bulge.

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

**System Requirements**

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

For a tracking installation a large, level field will be needed. The two aerials, 500 to 1,000ft. apart on an east-west line, should be level to $\frac{1}{10}$ in. and the aerial pattern area should be free of tall obstacles. To preclude excessive noise in the system, the installation should be moved from population centres, industrial installations, busy highways and other noise sources. The aerial and receiver system needed will depend on the signal strength received from the satellite, on the signal-to-noise ratio required for the system, and on the noise in the system.

Assuming a transmitted power (Pt) of 10 milliwatts, a transmitter aerial gain (Gi) of 0.5 (referred to...
isotropic), a receiver aerial gain (Gr) of unity, a wavelength (\ell) of 9ft., and a range (R) of 1,000 miles (5 \times 10^4 ft.), we can compute a theoretical signal strength from the following well-known formula:

\[
Pr = Pt Gr \frac{Gt^2}{(0.01)(110.5)(81)}
\]

\[
(4\pi R)^2 - 167^2 (20) 10^{-12} - 10^{-6} \text{ watts}
\]

The noise power in a perfect receiver is about 4 \times 10^{-24} \text{ watts/cycle or 204 dB/ cycle} (decibels below one watt per cycle of bandwidth). A noise figure of 4 dB and a pre-detection bandwidth of 10 Kc/s gives the noise as 160 dBW or 10^{-36} \text{ watts}.

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

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

The transmitted power and the range may be considered as fixed, leaving only the receiving aerial gain as a variable. The Minitrack aerial will cover an area of about 2.5 \times 10^{12} and will provide a gain of about 50 or 17 db. These changes give a theoretical received power of 5 \times 10^{-15} \text{ watts} or 0.5 \mu\text{V}. With a 5 Kc/s pre-detection a signal-to-noise ratio of 20 db is obtained.

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

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

Tracking Equipment

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

The transmission line used for either system must have a low loss and be stable in phase. For the Minitrack system \frac{1}{2} in. air-dielectric cable will be used. This cable is suitable but the cost is high. Another type that will be tested is the similar type made with \frac{1}{4} in. tubing. This cable has a greater loss but is less expensive. The only inexpensive low-loss cable is the "railroad" or "ladder" type of balanced line. If it could be so placed as to be stable in phase it would be suitable.

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

(Concluded on page 332)
ONLY a few wiring points arise in relation to Fig. 2. The 30 pF oscillator trimmer is soldered directly to the front section of the gang condenser. Three holes are drilled under the positions to be occupied by the condenser fixed plates, so that leads can pass directly down to the band switch. The condenser frame wiper contacts are all joined, the lead being taken to chassis. Underneath, the oscillator coils are earthed directly to this same connecting point.

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

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

**High/Low Switch**

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

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

---

**LIST OF COMPONENTS**

9 octal valveholders.

3 of 6K7, 6L7, 6H6, 6J5, 6V6, 6C5, 5Z4 valves.

1-gang .0005 μF tuning condenser.

2 of 30 pF preset condensers.

2 of 50 pF or 75 pF panel variable trimmers.

2 standard 465 kc/s I.F.T.s.

2 midget 465 kc/s I.F.T.s. (Astral Radio Products, 82 Centurion Rd., Brighton.)

6-pole 5-way rotary switch.

2-pole 2-way High Low switch (see text).

6.3 V. bulb and holder.

Mains transformer: 200/250 V. input, 250-0-250 V. 80 mA., 5 V. 2 A., 6.3 V. 3 A.

80 mA smoothing choke.

Electrolytics: 16 μF 350 V., 2 of 8 μF 350 V., 25 V., 25 μF., 50 V. 50 μF.

Tuning meter and shunt (see text).

Aerial, H.F. and Osc. coils for required wavebands (see text). (Astral Radio Products.)

Padders to suit (see text).

Chassis approx. 16 in. x 8 in. x 2½ in. deep.

Tuning drive. (Eddystone or J.B.)

Extension control spindle. (Coventry Radio.)

Knobs, etc.

P.M. speaker with 5000 ohm, 50 mA transformer.

Resistors: 3 of 220 ohm, 270 ohm, 400 ohm, 2 K., 5 K., 30 K., 33 K., 47 K., 5 of 50 K., 4 of 100 K., 25 megohm, 2 of 5 megohm, 2 of 1 megohm.

2 of 50 K. potentiometers. 1 megohm volume control with switch.

Fixed condensers: 50 pF. mica. 3 of 100 pF. mica.

2 of .001 μF., .005 μF., 2 of .01 μF., 10 of .1 μF.
sensitivity and sharpest tuning, but also considerably increases any chance of instability.

Top-coupled Filter

This is wired up separately upon a small aluminium base, as shown below. The base only requires to be large enough to accommodate the two I.F. transformers used, lifting these about 1 in. from the chassis. The individual tag connections are marked in Fig. 3. If transformers with tags in other positions are used, wiring must, of course, be modified to suit, and reference to the diagram will make this easy.

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

Miniature transformers of this kind have core-adjusting holes at top and bottom, centrally placed, and provision for reaching these must be made by drilling base and chassis. Transformers with side adjusting holes could be employed in the other positions and reached from the back, but this is not possible with the pair in the filter unit.

The small top-capacity coupling condenser is supported by short connections from the transformer tags, and is normally set near minimum capacity. As capacity is increased, sensitivity is slightly increased, but selectivity is reduced. Re-alignment of the I.F. transformers is necessary after adjusting the pre-set, but in actual practice this will not prove difficult, since it is only necessary to tune in a local station and turn the cores for maximum indication on the tuning meter. The 30 pF trimmer setting is in no way critical. It is suggested it be almost wholly in the centre section. A.V.C. and ganged tuning, but also considerably increases any chance of instability. When the unit is complete there will be the same number of leads from it as from a single I.F. transformer. Three pass through the chassis to H.T., A.V.C. and anode circuits. The remaining lead, issuing from the top for grid connection, is screened and taken to the High/Low switch.

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

Wiring Points

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

Beginning with the heaters, all points marked "H" are connected, leads being run close against the chassis. Various points are also taken to the chassis itself; these are marked M.C. and are soldered to 6 B.A. tags tightly bolted in position. The small screen is 2jin. by 8in. with jin. mounting flanges. The back nuts of the wavechange switch need to be removed, and two wafers, with spacers, are then removed. The last pair of spacers is sawn in half, and two halves placed on the switch bolts. The screen is then drilled to fit, requiring two 4 B.A. holes (for the long bolts) and a jin. diameter hole to clear the spindle. The remaining half spacers and wafers are then replaced and the nuts tightened. When the screen is bolted in place, the switch is thus rigidly supported here, while the two aerial wafers are screened from those associated with subsequent circuits. The screen also supports the L.W. mixer coil and aerial trimmer.

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

Bandswitch Wiring

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

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

Sound Is Their Business

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

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

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

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

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

Housewives who use an ordinary mincer might like to know that Messrs. Willis and Holden have a rather rusty one in their collection. It is used, fixed to a table, for giving the impression of the opening of a heavy steel door or cave. The most treasured possession is an old musical box dating back to 1870 which plays haunting Strauss waltzes.
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Coverage 120 Kc/s-200 Kc/s, 300 Kc/s-300 Kc/s, 500 Kc/s, 225 Kc/s, 275 Mio/s, 400 Mio/s, 8 Mio/s-20 Mio/s, 16 Mio/s-33 Mio/s, 24 Mio/s-34 Mio/s. Metal case 10 x 6 in, x 4 in, Size of scale, 6 in, x 3 in, 3 valves and rectifier, A.C. mains 240-220 V. Internal modulation of 600 c.p.s, to a depth of 30 per cent., modulated or unmodulated R.F. output continuous variable 100 milli-watts, C.W. and mod. output, variable A.F. output and moving coil output meter. Grey hammers finished case and white panel. Accuracy plus or minus 2%.

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SUITEABLE ANY TV, except Philips

NO ALTERATIONS TO SET

Complete with built-in power supply 240-220 V, A.C. mains or 40 V.C. mains. Cradle suit case 6 in. long, 3 3/4 in. wide, 4 in. high. Incorporates in control and test switch. Illustrated with cover removed.


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1-element folded dipole top aerial, 12 yard co-ax. cable and 2 co-ax. plugs. If purchased together 12/6 Plus P. & P. 2/6.

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Battery operated, comprising 2 valves, 3 valve holders, tuner, coil, resistors, condensers and volume control. 

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£8.19.6 Plus P. & P. 6/-.

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1 valve plus metal rectifier, A.C. mains 220-250 V. Medium and Long waves. In pastel blue or brown. Valve lineup: 2 V8C8 and 1 V7B8. Size 5 1/2 in. long by 8 in. high by 7 in. deep.


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3 band & gram set. 5 valve International Orca. Ideal for table gram, but still giving high quality output. 4 knob control. 8 in. P.M. speaker. With or without set of knobs, 2. Chassis 12 in. x 8 in. x 7 in. Lowless valves. Ins. & Carr. 4/6.

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MANOR PARK, LONDON, E.12.

CARR. 6781, 1957.

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TRANSDUCERS. Type " B " (Walkie-Talkie) complete in case with Five Valves (Four A.R.P.12, one A.T.P.4). These are unmarked by us but are serviceable. Price 1/6, 6/-. 3/6, each.

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TRANSCISTERS. Type " B " Mark III. TWO UNITS (Receiver and Sender) complete in Metal Case. Suitable for low, medium, High frequencies. Microphone, etc., etc. Less External Attachments, 4/6. ATTACHMENTS for USE WITH Type " B " Transducer. HEADPHONES with Plug and Lead, 15/6; HAND MICROPHONE (4a) with Lead and Plug, 12/6; AERIALS, 5/6.


RESISTANCES. 100 ASSORTED USEFUL VALUES. New, Wire-ended, 1/6 each per 100.

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11, LITTLE NEWPORT ST., LONDON, W.2.

CARR. 6210, 1957.
On Your Wavelength

BY THERMION

Dance Music, Trumpets and All That

RECALLING my numerous attacks on jazz crooners, dance music, rock and roll, skiffle, piffle, particularly the BBC variety, I could hardly believe my ears when listening to another evening to a BBC announcer interviewing a lady visitor to this country. She was asked what she thought of dance music, and it was obvious by her immediate reply that she had decided views on this subject. She said dance music, which she didn't like, was intended to be danced to, and not listened to, and she thought that only savages danced to the trumpet. There are so many dance bands and they all sound alike—and all competing for the same amount of programme time. They all sound tired to me: the music is tired and it is played in a tired way. It is time that there was a drastic overhaul of the orchestral side of the BBC.

Many of the bands are certainly not up to broadcast standard. Some of the vocalists sing with an adenoidal twang, and most of them are aping that frightful nasal Yankee-come-Canadian drawl with a strong flavouring of Negro accent. As for the songs themselves, they are just gutter rubbish. Just think of the nauseating tripe about Mary Ann sifting sand, Rocking through the Rye, Day-O and I Want to Go Home (wish they would), Don't Knock the Rock, etc.

There is no composition, and the words are an insult to a five-year-old. Before the minds of the teenagers of this country are further polluted by this bilge water, the BBC should investigate the matter, vet the programme material, and tighten up their auditions. Some of the bands are booked time and again without audition. They should be made to toe the line and prove that they are kept up to scratch. All of the bands to-day seem to me to pander to these silly, screeching, hysterical teenagers who form themselves into fan clubs at the instigation of the publicity agents for the bands. When they appear on the variety stage these publicity hounds plant a suitable claque in the best French tradition to whip up the enthusiasm of the gallery. We wonder why the variety theatre is slowly dying on its feet. The reason is obvious. No programme is considered complete to-day unless a large chunk of it is occupied by some crooner or some fifth-rate dance band, appealing to the demented creatures. Very few of the programmes are planned for an adult audience. The enthusiasm of the teenagers soon wains. I repeat that the BBC have a duty not to make national characters and heroes out of nonentities, especially those who cannot sing, and they are in the majority. I recommend them to read the definition of jazz in Eric Blom's dictionary of music published by the Oxford University Press.

The Show

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

Donegall Discs

ORD DONEGALL announces two new discs: DOM 1,000 331, "Esterban and His Caballeros de Montevideo," well-known South American numbers, played by "Mr. Latin America" and featuring Albert Delroy on accordion, folk songs and calypsoes with guitar, clarinet and bass accompaniment; and another, DOM 1,003 331, "Dixielanders Anonymous." Tunes you Have Hummed, played in the New Orleans manner by a group of top British jazz men. Old favourites played in quiet rhythm for "roll up the carpet dancing" or unobtrusive listening with a drink and the evening paper. These, of course, are hi-fi discs. Lord Donegall has always been a hi-fi fan, apart from being an authority on Dixieland and dance music.

Fun at Whiteleys

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

Mention of the name Whiteley, of course, reminds me that A. H. Whiteley, Ltd., the well-known speaker manufacturers of Mansfield, Nottinghamshire, are one of the very few firms which has remained in business from the earliest days of radio to the present time. My old friend Whiteley started business in a very modest way all those years ago with the fixed object not of getting rich quick by selling inferior goods to the avid public of that day but to found a business which was going to endure. His business year by year has continued to expand, as year by year he has ploughed back much of the profit, until to-day he employs several hundred people and "speakers" a goodly chunk of the industry. He has never forgotten the home constructors who were his main customers in those early struggling yet memorable and treasurable days. He is one of those whom I look forward to meeting year by year at the Radio Show.
MODERN radio sets of other than portable or miniature type are almost without exception fitted with sockets from which an extension loudspeaker can be operated. This extension speaker can be in the kitchen, or any second room, or may be upstairs for listening in bed in the event of illness. Such an arrangement costs little to fit up and nothing to run, and in very many cases is definitely worth while. The advantage, for example, of having a speaker in the kitchen is at once apparent when there is only one radio receiver in the house, situated elsewhere.

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

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

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

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

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

Extension Connections

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

If the leads will only be up to 20ft. or so, quite thin wire such as sold for bell wiring will do. But if the circuit is to be much longer, thin wire will cause a reduction in volume at the extension speaker. In this case it is best to use twin flex of the type employed for lighting fittings, standard lamps, etc. If the extension wires are to run permanently to one room, then it is in order to use solid insulated wires or cable of about 20 s.w.g. The extension leads should not be run with mains wiring, but kept wholly separate. The shortest and most convenient route should be chosen, and the wire can usually be secured along skirting board, etc., as
shown at “A” in Fig. 2. If a picture rail is fitted, the wire may often be out of sight along this, as at “B,” which is even better. Where required, insulating staples at 1 ft. intervals will normally be sufficient, except at corners, where they will need to be closer together.

**Fig. 2.—Methods of fitting leads.**

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

**Baffle Mountings**

A cabinet or baffle board is required, both to improve appearance and to allow the extension speaker to give best results. A baffle is merely a fairly strong board with aperture for the speaker, and a type suitable for corner suspension is illustrated in Fig. 3. Plywood can be used, but for preference it should not be less than 1/8 in. thick. If the baffle is shaped as shown, it will tilt downwards when suspended in a corner, provided support is given to the lower edge. If the lower corners can rest on small hooks in the wall, this will give a very secure mounting. If not, then two further cords of suitable length need to be taken up to the hook upon which the whole is hung.

A circular aperture is simplest to make, and the diameter can be found by measuring the diameter of the cone. A hole is then drilled to start a pad or key-hole saw, and the piece is removed, edges being glasspapered smooth. The baffle should then be varnished or stained. When dry, a piece of silk or speaker gauze is stretched across the aperture behind, and fixed by drawing-pins or glue. The speaker is then placed accurately in position, and secured by wood-screws or small bolts. If the speaker is to be in a dusty position, it is helpful to place it wholesale in a small muslin bag, as this keeps dirt, etc., out of the speech-coil gap. This is also worth while if the unit is of the type with a covered gap, so that dust cannot in any case enter.

When a corner is not available, but a wall mounting is still desired, the arrangement shown in Fig. 4 is satisfactory. Here, sides are cut from 1/4 in. or 1/2 in. wood, and tilt the front downwards. No top is fixed to this type of baffle, but a bottom strip is added in the interests of appearance. If the cord is correctly placed, according to the balance of the speaker, no support will be necessary at the bottom of the baffle, and the sides will hang flat against the wall. The hanging cord can pass through small holes drilled in the sides, or be taken to screw-eyes inside.

When the extension leads are connected up, the extension speaker should operate simultaneously with that in the receiver, and at about the same volume. No signal at all probably shows a bad joint or broken lead exists. Great volume at the extension, and poor results at the receiver, indicate a two- or three-ohm
extension unit is being used with a 15-ohm receiver
circuit. Weak volume at the extension unit, however,
shows resistance in the extension circuit is too high,
either from the wrong type of speaker, or from using
long, thin extension leads. If the details given earlier
have been followed, none of these difficulties will arise.

It will be noted that no further transformer is used
on the extension unit, as the output transformer in
the receiver operates in its place.

Separate Switching

Upon quite a number of occasions a person at the
extension position may want to silence his speaker.
This can easily be done by including an on/off switch
in one lead. It can often be mounted on the baffle
board, under the speaker. It may also be included
at the receiver end of the circuit, if this is more
convenient. Or the extension speaker can be silenced
from here by without one or both plugs from the
extension sockets.

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

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

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

Fig. 5 also shows a simple cabinet for standing on a
table, dimensions being those required for 1\1\2\ inch
thick wood. A back is desirable to exclude dust, but it
should have several large holes in it, to avoid unne-
cessary cabinet resonance. These holes can be covered
with gauze glued on inside.

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

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

News from the Clubs

CLIFTON AMATEUR RADIO SOCIETY
Hon. Sec.: C. H. Bullivant (G3DIC), 25, St. Fillans Road,
Cotford, S.E.6.

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

In the club transmitting/receiving contest held during the
week-end March 16th-17th, the respective winners in each section
were D. Buxley (G3ZKN) and D. Veasey.

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

INTERNATIONAL RADIO CONTROL MODEL SOCIETY
Hon. Sec.: Mr. D. Greene, 18, Fitzroy Street, Hull.

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

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

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

BURY RADIO SOCIETY
Hon. Sec.: L. Robinson, 56, Avondale Avenue, Bury.

FORTHCOMING meetings of the above society will be held
at 8 p.m. at the George Hotel, Kay Gardens, Bury, as
follows:
June 11th-Junk Sale.
July 9th—Noggin and Natter Night.

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

CRAY VALLEY RADIO CLUB
Hon. Sec.: S. W. Courey (G3JJC), 49, Duxterton Road,

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

RAVENSBORNE AMATEUR RADIO CLUB
Hon. Sec.: Mr. J. Wilshaw, 4, Station Road, Bromley, Kent.

SEVERAL of our members are interested in "amateur
Television" and one has obtained his licence as G3JNT T.
On the normal bands the club calls G3HEV, and occasionally
with operator G2DHV, also as GHEV/A. Field site will be at the
same location as last year, at Chislehurst, Kent.

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

THE AMATEUR RADIO CLUB OF NOTTINGHAM (G3EKW)
Hon. Sec.: F. V. Farnworth, 32, Harrow Road, West Bridford,
Nottingham.

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

PRACTICAL WIRELESS July, 1957
A.C. Double Triode I
A NOVEL SINGLE-VALVE SET FOR MAINS WORKING

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

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

If the dimensions given in Fig. 2 are to be followed, there is not a great deal of free space, and the components must be chosen with this in mind. Tuning and reaction condensers are solid dielectric. The two 8 \( \mu \)F condensers are of the small tubular type, 350 volt working. The valve only consumes .3 amp., but the usual 14 to 2 amp. 6.3 volt filament transformer can be accommodated. A 6.3 volt indicator lamp could be added, if desired. The rectifier is of the slender pencil type, 250 volt rating. Such rectifiers are usually of 25 to 60 mA rating. Any rectifier able to supply more than 15 mA is satisfactory.

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

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

**Building Details**

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

**COMPONENTS**

Fixed condensers : C1, 200 pF, .005 \( \mu \)F, .01 \( \mu \)F, and two 8 \( \mu \)F 350 volt.

Resistors, \( \frac{1}{4} \) watt : 1 K, 5 K, .25 megohm, .5 megohm and 2.2 megohm.

6SL7GT valve (Octal holder).

3½in. speaker and transformer (W/B Stentorian).

250 volt rectifier.

6.3 volt filament transformer.

Single-pole wavechange switch.

Double-pole mains switch.

Two .0005 \( \mu \)F solid dielectric condensers (Coventry Radio).

Dual-range coil, with primary and reaction (Astral Radio).

Large knob for tuning ; small knob for reaction.

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*Fig. 1 — Theoretical circuit.*
stands to the right of the speaker. The dual-range
coil and .01 µF condenser are below the speaker,
where the on/off switch is also situated. The output
transformer is fixed to the left side of the cabinet,
and the mains transformer similarly screwed to the cabinet
top. A long bolt with locknuts holds the valveholder in
position.

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

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

Switches

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

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

Fig. 3.—Essential wiring details.

Ferroxcube for Computers

Electronic computers are finding increasing
use in automation.

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

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

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

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

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

Fig. 2.—Details of the panel layout.
After use the Service sheets should be returned to their files. Leaving them about benches means torn and, eventually, illegible sheets. Modifications from makers are published from time to time, and if you are fortunate enough to be able to receive these, then it is advisable to see that the service sheets are corrected.

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

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

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

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

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

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

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

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

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

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

This will often give a clue to the trouble. It is of no use applying a voltmeter across the suspected circuit after the fault has occurred. As in 93 cases out of a 100 the mere making of the contact of the voltmeter leads will correct the intermittency.

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

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

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

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

Detector and A.V.C. Section

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

Intermediate Frequency Circuits

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

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

Oscillator Circuit Faults

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

Aerial Circuit

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

F.M. Sets

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

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

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

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

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

Aerial

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

Sundry noises which a customer may complain about cannot be investigated if normal reception is very noisy. As regards noises, the writer had an unusual experience. A customer complained that his radiogram distorted on certain notes. The set was brought in for service. A thorough frequency check, right through the whole gamut of audio frequencies, was given. No signs of distortion were apparent. The set was returned as being O.K. The customer was back the next day saying that the fault was still apparent. I went to to his house and found he worked the set at almost full volume. After a while this peculiar noise was heard and investigation showed that a vase on his mantelpiece was vibrating at this frequency, quite enough to make itself heard. The removal of this vase cleared the situation.
A MODIFIED VERSION OF OUR 1955 RECEIVER FOR A FORD "CONSUL"

By A. N. Robinson

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

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

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

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

Of much more importance to the constructor are the physical alterations to the layout. For installation on the shelf of the Consul the maximum height available is only about 5in. In order to ensure that fitting would be simple the dimensions of the casing were fixed at 4½in. outside height by 10½in. inside width by 8in. depth.

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

Choice of Components

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

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

No attempt has been made to "miniaturise" the sub-chassis assembly, as normal size components can be used, but obviously wiring will be simplified if small size components can be employed.

Chassis and Layout

A plan view of the layout is given in Fig. 2 and it will be seen that this does not differ materially from the original version, but the use of miniature L.F. transformers allows the length to be reduced by 3/4 in. to 10 in. The prototype chassis is in steel but, on account of non-rusting and ease of working, aluminium would be better. If the corners are not already strengthened it may be necessary to reinforce the front L.H. corner where the speaker cut-out has most effect.

Drilling details are given in Fig. 3. Mention was made earlier that existing valves were being used and, because of the height of these, and also because of the height limitation on the casing, it was necessary to sink the valveholders for V1, V2 and V4 below the chassis top to depths of 7/16 in., 11/16 in. and 7/16 in. respectively. This accounts for the three 3/16 in. diam. holes which are just large enough to clear the screening cans. These three valveholders are mounted on square "platforms" of sheet aluminium which, in turn, are attached to the chassis with 1/4 in. diameter bolts passing through tubular distance pieces, or stacks of washers, of the required length. The platforms for V2 and V4 have one corner removed to allow access to the connections on IFT2.

If suitable blanking punches are not readily available for the larger holes, the writer can recommend the use of an abrasive saw used in a hacksaw frame. Stressing again the limitation on casing height, the chassis depth was fixed at 1 1/4 in. to leave reasonable space for the sub-chassis components without too much room being occupied by the sunken valveholders.

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

Speaker Panel

Details of the speaker panel, between which and the front chassis face the 7 in. by 4 in. elliptical speaker is sandwiched by 3/16 in. diam. countersunk screws and nuts, will be shown next month. Since the speaker
frame and magnet housing project through the chassis, it will be necessary to carve away part of the chassis top and front face for clearance. The general shape of this cut-out is shown in Fig. 3. Chassis weakness as the result of this cut-out will be compensated by the stiffness of the panel on final assembly. The inner face of the panel should be relieved to a depth of one-ply over the area covered by the speaker, to allow the latter properly to bed down. A counterbored hole is provided to locate and sink the epicyclic slow-motion drive, which is mounted on the tuning condenser spindle extension, but the final dimensions will depend on the type and size of drive employed. Clearance holes are also provided for the volume control and wavechange switches and their associated locking nuts.

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

![Another view of the receiver.](image-url)

### LIST OF COMPONENTS

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Condensers</strong></td>
<td></td>
</tr>
<tr>
<td>C1, C5, C15</td>
<td>1,000 pF silver mica.</td>
</tr>
<tr>
<td>C2, C7, C14</td>
<td>0.05 pF (100 v. w.).</td>
</tr>
<tr>
<td>C3, C8, C16</td>
<td>10,000 pF (350 v. w.).</td>
</tr>
<tr>
<td>C4, C9, C17, C18</td>
<td>1 pF (100 v. w.).</td>
</tr>
<tr>
<td>C6</td>
<td>50 pF trimmer.</td>
</tr>
<tr>
<td>C10, C11</td>
<td>50 pF silver mica.</td>
</tr>
<tr>
<td>C12</td>
<td>250 pF trimmer.</td>
</tr>
<tr>
<td>C13</td>
<td>300 pF trimmer.</td>
</tr>
<tr>
<td>C19, C20</td>
<td>150 pF silver mica.</td>
</tr>
<tr>
<td>C21, C24</td>
<td>25 pF (50 v. electrolytic).</td>
</tr>
<tr>
<td>C22</td>
<td>1,000 v. (25).</td>
</tr>
<tr>
<td>C23, C26</td>
<td>8 pF (16, 350 v. electrolytic).</td>
</tr>
<tr>
<td>C25</td>
<td>0.001 pF (1,000,000 v.).</td>
</tr>
<tr>
<td>C27</td>
<td>30 pF silver mica.</td>
</tr>
<tr>
<td>TC1, TC2</td>
<td>2 gang -0.0005 pF tuning condenser.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resistors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>1/4 watt unless otherwise stated.</td>
</tr>
<tr>
<td>R1, R15</td>
<td>91 K ohms.</td>
</tr>
<tr>
<td>R11</td>
<td>4.7 K ohms.</td>
</tr>
<tr>
<td>R12</td>
<td>430 ohms.</td>
</tr>
<tr>
<td>R13</td>
<td>330 K ohms.</td>
</tr>
<tr>
<td>R14</td>
<td>330 K ohms.</td>
</tr>
<tr>
<td>R4</td>
<td>27 K ohms.</td>
</tr>
<tr>
<td>R5, R26</td>
<td>39 K ohms.</td>
</tr>
<tr>
<td>R17</td>
<td>1.2 megohms.</td>
</tr>
<tr>
<td>R6</td>
<td>470 ohms.</td>
</tr>
<tr>
<td>R18</td>
<td>1,200 ohms.</td>
</tr>
<tr>
<td>R19</td>
<td>240 K ohms.</td>
</tr>
<tr>
<td>R21</td>
<td>37 K ohms.</td>
</tr>
<tr>
<td>R22</td>
<td>56 K ohms.</td>
</tr>
<tr>
<td>R23</td>
<td>220 ohms.</td>
</tr>
<tr>
<td>R24</td>
<td>220 ohms.</td>
</tr>
<tr>
<td>R25</td>
<td>250 K ohms.</td>
</tr>
<tr>
<td>R9, R16</td>
<td>270 K ohms.</td>
</tr>
<tr>
<td>R10</td>
<td>3,000 ohms.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Valves</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12K7GT, 1-12K8GT, 1-12SK7</td>
<td></td>
</tr>
<tr>
<td>1-12Q7GT</td>
<td></td>
</tr>
<tr>
<td>1-12A6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coils</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 pair of superhet coils</td>
<td>long and medium waves.</td>
</tr>
<tr>
<td>Osmor, QA170 and QOS170</td>
<td></td>
</tr>
<tr>
<td>1 pair of 465 kc/s I.F. transformers</td>
<td>13/16in. square.</td>
</tr>
<tr>
<td>1 465 kc/s I.F. filter</td>
<td>Osmor, Q171.</td>
</tr>
<tr>
<td>1 wavechange switch</td>
<td>2-way, 3-pole.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sundries</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5 octal valve holders</td>
<td></td>
</tr>
<tr>
<td>Chassis-10in. x 7in. x 1in.</td>
<td></td>
</tr>
<tr>
<td>Output transformer</td>
<td>Elstone MRT.</td>
</tr>
<tr>
<td>Tag strips, nuts, bolts, shockproof washers, grommets.</td>
<td></td>
</tr>
<tr>
<td>1 Belling-Lec 7-pin plug and socket.</td>
<td></td>
</tr>
<tr>
<td>1 television coaxial plug and socket.</td>
<td></td>
</tr>
<tr>
<td>Aerial coaxial cable.</td>
<td></td>
</tr>
<tr>
<td>Heavy section coaxial cable (feed lines).</td>
<td></td>
</tr>
<tr>
<td>Screened lead for flying grid connections.</td>
<td></td>
</tr>
<tr>
<td>1 loudspeaker</td>
<td>Rola P.M., 7in. x 4in.</td>
</tr>
<tr>
<td>Slow motion drive for tuning condenser.</td>
<td></td>
</tr>
<tr>
<td>4 screening cans and bases.</td>
<td></td>
</tr>
<tr>
<td>Plywood panel, 10in. x 43in. x 3in.</td>
<td></td>
</tr>
<tr>
<td>Loudspeaker grille material.</td>
<td></td>
</tr>
</tbody>
</table>

**Power Supply**

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

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

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

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

Casing

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

(Continued on page 327)
**WIRELESS SET 19-30/-**
Transmitter receiver contains 220-450 6CO worth of spare parts including oscilloscope, antenna, microphone, etc. & is in good condition. See price list. Post & Ins. 50c.

**CRYSTAL MICROPHONE**
Miniature crystal type has high sensitivity and is suitable for all purposes—tape recorders—amplifiers. Price 5/-, post and Ins. 1d.

**CLOCKWORK UNIT 9/6**
Contains a clock movement, hands and balance. Mains and breaks heavy duty contacts. See price 9/-, Post & Ins. 3d.

**PORTABLE CABINET 19/6**
Product of a famous maker. Complete with top board and speaker grille. See price 18/-, 6d.

**VARIABLE RHEOSTAT**
This is a very heavy duty type, rated at 25 amp., but easily capable of twice this rating. Resistance is 4 ohms, but by the removal of one wire becomes 8 ohms. Alternatively it can be rewired to suit individual requirements. Adjustment is by rotating a Bakelite knob which controls rheostat to a heavy duty slider, ideal for dimmer circuit. Price 8/-, post and insurance 3½d.

**VALVE HOLDERS**
Amphenol type 87G-87A and others. See price 5/-, doz., as you want. Nylon loaded 2½d.

**MOLGONITE POTENTIOMETERS**
Standard size with good length sensitivity, potentiometer values, price 1/- each, plus 3½d. postage. Each of 10k, 25k, 50k, 100k, 250k, 500k, 1 meg. and 2 meg. 7½d. each.

**MANY OTHER BARGAINS**
These will be special bargains for callers at all branches and it will definitely be worth your while to pay each branch a visit.

**SUMMER SALE**
**AMPLIFIER CASE 62/-**
A robustly made cabinet in the modern style of two tone fabric, will comfortably house speaker and amplifier in the end compartment and has uncut motor board for tape recorder or record changer, lacquered fitting and plastic handle. See price 62/-, carriage and insurance 7½d.

**AMPLIFIER FOR ABOVE**
Use three valves one of which is low noise pentode. E.F. 80 mains transformer isolates chassis. See price £2.15.0, plus 2½ post and packing.

**MAINS MOTOR**
Powerful electric motor, size 4½ in. long by 2½ in. diameter, with speed varied suitably for operation on standard C.C. mains. Ideal for driving fans, mixers, car headlamps, etc. etc. Don't miss this snip. 12/6, plus 2½ post and insurance.

**TOWARDS AUTOMATION**
Rotary switch—Ministry Ref. No. AP575979. This is a motor-driven switch, the driving motor being a synchronous type for working on 110 volt 50 cycle. The two switches have 20 positions each and are enclosed by a Perspex fronted lid. Twin units 30/6, with tubes, complete with tube. Price 2½ for 25 watt standard tubes. See price 35/-, with tubes, complete with tube.

**MISCELLANEOUS SALE BARGAINS**
200 micro amp, basic 2½ moving coil meter 17½/-, post 3/½. 100,250, 500, 1000, 2500, 5000, 1 meg. and 2 meg. 7½d. each.

**ORGANTONE PARCEL 39/6**
Here is an opportunity to build a fine set at a low figure. The parcel contains all the essential parts as follows:
- Punched and prepared chassis with scale pan-coloured glass dial with fixed cushions—drum drive and slide main transformers—volume control—tone control—3½ valve holders—circuits, instructions. Limited quantity only for 30/-.
- Plus 3½ post and insurance.

**SAVE £12-0-0**
The Cleveland Band III Converter is one of the best on the market—literally thousands are in use all over Britain. See price 3½/-, plus 5/- carriage and insurance.

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

**ELECTRONIC PRECISION EQUIPMENT, LTD.**
Post orders to E.P.E., LTD., Dept. 7, Setton Road, Eastbourne.

**FLUORESCENT LIGHTS**
These are complete fluorescent lighting fittings, built-in ballasts and starters—stove enamelled, ready and ready to work. Ideal for the kitchen, over the workbench in similar locations.

**SAVE £12-0-0**
*THE CLEVELAND BAND III CONVERTER IS ONE OF THE BEST ON THE MARKET—LITERALLY THOUSANDS ARE IN USE ALL OVER BRITAIN. SEE PRICE 3½/-, PLUS 5/- CARRIAGE AND INSURANCE.*

**ELECTRONIC PRECISION EQUIPMENT, LTD.**
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**SAVE £12-0-0**
*THE CLEVELAND BAND III CONVERTER IS ONE OF THE BEST ON THE MARKET—LITERALLY THOUSANDS ARE IN USE ALL OVER BRITAIN. SEE PRICE 3½/-, PLUS 5/- CARRIAGE AND INSURANCE.*

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**BRIMAR 6BQ7A**

The Brimar 6BQ7A is a double triode consisting of two independent high slope sections with similar characteristics. The valve is particularly useful as a cascode R.F. amplifier for television receivers and also as a combined oscillator and mixer for frequency modulation receivers. It can, of course, be used wherever high slope triodes are required, and features low interaction between the sections as an internal screen is provided which brings out to a separate base pin.

**Heater voltage** .................................................. 6.3 volts
**Heater current** .................................................. 0.4 amp
**Anode voltage** .................................................. 150 volts
**Cathode bias resistor** ............................................ 220 ohms
**Anode current** .................................................. 9 mA
**Mutual conductance** ............................................. 6.4 mA V
**Amplification factor** ............................................. 39
**Anode resistance** ................................................ 6.100 ohms
**Grid cut-off voltage (1-10μA)** .................................. -10 volts approx.

Write to the Publicity Department for a data sheet.

---

**TYPICAL CHARACTERISTICS**

- **R.M.S. Conductance**
  - Anode: 0.35 mS
  - Cathode: 0.25 mS
- **Input Impedance**
  - B.E.N.: 2000 ohms
  - B.S.C.: 1000 ohms
- **Output Impedance**
  - B.E.N.: 400 ohms
  - B.S.C.: 200 ohms

---

**BRIMAR 6BQ7A each section**

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**STANDARD TELEPHONES AND CABLES LIMITED**

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**FOOTSCRAY SIDCUP KENT**

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**PREMIER RADIO COMPANY**

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**B. H. MORRIS & CO. (RADIO) LTD.**

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**2-BAND T.R.F. RECEIVER**

**MAY BE BUILT FOR**

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**MULLARD AMPLIFIER KIT**

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**All the components for the Mullard Hi-Fi receiver on one chassis. Total six valves may be purchased for £12.12.0 plus plug. & post 7s.9d. or amplifier and tone control in a separate unit for £14.14.0 plus plug. & post 7s.9d.**

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**COMPACT GRAM AMPLIFIER**

**Suitable for any type of Pick-up Volume and tone control fitted with knobs. Overall size 2½, long 9in., wide 5½in. high. Complete new model, for £12.14.0 plus plug. & post 2s.**

**£219.6**

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**A NEW TAPE RECORDER**

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**CREDIT TERMS:**

- **DEPOSIT**: £5
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**H.P. TERMS:**

- **DEPOSIT**: £20
- **£12.10.0** and 12 monthly payments of £1.17.1

---

**Send for Leaflet**
readily visible after installation. An oval hole must be cut in the front face to match the speaker opening, and clearance holes for the control spindles. The prototype is finished in black "Pan!" with white control knobs. Black dots have been added to the V.C. and W.C. knobs by drilling dimples and filling with black paint to give an indication of the operating positions. The tuning dial is graduated 0/100, but the provision of station names is a matter for individual choice. Since the main bulkhead comes between the set and the engine, no back has been provided for the casing. For additional ventilation, three rows of holes have been drilled through the sides of the casing, just above the top of the chassis. On a journey lasting three hours, with the set continually in use, the casing does get warm, but inspection has shown that there is insufficient heat below the chassis to cause any concern.

One further refinement should be mentioned. It is advisable to drill additional holes through the top, bottom, and right-hand side of the casing to line up with trimmers and aerial coil cores to allow final adjustments to be made with the set in its casing inside the car. Those for core adjustment can conveniently be $\frac{3}{8}$ in. diam. and will be out of sight after final installation.

**Power Supply Connections**

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

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**CHASSIS DRILLING**

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<tr>
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<tr>
<td>B</td>
<td>5/32 in.</td>
<td>G</td>
<td>$\frac{5}{16}$ in.</td>
</tr>
<tr>
<td>C</td>
<td>5/32 in. csk.</td>
<td>H</td>
<td>1 in.</td>
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<tr>
<td>D</td>
<td>13/64 in.</td>
<td>J</td>
<td>1 $\frac{3}{8}$ in.</td>
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<tr>
<td>E</td>
<td>1 in.</td>
<td>K</td>
<td>1 in.</td>
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(To be continued)
Built-in Metering

CHECKING PERFORMANCE WITH A FIXED METER AND SWITCHING

By A. M. St. Clair

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

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

Principles

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

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

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

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

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

(Continued on page 331)
A highly successful unit (W/World circuit), incorporating various valuable and innovative, Midget BVA valves, etc. Chassis size 7 1/2 x 2 1/2 in. Thousands already in use. Suitable for most types of T.V. sets. TRF or Superhet. Kit of parts, Blueprint 1-6, Power pack kit 30c. Switch kit (Band 1 - Band 3 A.C. switching), 6d—all Post free. Wiring and aligning of above. Full range of Band 3 aerials in stock. Adaptors from 7/6 per set. Outdoor or indoor dipoles with 4 yds. cable, 13/9. Band 1 — Band 3 crossover filter unit, 7/6, 6 db—36 db. 7/6. BBC Break-through Filter, suitable for BBC pattern rejection, 8/6.

**BAND 3 T/V CONVERTER—185 Mc/s - 199 Mc/s**
Suitable for London, Birmingham and Northem Transmissions
£2.50 - 5 post free

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**Volume Controls**
80 ohm COAX
80 ohm COAX

**Specifications**

- **Gain**: 10,000 ohms
- **Input Impedance**: 15,000 ohms
- **Output Impedance**: 5000 ohms
- **Frequency Response**: 150 Hz to 15,000 Hz
- **Sensitivity**: 1 mV
- **Distortion**: <0.1%
- **S/N Ratio**: >50 dB

**TWIN SCREEN PAYS**
80 ohm CARL COAX, 4/5 d.p.
80 ohm CARL COAX, 4/5 d.p.

**Units**
10 units. 4 of 4 d.p. and 6 of 5 d.p.

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**ALL-WAVE RADIOGRAM CHASSIS**

- **Antenna Inputs**: 3-band, 2-band, and 1-band
- **Valves**: 3 bands, 2 bands, and 1 band
- **Frequency Range**: 0.1 MHz to 30 MHz

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**NEW VALVES GUARANTEED**

**EBC33**
**EL84**
**EBC33**
**EL84**

**SPECIAL PRICE FOR SET**

**F.M. TUNER**
174-170 630p/m.
175-170 630p/m.
176-170 630p/m.
177-170 630p/m.

**AMPLIFIER**
630p/m. 640p/m.
650p/m. 660p/m.
670p/m. 680p/m.
690p/m. 700p/m.

---

**SPEAKER PRICING**

**Expanded Bronze Alloys**
5 in. 6 in. 7 in. 8 in. 10 in. 12 in.

**SUPERIOR TYPE**

**Glass TNF, etc.**

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**TRR AND BANDS**

- **Band 1**: 150 kHz to 30 MHz
- **Band 2**: 30 MHz to 90 MHz
- **Band 3**: 90 MHz to 150 MHz

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**F.M. TUNER-UNIT (87 out) 105 meter by Jason**

As described in Radio Constructor, and Approved Kit of parts to build this highly commercial radio Valves are diode and 4-300 B, etc., and have a 10 MHz post free.

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**TRR RADIO COMPONENT SPECIALISTS**

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**50 yards Thornton Heath Station.**

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R.C.S. VALVELESS "ALLTIME" RADIO

REALY WORKS FOR LIFE!
Works without valves or batteries. Will never run down or burn out. Utilises sensational new Loopstick tuner. Will receive local stations any time. Permanent crystal diode in attractive case. Full construction data, point-to-point circuit and price list of components.

PRACTICAL WIRELESS July, 1957

POST and packing: Under 10/- add 9d.; under 40/- add 1/6; over POST FREE.

R.C.S. PRODUCTS (RADIO) LTD., 11, OLIVER ROAD, LONDON, E.17. (Mail Order only)

Presenting the new HOMELAB range of SIGNAL GENERATORS

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100 kc/s. to 100 Mc/s CW or 400 ~ modulation. Audio signal for amplifier tests PRICE: £4.10.0d., p. & p. 5/-

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100 kc/s. to 130 Mc/s. Sine and square wave modulation at 1,000 ~ . Sine or square wave signal for amplifier tests PRICE £8.10.0d., p. & p. 5/-

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An AM/FM signal generator covering all modern radio and TV requirements up to 240 Mc/s PRICE £15.15.0d., p. & p. 5/-

Send stamp for full details of above, and also our Mullard FM Tuner complete with power supply PRICE: £12.0.0d.

HOMELAB INSTRUMENTS LIMITED
615-617, HIGH ROAD, LEYTON, LONDON, E.10
Telephone: LEYtonstone 6851
But look at Fig. 2. Here we have the same amplifier section, with suitable metering points added.

It will be seen that there are five points, marked on the diagram A, B, C, D and E. A and E will give a measure of the total current of V.1 and V.2 respectively. B will check the H.T. to V.1, and D that to V.2. C, which is optional but very valuable, gives the leakage of the H.T. decoupling condenser C.I. These measurements will give a very complete diagnostic picture of the condition of the circuit—better, perhaps, than that obtained with a multi-range voltmeter.

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

Such a meter will require 0.1 volts for full-scale deflection (1 mA x 100 ohms = 0.1 volts). If we agree to use a centre-scale deflection for a “normal” reading, this means that we need 0.05 volts at each metering point when the meter is connected. In the case of A and E (Fig. 2) we see that we have a current of 6 mA (5 anode plus 1 screen) with which to develop this voltage. By Ohm’s Law we get E/I = 0.05 x 1000/6 = 8.7 ohms approximately. This is the value of r.1 or r.7 in parallel with the 100 ohms of the meter. Therefore, r.1 and r.7 = 8.7 x 100/(100 - 8.7) = 9.5 ohms, approximately. Wattage = FR = 36 x 10^-4 x 9.5, approximately a third of a milliwatt; nothing big required here! Select a 10 ohm a little low on tolerance.

Make r.3 100 ohms. When the switch puts the meter across it, the net resistance between B and earth will then be 50 ohms. To produce 0.05 volts we therefore require 1 mA. An extra drain of 1 mA through r.8 will drop the voltage at the low end of it to 230 volts. (This drop will be unimportant in most cases; if it is not, r.8 must be changed to a slightly lower value). Hence, by Ohm’s Law again, r.2 must be 230 K ohms. Wattage = 10^-4 x 230,000, approximately a quarter-watt. Select a half-watt 220 K a little high on tolerance.

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

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

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

In the circuit used as an example, three of the metering points—A, C, and E—will have small alternating components in the voltages developed. That at E will be too small to cause any trouble. That at C will be either 50 or 100 c/s, depending upon the rectification system employed in the power pack. It will also be small, and, since it cannot be effectively decoupled, will have to be tolerated.

A should be decoupled as shown. If the circuit is working at audio frequencies, 50 μF will give good decoupling down to 1 kc/s, and lower frequencies will not give appreciable trouble. At R.F. a 0.5 μF would be adequate.

![Fig. 3. Metering points connected to a switch.](image-url)

![Fig. 4. Metering several points on a special panel set-up.](image-url)
Connections

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

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

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

TRACING THE EARTH SATELLITE
(Concluded from page 305)

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

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Tracking the Earth Satellite
(Concluded from page 305)

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

A Diode & 3 Transistor PORTABLE

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

By Capt. R. F. Graham

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

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

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

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

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

C3, C4, R1, R2 and R3—C3 by-passes R.F. R3 supplies bias for Tr3.

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

Tr2—Driver Transistor may be any small audio p-n-p type. It works on the steep straight part of the curve efficiently. Input is primarily to base then emitter at +11 volts. As audio rises to a peak Tr1 collector and Tr2 base become more positive due to increasing potential across R4 and R5, thus Tr2 output current falls. Tr2 bias is audio modulated within pre-set limits on the steep curve. Excessive input to L2 cannot damage Tr2 as it could damage Tr1, but R4 limits Tr1 output. Both transistors are quite safe. Excessive input will drop Tr2 working point below the bend, distorting fidelity like an over-biased tube does.

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

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

Cn—The Choke may be any audio type provided that its D.C. resistance is not so high as to produce excessive bias for Tr3. A tap ratio 3:1 or more
provides matching. The impedance to audio should be 10 to 20 H.

Tr3—Output Transistor may be OC72 or any \( \frac{1}{2} \) to \( 2 \frac{1}{2} \) watt p-n-p type. As audio rises to a peak the Tr2e and Tr3e become more positive, but in this case the input is primarily to Tr3 emitter then base at \(-1\frac{1}{2}\) volts. Bias to Tr3 increases and its output increases. Tr3 works from near the bottom of the load line across its Ic-Ec curves up to the maximum current or wattage. It requires little bias so it keeps cool. Efficiency is better than by transformer coupling. The emitter cannot be said to be grounded, it is common to input from one battery and has another battery for output.

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

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

The Output Transformer should be a good fidelity type. Miniatures are no good. The best for home use was out of my spares box. It is a mains power type for a transmitter, has many taps to match a speaker, has good fidelity due to well interleaved windings, and in spite of excessively heavy laminations it works in a large speaker cabinet. All windings are in series for better

Z; it acts as an auto-transformer. Windings should have low D.C. resistance and high impedance to audio, impossible in a miniature.

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

Fig. 1.—Theoretical circuit of the portable.

connected across an open switch, S1 or S2.

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

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

Construction and Tests

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

L1 and L2—Loop coils are easily made from square sheets of insulating material 1/16 in., but thin plywood will do. The 15 radial slots at 24 deg. angles are cut out 1/32 in. wide. M.W.185 \( \mu \)H coils have 24 turns .036 tinned Cu polythene insulated. The inside diameter is 6/16 in., outside

(Continued on page 339)
This catalogue gives you full details of electrical characteristics, dimensions AND PRICES of 71 Solent transformers and chokes available IN STOCK for radio and electronics constructors. The Solent series is designed to BSS.2214 Group 10/55 with fixing centres complying with RCL.216.

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Adding carriage: 10/- for receiver, 5/- for power pack.

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

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

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

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

A view of the underside of the receiver.

**LIST OF COMPONENTS**

<table>
<thead>
<tr>
<th>Number</th>
<th>Component</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 and C2</td>
<td>365 µF variable and dial.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>0.01 µF moulded plastic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>0.001 µF mica.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td>0.001 µF moulded plastic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>50 or 100 µF electrolytic, 25 volt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td>0.002 µF ceramic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td>100 ohm wire-wound variable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>2,000 ohm 1/2 w. carbon.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R3</td>
<td>200 ohm wire-wound variable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R4</td>
<td>10,000 ohm 1/2 w. carbon.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R5</td>
<td>50,000 ohm wire-wound variable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R6</td>
<td>See text. (500 ohm variable.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diode</td>
<td>Germanium, BRIMAR GD3 or OA70.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tr1</td>
<td>OC70, Tr2-OC71 or similar.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tr3</td>
<td>OC72 or Sylvana 1/2 w. 2N68 or 2 1/2 w. 2N242 or any between.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ch. and Trans.—See text. John Bell and Croyden, 117 High Street, Oxford.

Ch. type LR—XXTYQ—85.

Trans. Type LR—TYQ—21 for 150 L.S.

S1—Switch s.p.s.t. any type.

S2—Switch s.p.d.t. with centre OFF.

M1—Meter 2 mA D.C. moving coil.

M2—Meter 5 mA D.C. temporary use.

Battery 1 to 2 volts, any type.

Battery 3 to 6 volts, any type.

Phones jack and socket, any type.

Panel, Bakelite or equivalent.

Box or carrying case to suit components and personal taste.

L.S.—Loudspeaker, see text.
M2, in series. Connect Tr3 emitter direct to Tr2-C and to 3V plus. Another 5 mA meter is at M1 between S2 and direct to Tr3-collector; no transformer. Set 500 ohms to be zero ohms. Wire up Tr3 base, switch on S1 and S2 and adjust R5 and test resistor for both meters to read 1.6 mA. Switch off, remove and measure the test resistance. A choke with a 3:1 ratio tap may have less than three times the measured resistance, allowing final adjustment by R3. If a tapped choke is not obtainable use a small mains transformer, all windings in series for desired tap and D.C. resistance. Measure transformer primary D.C. resistance. This D.C. load must be sufficient to limit wattage specified by transistor manufacturers. If an additional load is necessary it is better to put R6 as shown for some D.C. and A.C. feedback. If audio feedback is not wanted the C6 is connected direct to Tr2-E then transformer will give a greater output to L.S. If the transformer has more D.C. resistance than necessary it will waste wattage. With 3 volt batteries and 50 ohms correct load for 45 mW OC72, peak audio will rise to 110 mA and voltage at collector will drop to near zero. A 4 volt battery requires 90 ohms load or 43 volts—113 ohms for OC72. A 6 volt must have 200 ohms—13 volts—935 ohms is not recommended for OC72. Other type transistors must be safeguarded from overload by calculating safe load to be used. There are two formulae and the higher resistance of the two must be used as load. 1: To avoid current overload fcp: load equals battery voltage multiplied by peak rating. 2: To avoid wattage or dissipation rating: load equals battery voltage squared and divided by four times milliamp rating.

\[ R_L = \frac{V_C}{I_C} \]

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

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

If output is matched to speaker M1 will give a steady reading (C6 disconnected). If there are too many turns for LS, M1 will kick up on louder sounds and output will sound muted. If there are too few turns M1 dips and output is crispier but harsh. Meter movements due to loud percussion sounds are ignored. Somewhat the same applies to match between choke and Tr3 by watching M1 and M2. Excessive inputs cause meter fluctuation. Do not match up with too much volume or input. Correct input produces a drop of 0.3 mA on M1 and OC72. 2\(\frac{1}{2}\) watt type will take a bigger drop, with more bias to Tr2. Correct input will produce maximum watts with no distortion. Everybody who has heard this receiver remarked on its excellent fidelity and no background noise. Connect up C6 to complete circuit.

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

**TAPE RECORDER MAINTENANCE**

(Continued from page 202)

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

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

These faults again can easily be traced. For music the maximum speed must be used to avoid the wow, e.g., 15 in./sec. or 71/2 in./sec. For speech any of the slower speeds will be sufficient and therefore we have longer playing time. We have another cause of wow as in Fig. 2. In this case the ballbearing at the bottom of the shaft wears the spindle to a concave; therefore we have more surface area and the thrust is not taken up as it should be. The solution in this case is either to grind or file the spindle flat and to adjust the thrust by the thrust screw.

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

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

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CAT. NO. OR/AFM48PP, complete audio Chassis of Latest Design and Technique. 9 valves. 4 wavebands including FM/VHF Band. Puts full output stage, including special 4Hz high-v. density speaker, A.C. 200-250 volts 60 cycles only. Suitable for Multi-coloured glass dial of the horizontal type. Mains motor tuning drive. Full provision of Automatic Volume Control. Negative feedback from output transformer secondary. Speaker provided for Aerial, Earth, Gram. Pickup and Extension Speaker. Connections provided for 6m. Motor controlled by Chasis on/off switch. All Chassis have an exceptionally high Q value. The Audio Section is designed for first rate reproduction on Radio and Gramophone. The tone controls have been given an extra wide range to embrace all types of recordings. From 17t. long & radio to 25t. deep. 

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Radio and Automation

Radio apparatus is finding increasing use in modern commercial practice. Some details are given here

By F. E. Sonn

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

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

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

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

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

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

Little Inertia

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

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

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

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

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

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

Transistors in Automation

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

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

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

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

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

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

Limitations of Transistors

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

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

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

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

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

Automatic Control

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

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

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

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

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

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

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

and things as they are met with on our daily rounds, and which make the salt of real humour.

Music

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

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

Plays

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

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Early Tape Recording

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

Earliest Licence?

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

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

An F.M. Tuner

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

A small (2in. x 2in.) chassis is added at the R.F. end, and on this are mounted VI and the aerial coil. The latter is not wound on an I.F.T. core, but on a new 1in. former with dust core, and its own screening can. Thus three of the original I.F.Ts are left, and two I.F. stages can be used to give extra sensitivity: or the second I.F. valve can be connected as a limiter, two limiters in series giving better suppression of interference.

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

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

Replacing the Line-cord

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

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

If it is decided to drop the H.T. to the correct voltage by fitting a resistor in the anode lead of the rectifier, the following interesting effect should be taken into account. Any appreciable resistance in the anode circuit of the rectifier produces a voltage drop across the valve itself, and the higher the resistance the greater the drop. As an extreme example, I came across a set with a 2,200-ohm resistor in the rectifier anode circuit which dropped the 240 v. A.C. mains to 150 v. on the anode, but at the rectifier cathode the D.C. voltage was only 40 v.

The reservoir capacitor was in order and replacing the rectifier with either of two others gave just the same result. Tapping the H.T. into the line-cord reduced the voltage drop across the rectifier to 30 (there was still about 280 ohms in circuit), giving at
the cathode 110 v. at 73 mA (a parallel fed energised speaker was used). So the voltage should be checked at the rectifier cathode rather than at the anode.

If a line-cord or dropper is used it is wise to fit a "Brimistor" (connected between the line-cord or dropper and the rectifier heater) as this completely eliminates the switching-on surge, which is so damaging, especially to dial bulbs. Valve heaters have a lower resistance when cold and therefore pass more current, but a "Brimistor," on the other hand, is a special resistor that has a very high resistance when cold and this falls to a low value as it warms up. Type CZI (1½ in. long) should be used for 0.3 amp. heaters, its resistance when hot at this current being 44 ohms, and this may need to be deduced from the line-cord or dropper. Type CZ2 (2½ in. long) is best for lower currents, as there is less delay after switching on; for currents of 0.1, 0.15 and 0.2 amp. it has a resistance when hot of 170, 90 and 66 ohms, respectively. I usually fit the "Brimistor" on a small tag-board mounted on top of the chassis because of the heat, and at least 1 in. of wire should be left between the body and the tags for the same reason.

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

**Sound Reproduction**

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

It might have applied to table models, but the larger sets, No. 1! In fact, the larger loudspeakers had a natural resonance of around 75 c/s and some 50 c/s in the lower register, and there has been no appreciable problem in the loudspeaker lower register since.

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

**Midget Receivers**

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

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

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

Originally I considered making a very small power pack to eliminate the H.T. battery, but I am now quite convinced that this is absolutely unnecessary as the specific batteries for this type of equipment are very small, very cheap and have an exceptionally long life. (Nearly 300 hours of intermittent listening for 22.5 volts at 300µA, the cost being 2½.) The one I am now using was purchased in July, 1955, and has had intermittent use ever since, including some long periods of daily use for an average of half to one hour at a stretch (during lunch hours, etc.) and I have been carrying round a spare for over nine months! For the L.T. an ordinary 3d. pen-torch cell will serve, but tends to run out suddenly after a rather short life and the Vidor Kallium cell is preferable in every way, being 1.3 volts for the 1.25 volt filament.

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

Before concluding, I feel the subject of the Rx BC-1206 is relevant when considering small equipment. Originally this little receiver consisted of a complete five-stage superhet circuit, comprising six valves (the two output valves were wired in parallel). The valves were ordinary *international* octals of the GT or metal series, and there is a three-gang tuning condenser a delight to see for its minute size, complete with slow-motion drive. The size of the complete receiver is 4½ in. x 4½ in. x 5½ in! The entire thing worked off 28 volts D.C. for both H.T. and heaters. (The latter 6.3 volts being wired in series.) It is not an insuperable task to convert this set to work off a normal 250 volts H.T. and 6.3 volt heaters.—MICHAEL J. DUNN (Cambridge).

**Correspondents Wanted**

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

**SIR.—**Would anyone, with the time and energy, correspond with me? I am most interested in every aspect of radio construction and operation.—A. BARKER, 5, Glenthorne Ave., Brickfields, Worcester.
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Consortium (D, Pen), A.C. ... ... AW403*

SPECIAL NOTE

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

The index letters which precede the Blueprint Number indicate the period 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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S.W. One-valver for American ... ... AW429*
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Ultra-short Battery Two (SG, det Pen) ... ... WM402*
Four-valve : 3/6 each
A.W. Short Wave World-beater (HF Pen, D, RC, Trans) ... ... AW436*
Standard Four-valver Short-waver (SG, D, LF, P) ... ... WM383*
Mains Operated
Three-valve : 3/6 each
Standard Four-valver A.C. Short-waver (SG, D, RC, Trans) ... ... WM391*

MISCELLANEOUS

Enthusiast's Power Amplifier (10 Watts) (3/6) WM387*
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