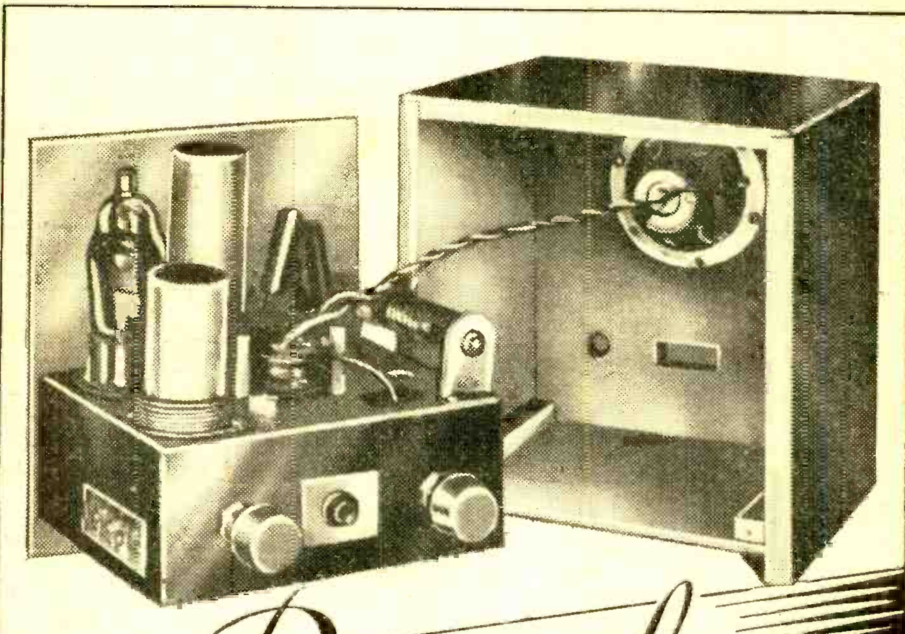
A BEGINNER'S GUIDE TO RADIO

1/-

Vol. 29. No. 559
MAY, 1953

EDITOR:
F.J.CAMM

PRACTICAL WIRELESS



A Personal TWO

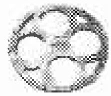
IN THIS ISSUE:

- AERIAL HINTS
- SHORT-WAVE SECTION
- A RADIO CONTROL FREQUENCY METER
- DESIGNING METERS
- TRACING AND CURING HUM
- NOTES ON CAPACITY BRIDGE
- USING A.F. TRANSFORMERS

Sound RECORDING?

—these are your accessories

Recording Tapes



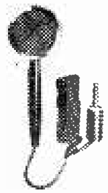
A complete range of recording tapes is available and the following can generally be supplied from stock. Simphonic Grade "A" High coercive tape, per 1,200ft. spool, 35/-. Simphonic Grade "B" Medium coercive tape, per 1,200ft. spool, 25/-. G.E.C. Grade "A" tape, per 1,200ft. spool, 30/-. E.M.I. Grade H65A Low coercive tape, per 1,200ft. spool, 35/-. E.M.I. Grade H60A High coercive tape, per 1,200ft. spool, 35/-. Scotch Boy Grade MC1-111 tape, per 1,200ft. spool, 35/-.

Spare Tape Spools

7in. diameter standard metal spools, capacity 1,200ft., 4/-. 5in. diameter standard metal spools, capacity 600ft., 3/6. 7in. diameter plastic spools, capacity 1,200ft., 4/-.

Microphones

The microphone illustrated is the standard one supplied with the Simphonic 2B Recorder. It is a crystal type hand microphone, and has a particular appeal because it is ideally suited for speech applications with small recording equipments. Chief characteristic is its high sensitivity at comparatively low cost. Complete with 9ft. screened lead and jack plug, £2.10.0.



Tape Joining Fluid

This special preparation is available to facilitate the splicing of broken plastic recording tapes. Dries firmly in a few seconds. Glass rod fixed into bottle cap for easy application. Per bottle, 4/9.

Type DML

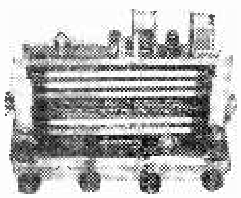
Recommended for use where a higher standard of quality than is obtained with the crystal type is demanded. Useful as a general purpose microphone for Public Address work as well as many other applications. Sensitivity approximately the same as the crystal type, and this microphone has a substantially even frequency response up to 6,000 cycles. Complete with heavy cast base, 9ft. screened lead and jack plug with built-in transformer and muting switch, £7.5.0.

SIMON SOUND SERVICE 48-50, GEORGE STREET, LONDON, W.1

Telephone : WELbeck 2371 (5 lines). *Grams* : Simsale, Wesdo, London. *Cables* : Simsale, London.

Armstrong

THE Chassis People



The prestige of Armstrong chassis is firmly based upon many years of constant endeavour to produce reliable and efficient receivers at an economical price. Our present range of chassis will even further advance the already high reputation enjoyed by our receivers. We are delighted to give demonstrations in our showroom and our illustrated catalogue will be gladly sent on request.

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MODEL EXP 73. 8-STAGE ALL-WAVE RADIO CHASSIS. 3 wave bands. Variable selectivity. Fly-wheel tuning. 8-watt push-pull output with negative feedback. For A.C. mains. £17.15.0, plus P.T.

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RIGHT FIRST TIME!

Trial and error is a costly and often disappointing business. For too long the radio amateur has had such methods forced upon him by the high cost of test instruments. The RADIO MAIL RES/CAP. BRIDGE has changed all that. For 31/6 he now has at his command an instrument to check each component before use, and ensure 100% results.

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5 Megohms—50,000 ohms	50 mfd.—.2 mfd.
100,000 ohms—1,000 ohms	1 mfd.—.01 mfd.
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New components, specially selected for accuracy. Instructions and diagrams for easy assembly.
Prompt delivery Cash with order or C.O.D.
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RECORDING UNIT	Cash Price	Deposit	Monthly pmts.
Recording unit kit, all parts except motors and heads	£5.15.0	£2. 0.0	4½ at £1.0.0
Recording unit kit, including motors but less heads	£9. 5.0	£3. 5.0	7 at £1.0.0
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Recording unit complete, wired and tested but less tape and reels	£18. 0.0	£6. 0.0	12 at £1.3.0
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Complete amplifier kit, less valves ...	£12. 3.9	£4. 7.9	9 at £1.0.0
Complete amplifier kit, with "surplus" valves	£14.14.0	£5. 0.0	11 at £1.0.0
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TELEKING. Constructor's Envelope, **6/-.** Coilsets, **54/3**; Chassis Kits, **70/-**; T.C.C. Kit, **£7/4/3**; R.M.4 rectifier, **21/-**; Allen Wide Angle Components, LO.308, **50/-**; FO.305 **21/-**; DC.300, **42/-**; FC.302, **35/-**; GL.16 and GL.18, **10/-** each; BT.314, **15/-**; SC312, **22/6**; AT.310, **30/-**; OP.117, **9/-**; Resistors and Pots. are detailed in our TK Supplement.

MAGNAVIEW. Constructor's Book from BRIMAR Valves. Denco coilsets, **41/2**; Chassis kit, **37/6**; Erie resistor kit, **39/2**; EDENCO Wide Angle Components (also suitable for TK). WA/DCA1, **43/-**; WA/FCA1, **31/-**; WA/LC1 and WA/WC1, **7/6** each; WA/FBT1, **16/-.** Condensers and pots as per our Magnaview Supplement. ELAC Mark 2 PM Focus Rings (with Vernier Control). R.17, **28/6**; R.X0, **30/-**; R.25, **32/6**; W.22, **52/6**; W.25, **57/6.** Ion Traps IT6, IT8, and IT9, **5/-** each.

LANE Mark 3 Tape Tables with 3 Collaro motors, **£16/10/-**, plus 10/- carriage and packing. Constructors' envelope for the Lane Record-Playback Amplifier, **5/-.**

SUNDRIES. Osmor Q coilpacks, HO, **52/-**; LM, **43/4**; TRF, **43/4**; Osmor Q coils, **4/-** each; QC1 chokes, **4/-**; Weymouth H coils, **3/9**; Wearite P coils, **3/-**; Denco Maxi-Q coils, **3/11**; Denco type C TRF coils, **8/-** pr.; Astral TRF coils, **4/3** each; Polystyrene Varnish, genuine Distrene, **1/10** bottle; 50 watt potted output trans. for 6L6, KT66, 6V6 or PX4 in P/P, **47/3.** Send 6d. stamp for our list covering Teleking, Viewmaster, Magnaview, Williamson Amplifier, P.W. 3-speed Autogram, Tape-Deck Amplifier Modern 1 and 2 Valver, Highspeed Fault Finder, Battery-Mains Attache Case Portable, also General Components, Chassis, etc.

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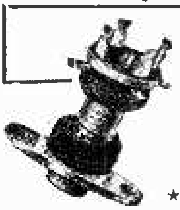

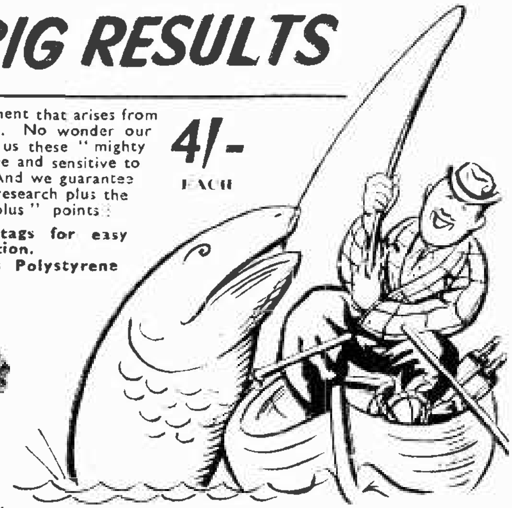

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- ★ **Variable iron dust cores**
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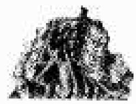

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EF50		VR91	5 -	SP61	2 6	SP41	2 6
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EF36	4 6	EL32	7 6	EBC33	8 -	EB34	2 -
EL50	7 6	D1	2 -	6V6	10 -	KT66	12 6
EA50	2 -	6SH7	4 6	12SH7	4 6	12SJ7	4 6
6SK7	4 6	6Q7	10 -	6SN7	12 -	6AC7	7 6
6K8	12 6	ECC32	8 -	6K7	6 -	955	5 -
ECC31	7 6	9001	5 6	KT44	8 -	1625	7/6
954	3 6	5Z4	10 -	5U4G	10 -	5Z3	7 6
VU39	10 -	HLK2	2 6	S130	6 -	S110A	6 -
105 30	8 -	VU111	3 -	VU133	3 -	6J5	5/-
6N7	7 -	SG215	3	Pen45	5 6	RK34	2 -
12A6	7 -	VR21	2 6	Pen220	4 -	VR13	3 -
1299A	5/6	1R5	8 -	1S5	8 -	1S4	8 -
1T4	8 -	PT15	7 -	CV73	5 -	VR116	6 -
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CONDENSERS.—Electrolytic W.E. B.E.C. 450 volt. Small 8 mfd., **2 6**; 8+8 mfd., **3 9.** Dubilier, 16 mfd., 500 volt W.E., **3/9.**

POTENTIOMETERS.—All values to 2 mg., **2 6** each.

RESISTORS.—All values 1 watt, **6 6** dozen. ½ W. Mixture, **4 6** dozen.

AMPLIFIER CHASSIS LESS VALVES.—I.F. 13 m.c., 3 meg. B.W., 4 stage, 7.SP61, 1 EA50, **15 -**. New condition.

RECEIVER TR9 (Complete with Valves). New. **15 -**. Coaxial Cable, 80 ohms, **10d.** per yard.

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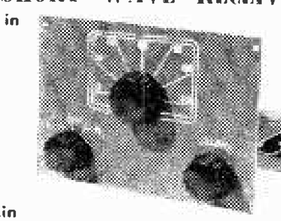

FOR 30/- Post Free

In response to many enquiries we have produced this neatly engineered short wave receiver which will receive stations from every part of the world, including television sound. Only one coil is included for 30/-. Two other coils 7-40 metres can be supplied for 4/- each.

Send 2/- for Layout, Wiring Diagram and Component Price List. 2/- Refunded on Orders over £1.

Mail Order only.

R.C.S. PRODUCTS

DEPT.B. 11, OLIVER ROAD, LONDON, E.17.

Practical Wireless

EVERY MONTH
VOL. XXIX, No. 559, MAY, 1953

Editor F. J. CAMM

21st YEAR OF ISSUE

COMMENTS OF THE MONTH By THE EDITOR

The Effect of P.T. and H.P. on Sales

IT came as a surprise to learn that the production of radiograms for last year was down by about 40 per cent., because our experience is that there is an increasing demand among constructors for radiogram designs. Our recently introduced 3-Speed Autogram is being built in large numbers, as the sale of the components for it demonstrates. We continue to receive good reports of its performance from various parts of the country. Of course, even the most modest commercial radiogram to-day is an expensive item, and unfortunately the manufacturers, in an endeavour to keep the price down and therefore the purchase tax low, have been compelled to use cheap components and the minimum number of valves, housing the set in a very poor ply cabinet. We are, of course, referring to the cheaper radiograms. For their price they give very good performance, however.

The dealers are well stocked with receivers which they cannot sell, although television sales continue to advance. Perhaps by the time these words appear the Chancellor will have made some announcement regarding reduction of purchase tax, and also of income tax.

The position is summarised in the 8th Annual Report of the British Radio Equipment Manufacturers Association. It makes the point that the Chancellor of the Exchequer intended, during 1952, to limit supplies, and states that the conditions in the industry, which is suffering a severe depression, are almost entirely due to hire purchase restrictions and heavy purchase tax. From this they arrive at the conclusion that conditions are now so adverse that there is no longer a need to impose production control in order to achieve what the Chancellor had in mind. These conditions have made trade so bad that by the end of June, 1952, the turnover in B.R.E.M.A. products in this country had dropped by 28 per cent. compared with a similar period in 1951. Stocks, both in the manufacturers' premises and in retailers' shops, accumulated in an alarming way during this period in 1952 and "the arbitrary injection of these fiscal measures greatly distorted the normal trade of the industry and for three-quarters of the year created havoc."

The report goes on to say that had it continued for even a few weeks longer it would almost certainly have brought extensive unemployment and even bankruptcy, and the object behind it has not been achieved. It also states that it is inequitable and inconsistent to apply purchase tax to valves and cathode ray tubes for maintenance purposes while similar expendable component parts of other products are exempt.

SMALL MANUFACTURERS AT EARLS COURT

WE are glad to note that the R.I.C. has adopted our suggestion of including a special components section of interest to amateur constructors at the forthcoming Radio Show at Earls Court. Space has been allocated for small manufacturers supplying components for amateurs, in the form of about two dozen stands on the first floor, each stand measuring about 12ft. by 12ft. and arranged on each side of the double escalator leading from the ground floor over the Warwick Road entrance.

This is certainly a move in the right direction, for that small band of small makers who continue to supply the home constructor market has been neglected in former years. They are not able to pay the very high prices for stands because their turnovers are smaller than those of set manufacturers. The price of these special stands is reasonable and we hope that the component trade will take them up.

CAR RADIO—NEW REGULATION

THE Post-Master evidently has his eye on the large number of car radio receivers in existence which are unlicensed, for there is now a new regulation in connection with the Road Vehicles (Registration and Licensing) Regulations, 1953, under which councils are required upon application to supply to the Post-Master General the name and address of the owner and registration particulars of every vehicle registered with them and which is shown to be fitted with a wireless receiver. The Regulations came into force on February 28th. This augments the arrangements already reported in this journal under which motorists are asked when applying for vehicle licences to declare whether or not the vehicle is fitted with a radio set.—F.J.C.

ROUND the WORLD of WIRELESS

B.I.R.E.

THE following meetings will be held during April, 1953:

London Section.—*Wednesday, April 8th*, 6.30 p.m., at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1. "Lens Aerials for Centimetric Wavelengths," by Lt.-Col. J. P. A. Martindale, B.A., A.M.Brit.I.R.E.

North-eastern Section.—*Wednesday, April 8th*, 6 p.m., at the Institute of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle - upon - Tyne. Annual General Meeting of the Section, followed by a demonstration of Stereophonic Reproduction.

Scottish Section.—*Thursday, April 9th*, 7 p.m., at the Institute of Engineers and Shipbuilders, Glasgow. "Remote Control Devices and Servomechanisms," by A. E. W. Hibbitt.

Thursday, April 16th, 7 p.m., at the Department of Natural Philosophy, The University, Edinburgh. "The Principle and Applications of the Telescribe," by C. A. Gilbert.

Merseyside Section.—*Thursday, April 16th*, 7 p.m., at the Electricity Service Centre, Whitechapel, Liverpool.

West Midlands Section.—*Tuesday, April 28th*, 7.15 p.m., at Wolverhampton Technical College, Wulfruna Street, Wolverhampton.

Mr. R. Y. Parry

MR. R. Y. PARRY, Chief of the Nucleonics Section, at the Malmesbury, Wiltshire, works of E. K. Cole, Ltd., has been elected a Senior Member of the Institute of Radio Engineers.

Technical Data Service

A TECHNICAL data service for the benefit of engineers engaged in the design of radio and industrial electronic apparatus has been introduced by the General Electric Co., Ltd.

This service, which covers Osram valves, G.E.C. cathode-ray tubes, Germanium crystals and associated electronic devices, consists of the distribution of technical data sheets as they are published.

The information provided meets the full needs of the designer and is published in a standardised form which allows easy and quick reference to be made. Application forms can be obtained from the Osram Valve and Electronics Dept., The General Electric Co., Ltd., Kingsway, London, W.C.2.

Marconi Appointments

MARCONI'S WIRELESS TELEGRAPH CO., LTD., have created a new post of General Works Manager of all works and model shops of the company. It will be filled by Mr. Robert Telford, A.M.I.E.E., who was formerly assistant to the general manager.

Mr. J. P. Wykes, A.M.I.E.E., will continue as works manager of the Chelmsford works, and Mr. E. B. Greenwood, A.M.I.E.E., has been appointed works manager of a self-contained factory now being built at Basildon New Town (Essex).

American Visitors

LEONARD CARDUNER, President of the British Industries Corporation of New York, who are the U.S.A. distributors for Garrard Record Changers and Ersin Multicore Solder, is arranging to fly over a party of important U.S.A. radio buyers for the R.E.C.M.F. Exhibition which opens at the Grosvenor House on April 14th. This is believed to be the first time that an organised party from the U.S.A. have ever made a trip to England for an exhibition held in connection with the radio industry.

Since the war the efforts of the B.I.C. to promote the sales of British radio components and materials, particularly Garrard Record Changers and Ersin Multicore Solder, have met with considerable success, and for some time now some British companies have had difficulty in coping with the U.S.A. demand for their respective products.

Many structures and buildings are being cleaned and renovated in readiness for the Coronation. In the Green Park, London, the BBC Control Hut has already been erected for the great event.

25 Years with Mullard

MR. GEORGE MORRIS, Mullard Area Representative for London and the Home Counties, recently completed 25 years with the Mullard organisation. To mark the occasion, Mr. L. A. Sawtell, Commercial Manager, Entertainment Valve Department, presented Mr. Morris with an inscribed gold watch and a cheque. The presentation was followed by an informal luncheon.

During the first World War, Mr. Morris served with the R.F.C. and R.A.F. and later was associated with Radio Press Ltd., and Scott Taggart Ltd. He was appointed Area representative in 1948 and maintains direct contact with wholesalers, chain stores and large buyers of valves for maintenance purposes.

Youth Programme

"QUESTION TIME" usually comes from wherever young people gather together, but a special studio recording is

Mr. George Morris, who recently completed 25 years with Mullard, Ltd.

being made to celebrate the hundredth programme in this Younger Generation series, which began four years ago. The recording will be broadcast in the Light Programme on April 9.

Jack Longland, Director of Education for Derbyshire and a former Everest climber, will be in the chair and the team will consist of Lady Megan Lloyd George; Fielden Hughes, Huddersfield-born novelist and headmaster of a school in Wimbledon, and J. F. Wolfenden, Vice-Chancellor of Reading University and one-time headmaster of Uppingham and Shrewsbury Schools.

Electronic Development

IT is reported that a new electronic instrument, to detect the presence of radio-activity, has been developed by British scientists.

These sets, which are small enough to be carried in a haversack, are to be tested by Civil Defence units.

Radio Procedure Standardisation

IT is learned that N.A.T.O. officers are to meet in London for discussions on the standardising of radio procedure during the North Atlantic exercises.

Broadcast Receiving Licences

THE following statement shows the approximate number of licences issued during the year ended January, 1953. The grand total of sound and television licences was 12,868,183.

Region	*Number*
London Postal ...	1,756,555
Home Counties ...	1,484,353
Midland	1,348,789
North Eastern ...	1,783,429
North Western ...	1,413,332
South Western ...	1,040,566
Welsh and Border ...	693,264
Total England & Wales	9,520,288
Scotland	1,129,960
Northern Ireland ...	214,486
Grand Total ...	10,864,734

Street Lamp Interference

MINISTRY OF TRANSPORT technicians have found that the orange and blue lamps that light the streets of many Midland towns are causing a lot of interference to radio and television reception.

Steps are being taken towards their suppression.

Visit to Italy

MR. P. B. WHITELEY (Director) and Mr. R. T. Lakin (Chief Radio Engineer), of Whiteley Electrical Radio Co., Ltd., flew on a successful business trip recently to Beirut and Rome.

They were received at Beirut Airfield by Government officials and, during their stay of a few days, superintended the installation of equipment shipped from the company's works at Mansfield.

Research in Ulster

THE Audience Research Department of the BBC is to extend its inquiries into listeners' appreciation of radio programmes to Northern Ireland.

Each day a team of part-time interviewers question people in the street on the programmes they heard the previous day. Information gleaned by this method is kept secret by the BBC and considered in planning new programmes.

One piece of information not kept secret by the Research Department is that the 9 p.m. news is still the peak listening item.

BBC Transmitter Orders

THE BBC has placed orders with the Marconi Wireless and Telegraph Co., Ltd., for three pairs of medium-power sound and vision transmitters.

The sound transmitters will have an output power of two kilowatts and the vision five kilowatts. They are being bought for stock.

Largest Audience ?

IT is estimated that 60 per cent. of the nation hears the sovereign's speech on Christmas Day and a possible 70 per cent. tunes in to a big fight.

On Coronation Day, the largest audience in the history of British broadcasting is expected to hear and see on sound and vision the crowning of the Queen; probably, it is calculated, at least 75 per cent.

Armstrong Medal Award

CAPT. HENRY J. ROUND has been awarded the Armstrong Medal by the Radio Club of America for his outstanding achievements in the world of wireless.

Captain Round is one of the few surviving pioneers who worked with Marconi in his early experiments and was an operator at the world's first commercial station at Babylon, New York, from 1905 to 1907.

Mr. P. B. Whiteley and Mr. R. T. Lakin, of Whiteley Electrical, Ltd., are seen on their arrival from Rome at London Airport.

The Beginner's Guide to RADIO

The First of a Series of Articles Specially Written for Those Who Have Become Interested in Radio for the First Time, Explaining the Principles of Radio Transmission and Reception

By F. J. Camm

THE usual method of explaining the fundamental principles of wireless transmission and reception is to start at the transmitting end by explaining how wireless waves are generated and radiated from the transmitter. The explanation usually employs the analogy of a stone being dropped into the centre of a pond (the transmitter) causing waves to form which gradually spread to the shore (the receiver).

In this series I propose to start at the receiving end and to explain how a receiver works by encouraging the reader to build simple apparatus, in the belief that the practical demonstration is more likely to teach than lengthy descriptions and theoretical definitions. I shall, of course, deal with theory and practice at the same time, but I firmly believe that many are lost to the fascinating hobby of constructing receivers of all types because when they take it up they find the study of underlying principles dull and tedious. In this series the beginner will build as he learns.

For this purpose, therefore, I open the series with constructional details of the very simplest one-valve set. The circuit employed is shown below and on the following three pages are illustrated the elements of that circuit with pictorial illustrations of the actual part represented by its theoretical representation in the circuit.

Now a *circuit diagram* is merely a collection of *theoretical signs* connected together by a series of lines representing connecting wires. These theoretical signs are standard, and you will find a complete list of them in most elementary books on radio, including my own "Everyman's Wireless Book," and "The Practical Wireless Encyclopaedia." They will all be shown, of course, in the series as it develops. They represent the shorthand of wireless, and as all wireless literature is illustrated mostly by theoretical diagrams, if the beginner is to make progress it is essential for him to learn those signs and what they stand for, just as it is necessary to learn the morse code if you desire to become an amateur transmitter, or the keyboard of a typewriter if you wish to become a typist.

Now examine the circuit given below. You will find that the theoretical symbols have been numbered from 1 to 13, which

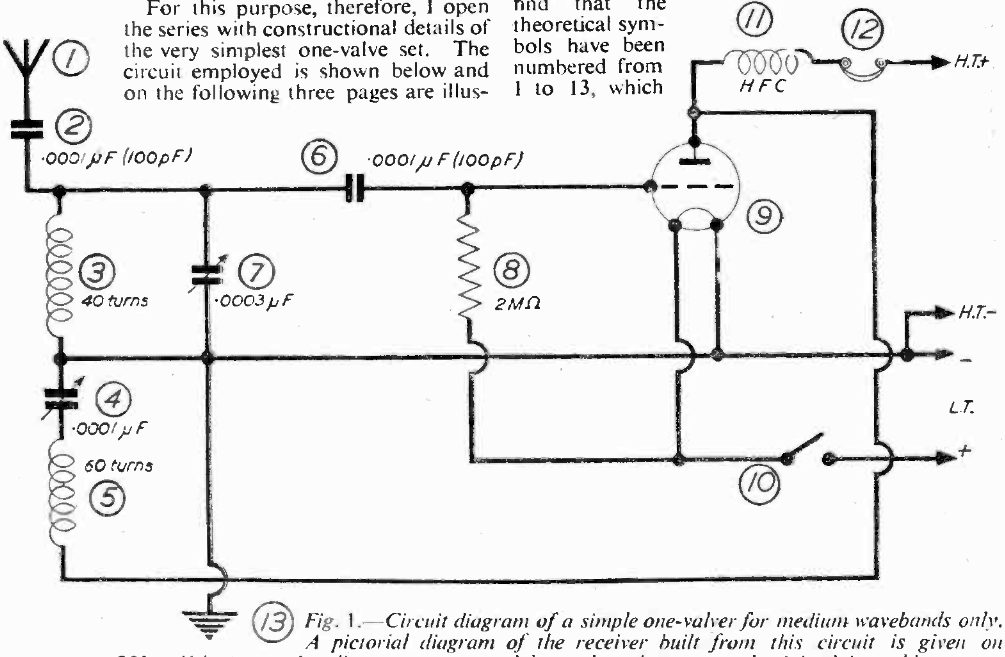

Fig. 1.—Circuit diagram of a simple one-valver for medium wavebands only. A pictorial diagram of the receiver built from this circuit is given on page 253. Where crossing lines are connected by a dot, they are to be joined by solder.

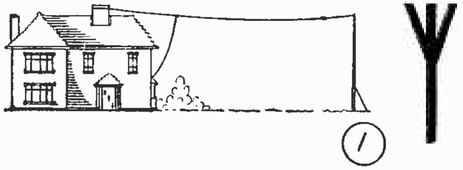

Fig. 1.—The aerial.

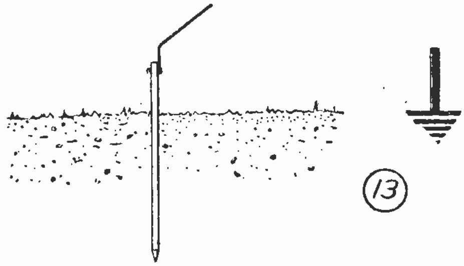

Fig. 2.—The earth.

means that there are 13 components employed in this very simple one-valver, for which it is not claimed that it is the most efficient one-valver, although it is certainly the cheapest. It possesses the advantage that the reader is able to make his own *coils*, *baseboard* and *panel* (which are of wood), and that he can assemble the complete receiver in about an hour and obtain signals.

Each part of the circuit has been separately illustrated and the object it represents drawn adjacent to it on this and the next page. Everyone knows that a receiver needs an *aerial* and, except in the case of portables, an *earth*. It will be seen that the aerial (part 1) is represented by a sign which looks like an umbrella which is blown inside out, and the earth (part 13) by a series of parallel lines gradually diminishing in length so that they form an inverted cone. There are many types of aerial, both indoor and outdoor and, in the case of portable receivers, frame aerials which are built into the set. Very few outdoor aerials are used to-day because the strength of the signals radiated by the transmitter has increased enormously in latter years and receivers have become more sensitive and able to receive even very weak signals. An outdoor aerial is, of course, more efficient and it will enable the set to receive programmes from stations located greater distances away than is possible with an indoor aerial. The shorter the aerial the weaker will be the signal which it picks up. Although the power of the signal is very great at the transmitter, it gradually gets weaker as the distance from the transmitter increases, and the strength of the signal at distances of only twenty miles from it is very weak. This means that unless many valves are used with several stages of amplification (there is at least one stage of amplification in modern receivers of more than two valves; in a one-valve receiver the valve acts both as a detector and an amplifier), the longest possible indoor aerial should be used, but preferably an outdoor aerial. This must be placed as high as possible within the limits of the length set by law—namely, 150ft. inclusive of the length of lead-in, the lead-in, of course, being the wire connecting the aerial to the set.

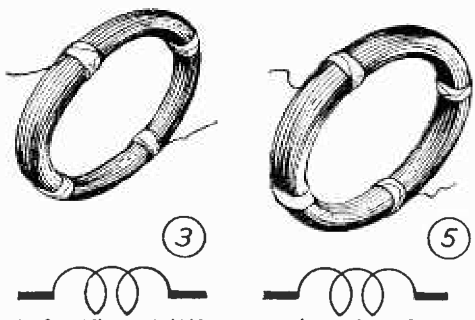

Fig. 3.—The aerial (40 turns) and reaction (60 turns) coils.

The *earth* consists of a metal plate or a piece of copper tube buried in moist earth. Later on I shall explain the purpose of the earth and also the special properties of aerials. Whilst an earth is not absolutely necessary, it is beyond all doubt very desirable, especially with mains sets. Should the aerial be struck by lightning it becomes a safety device when a switch is employed to connect the aerial to the earth when the receiver is not in operation. By this means the considerable electric charge picked up by the aerial is carried safely to earth instead of passing through the set. There are other reasons which will emerge why an earth should be used. The deeper the earth is buried the better: for deep soil remains moist and for good earthing moist earth is essential.

There is no need at this stage to explain how it is that the aerial, the receiver and the earth complete an electrical circuit by means of the ether, but that, in fact, is what these three units do.

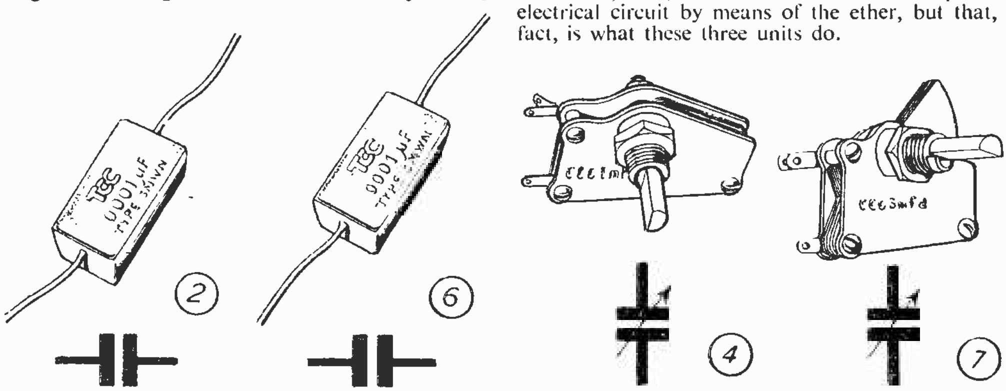

Fig. 4. (left)—Fixed, and (right)—Variable condensers.

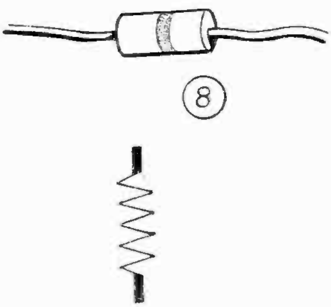

Fig. 5.—The resistance.

Part No. 2 in our circuit is a *series aerial or coupling*, which is a piece of apparatus designed to store electricity. Many condensers are employed in a receiver of various sizes or capacities, the capacity being decided according to the part of the receiver in which it is incorporated and the amount of current it is expected to store. You can conduct a simple experiment to prove that a condenser will hold a charge of electricity. Take one of the condensers which you have obtained for this simple one-valver, and connect the two wires, extending one from each side of it to the terminals of an ordinary flash lamp battery, leaving it so connected for a second or so. Then disconnect it, put the earphones on and connect one lead to one wire of the condenser and the other lead to the second connection. A distinct click will be heard in the earphones, the click indicating that the condenser has become discharged. This, in fact, is a simple practical test if you are in doubt as to whether a condenser has broken down. There are several types of condensers, both fixed and variable. The best fixed condensers consist of alternate layers or *plates* or *laminae* of mica and tinfoil, the tinfoil layers being connected together at each end and to the connecting wires. Cheaper condensers use paper and tinfoil, whilst *electrolytic condensers* consist of two plates of different metals in a chemical liquid solution or paste. They are called electrolytic condensers because they do not become condensers until a voltage, or *potential* is applied to them, which causes a film to form over one of the plates, this film forming the insulator which in other types consists of the paper or mica. Its connecting wires or electrodes are positive and negative.

The material separating the plates of a condenser is known as the *dielectric*. In the case of a *variable condenser* the dielectric can be air (and usually is), although in the case of our simple one-valver here illustrated, a solid dielectric is used of some insulating material, such as paxolin. A condenser has *capacity*, and the capacity is expressed in Farads and the sub-multiples of a *Farad*, such as the *micro-farad* (one millionth of a Farad, which is written as .000001 mfd. or μF). *Micro-micro-farads*, nowadays termed *picafarads* (pF) which equals .000000000001 μF, or a millionth of a millionth of a Farad. The selection of the capacity of a condenser for a particular stage in a circuit is an important part of radio design as we shall see in later instalments. In this receiver there are two fixed condensers and two variable condensers (parts 2, 4, 6 and 7).

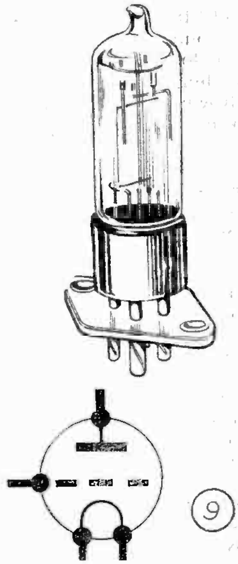

Fig. 6.—The valve.

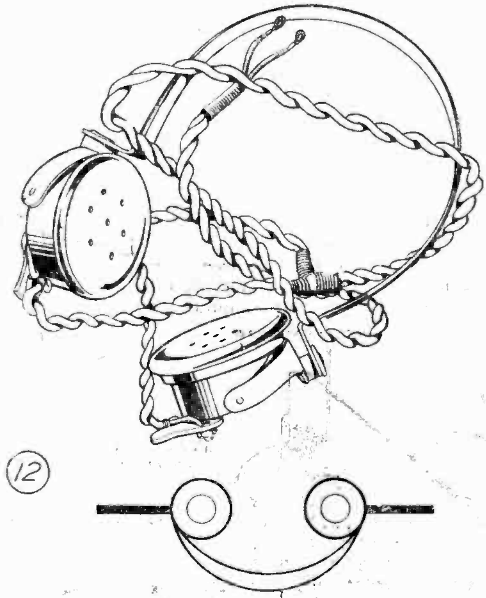

Fig. 7.—The earphones or telephones.

One variable condenser (the *aerial tuning condenser*) enables the aerial to be tuned to the wavelength of the station it is desired to receive; whilst the second is a *reaction* condenser. It will suit present purposes if it is stated that reaction is used to build up the strength of weak signals.

Parts 3 and 5 are the coils, in this case simple hank wound coils made from 26 gauge cotton covered wire. They can be wound in a few minutes on a piece of wood 1¼in. diameter or any round object of that size. The *aerial coil* consists of 40 turns of wire,

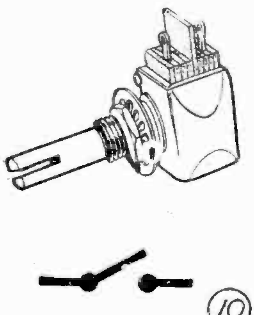

Fig. 8.—The switch.

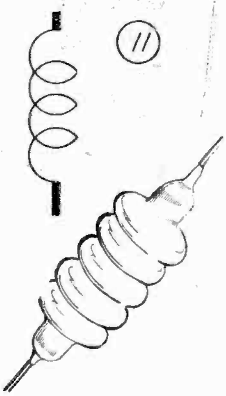

Fig. 9.—The high-frequency choke.

whilst the reaction coil has 60 turns. One coil should be wound in a clockwise direction and the other in an anti-clockwise direction. This is known as *astatic* winding. Of course, commercial coils are more efficient than these, and also they are of different form, and contain more than two windings, a long-wave winding, a short-wave winding, a reaction winding and other windings according to the purpose for which the coil is to be used. There are other coils used in a multi-valve set apart from aerial tuning coils, but I shall deal with these as we develop instruction from one-valvers to receivers employing several valves. For the sake of simplicity the one-valver here dealt with is only intended to receive the medium wavebands.

The Resistance and Valve

Part 8 is a *resistance*. A resistance is used to oppose the flow of current, and its value is decided by the amount of current it is intended to hold back. Its value is measured in *ohms*, the ohm being the unit of resistance. The purpose of the resistance will emerge later. As with condensers several resistances of differing values are used in modern receivers, and the type selected is decided by the amount of current it has to pass or resist. Only one is used in this receiver.

Part 9 is the *valve*. It has a *filament* like an electric light bulb. It also has a *grid* and a *plate*. The *accumulator* or *dry battery* is connected to the two pins, which, in turn, are connected to the filament, and when the filament is hot it emits *electrons*. The plate is connected to the *high-tension battery*. The grid surrounds the filament and the plate surrounds the grid. Some valves have additional grids, according to the circuit in which they are employed. The valve employed in this receiver has only one grid.

When the electrons are emitted from the filament they pass to the grid and are attracted to the plate, also known as the *anode* from whence they flow back to the high-tension battery.

The grid is a spirally wound length of special wire to which the incoming wireless signals are fed.

We shall have more to say about the action of the *thermionic valve* as this series develops. Part 10 is the *on/off switch*. It will be seen that it is connected in the low-tension positive lead. In its open position it disconnects the battery supply. In its closed position it acts just as though there is a continuous wire from the battery to the set.

The Choke and 'Phones

Part 11 is the *high-frequency choke* which is a coil of wire presenting a barrier to *high-frequency current*. Its principal use is to divert the high-frequency oscillations of the detector valve for reaction purposes. It must have a low *self-capacity* and to achieve this the best are wound in sections.

Part 12, of course, represents the *telephones*, or earpieces, by means of which the received signals are heard. It consists of an electro-magnet with a disc or diaphragm of soft iron fixed just in front of the pole piece of the magnet. This disc vibrates when signals are applied to the magnet, producing audible sounds. *(To be continued)*

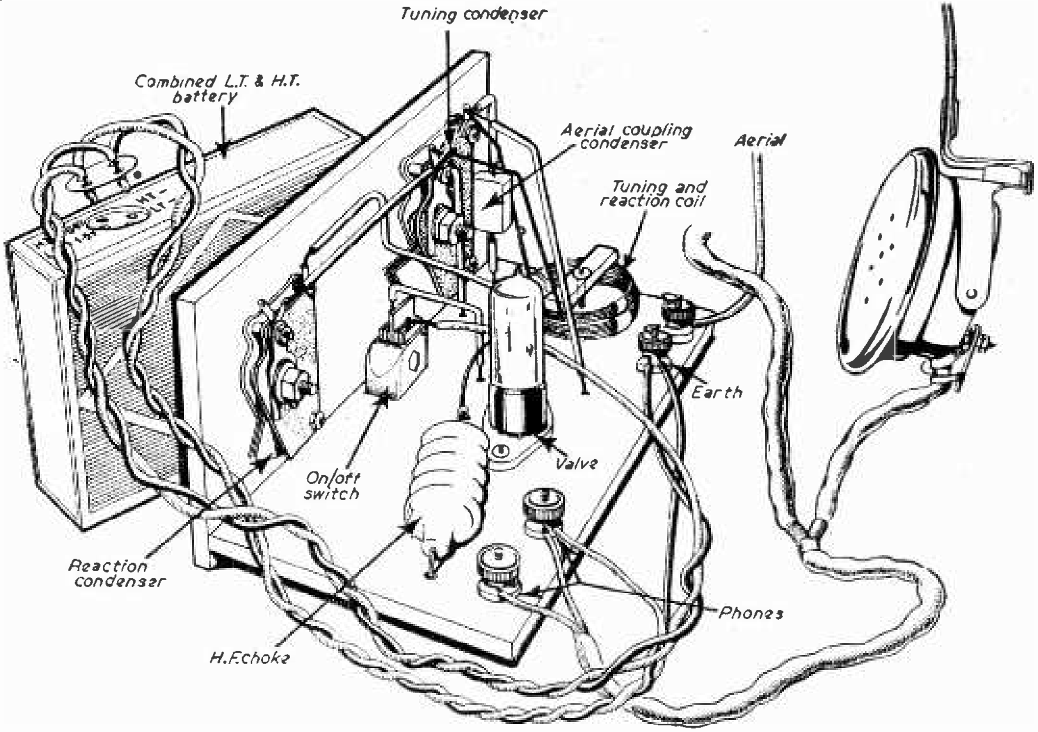

Fig. 10.—Pictorial wiring diagram of circuit shown by Fig. 1. Some of the wiring is underneath the baseboard, which is fixed to the panel to clear the valve holder sockets.

Notes on the Direct-reading Bridge

REPLIES TO SOME QUERIES ON THE INSTRUMENT DESCRIBED IN THE ISSUE DATED SEPTEMBER, 1952

By Robert D. Paterson

QUESTION.—I have been unable to obtain a 4-pole, 11-way switch. Can two or more simpler switches be arranged to give the same ranges?

Answer.—Four-pole, eleven-way switches appear to be in shorter supply than when the prototype bridge was built, but one cannot use two or more simpler switches without sacrificing the simplicity of handling which is the most desirable feature of the bridge. To set a number of independent switches to obtain the requisite network and range would be troublesome and entail greater risk of error. However, there are alternatives. The first (and least profitable) of these is to limit the number of ranges to suit the switch available, omitting for preference the 10-1,000 μF range and one or more of the inductance ranges according to the work expected of the bridge. The reason for choosing to omit this particular capacity range is that condensers of over 10 μF can be dealt with on the 10 μF range by measuring them in series with another condenser of 2 to 10 μF whose capacitance has been previously ascertained and then calculating their values from the familiar equation :—

$$1 / x = 1 / \text{resultant} - 1 / \text{known}.$$

The better alternative is to build up the switch from Yaxley wafers, which are still available, and this again can be done in more than one way.

First consider the possibility of using *for each pole* of the switch two wafers with their moving arms joined and their contacts placed to supplement each other, so that successive positions of the switch will bring into circuit (say) five contacts on one wafer followed by six on the other, and so on.

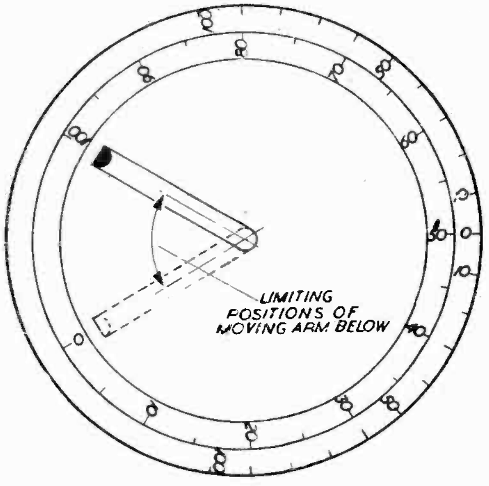

Fig. 1.—Subsidiary 'bracketing' scale for multiplier dial.

If this proves impracticable build up the necessary combination. Since Yaxley switches are mass-produced each insulating frame is capable of accommodating twelve contacts whatever its complement when purchased. So buy four wafers of the one-pole type with as many as possible contacts on them. Buy also sufficient surplus wafers to provide enough contacts (when dismantled) to fill the vacant spaces on the one-pole wafers. Carefully drill out the rivets which hold the contacts to the spare wafers and transfer the extra contacts to their new places fixing them with fine screws furnished, preferably, with locknuts. If a complete four-pole switch was bought in the first instance it can now be reassembled and incorporated in the bridge. Otherwise a base-plate must be obtained and this should possess a spindle long enough to operate all four wafers when suitably spaced. It may also be necessary to alter or eliminate the stop or stops on the base-plate by hammering them flat with the surrounding metal. The stops are not required and are actually a nuisance as they prevent the range switch from being turned freely in either direction to the required range. Make spacers from brass tube taking care to make opposite spacers exactly equal to prevent strain on the wafers. Lastly assemble the switch with long bolts or pieces of screwed rod.

Question.—Can I use a linear variable resistance for VR1 or must it be logarithmic as the panel lay-out you propose suggests?

Answer.—Either will do since the readings of the bridge do not depend on the law which VR1 follows but are directly and solely proportional, in each range, to the value of VR1 in ohms at the point of balance.

A linear VR1 of exactly 100 K Ω will, however, produce the most open and readable scale while a log. VR1 or a linear one of more than 100 K Ω corrected to that value by a parallel resistor as suggested on page 418, will produce a non-linear

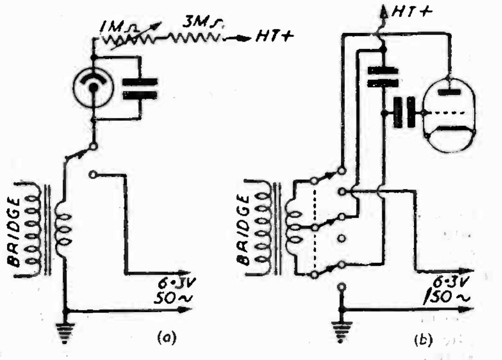

Fig. 2.—Connections for various types of oscillators.

scale which will be cramped at one end to a greater or less extent.

Question.—It seems to me that the voltage with which you propose to energise the bridge is too low to be effective. Can you suggest how a higher voltage could be applied ?

Answer.—The high amplification of the 6AC7 should produce a clear end-point even with 6v. excitation, but if you prefer to apply a higher voltage there are several ways of obtaining it. The first is to incorporate in the power-pack one of these mains transformers still obtainable ex-W.D. which have a 50 volt winding, and to feed this voltage to the bridge instead of the heater volts. This transformer may be placed with its primary in parallel with that of the normal power-pack transformer or, if it possesses another suitable winding may be formed into an independent pack for the bridge with a suitable rectifier and smoothing. Another way is to feed the heater volts into the primary of a small transformer from which some 30 to 50 volts may be drawn. An old L.F. type may be used, rewound if need be with thicker wire. The making of such a transformer by experimental winding and rewinding might appeal to some constructors who would fight shy of tackling the making of a full-scale mains transformer.

Question.—Is there available any simpler and cheaper zero indicator than the magic eye with its attendant amplifier ? I want to keep the cost of the bridge as low as possible.

Answer.—Headphones may be used as an alternative to the magic eye. They should be connected either across the output of the bridge or in the anode circuit of the amplifier valve or still better between the earth line and the D.C.-free end of the 0.1 μF coupling condenser. Since the ear is more sensitive to medium frequencies than to low, this type of bridge would be best energised by one or other of the 1,000 c/s oscillators.

Note.—Some constructors might like to fit a change-over switch so that either the magic-eye could be used or phones, as desired. At the other extreme a very simple bridge could be made with phones as detector and energised by 50 c/s from the mains or by a neon oscillator. With 50 c/s low values of inductance and capacity could not be accurately measured.

Question.—Though the magic-eye functions satisfactorily with most unknowns I find it difficult to judge the zero point when measuring small condensers and high resistances. Is there any way of making the zero sharper ?

Answer.—With low values of capacity and inductance and high resistances the response from the magic-eye (or phones) is necessarily less than with intermediate values. In these cases "bracketing" should be resorted to. Having set the correct range swing the multiplier dial back and forward and note at which points on the dial the shadow of the eye just appears then set the scale by eye to the point mid-way between them and read off the value. A subsidiary scale in arbitrary units 1 to 100 set off round the outer one-eigth of an inch of the Multiplier Dial would make bracketing more accurate. If the resistor VR1 is linear, a useful scale would be 100-0-100 set out at (say) intervals of 5 with the zero lying on the external bisector of the angle formed by the limiting positions of the moving arm. The 100's need not lie over the extreme positions of the moving arm, but perhaps one hundred degrees on either side of the zero thus facilitating the making of the scale. If on bracketing the shadow appeared when 60 lay opposite the index, and also at 20 on the opposite side of zero the factor by which the range set should be multiplied would be found opposite $\frac{60 + 20}{2}$, that is 40 on the subsidiary scale. (Fig. 1.)

Question.—I do not understand how the external oscillator such as the neon one you describe should be connected to the bridge. Please explain.

Answer.—The connections depend on what oscillator or combination of oscillators is to be used. If 50 c/s excitation alone is desired connect the primary of the bridge transformer across the heater sockets of a valve-holder one of which is already earthed. In the neon oscillator shown in the original Fig. 3a, one end of the primary is also earthed, so if this is to be used as an alternative to 50 c/s, the two terminals of the 2-way switch must be connected respectively to the non-earthed socket of a valve-holder and to the junction of the neon and the 0.002 μF condenser at the opposite side from the 1 megohm variable resistor. Since with the valve oscillator of Fig. 3b, the primary is not earthed, a 3-pole, 2-way switch is required to alternate 50 c/s and the valve-generated oscillation. The accompanying diagram Figs. 2 (a) and (b) shows the necessary connections.

PREMIUMS FOR TECHNICAL WRITING

THE Radio Industry Council, organisation of the manufacturers in all branches of the industry, announces six further awards of premiums for technical writing.

Full awards of 25 guineas go to :

Mr. P. H. Parkin, B.Sc., A.M.I.E.E., and Mr. P. H. Taylor, A.M.I.E.E.

Mr. T. Somerville, B.Sc., M.I.E.E., F.Inst.P., head of the Electro Acoustics Group of the Engineering Research Department, BBC, and Mr. C. L. S. Gilford, M.Sc., F.Inst.P., head of the acoustics section of the Group.

Mr. J. A. Jenkins, M.A., M.Inst.P., and Mr. R. A. Chippendale, B.Sc.

Mr. W. R. Stamp, on the staff of the Admiralty Research Laboratory, Teddington.

Ex gratia awards of £10 each were made to Mr. T. W. Bennington, who is engaged on ionospheric and short-wave propagation work in the Research Department, BBC, and to Mr. G. N. Patchett, Ph.D., B.Sc., A.M.I.E.E., M.I.R.E., A.M.Brit.I.R.E., head of the Electrical Engineering Department of Bradford Technical College.

One of the judges, Vice-Admiral Dorling, director of the Radio Industry Council, in announcing the new awards, said :

"We should like to have submitted to us more articles of the particular kind we want to encourage. . . . Greater attention, we consider, should also be paid to clarity.

"We hope the writers of articles which have not qualified this time, will get other articles published during 1953 and submit them to us. We should also like to have some entries from journals published overseas"

Tracing and Curing Hum

ONE OF THE MAJOR TROUBLES IN HOME-MADE AND COMMERCIAL RECEIVERS EXPLAINED

By Gordon J. King, A.M.I.P.R.E.

DURING the initial tests of a newly-built receiver the constructor should be very critical about the level of mains hum—for listening is made exceedingly tiresome if a discernable hum accompanies the reproduction. Mains hum of a general character is often due to ripple voltage in the output of the rectifier-filter system, mainly introduced by insufficient reservoir or decoupling capacitance. In the case of a receiver designed to a tested specification this type of hum is very rare, although it is frequently noticeable in receivers of an experimental nature, which have been designed and built by the home-constructor. Little trouble is usually encountered in removing it, however ; often a few extra micro-farads of smoothing, or a higher value filter choke, is all that is necessary.

Hum which gradually develops in a receiver is not always so easy to trace to its source. It may be due, of course, to a reduction in filter capacitance, in which case proof is readily available by shunting the suspected capacitor with a similar one of known value. The filter (smoothing) choke may have developed a fault, such as short-circuited turns with a consequent lowering of its inductance, or the same may apply to the loudspeaker field should the receiver use this in place of a choke.

Start from the Loudspeaker

Should, however, a few simple tests in this direction indicate that the filter circuit is free from fault, a little more involved procedure must be adopted to localise the hum source. In tests of this nature it is always advisable to work from the loudspeaker back to the aerial input. Firstly, it is just as well to ascertain that the loudspeaker itself is in no way aggravating the trouble. This can be proved by completely disconnecting the primary winding on the output transformer from the output valve anode circuit ; short-circuiting the anode of the output valve direct to the H.T. rail—to maintain a constant H.T. load, and to prevent damage to the valve ; and finally, load the transformer primary by a resistor of equivalent value to the anode impedance of the output valve. In this way we can be absolutely certain that any hum from the loudspeaker is (a) induced into the output transformer from the mains transformer or smoothing choke, or (b) induced into the voice-coil of the loudspeaker by similar means, or via the voice-coil connecting leads, particularly if of a necessity they are extra long in order to connect the output transformer—which may be on the receiver chassis—to the loudspeaker in the receiver cabinet.

A modification in the position of the output transformer usually effects a perfect cure where the hum is known to be introduced by these means. On the other hand, the loudspeaker may be of the energised variety, giving rise to hum which is directly induced into the voice-coil from the loudspeaker field winding. A hum-bucking coil is usually fitted to a loudspeaker of this nature to counteract this effect. Should the loudspeaker not be furnished in this way, however, it is a fairly easy matter for the constructor to wind a coil himself.

About a dozen turns of insulated 20 s.w.g. copper wire should be wound on top of the field winding, and connected in series with the voice-coil and output transformer, as shown in Fig. 1. The way in which the hum-bucking coil is connected to the voice-coil is extremely important—for the correct way tends to neutralise the hum, while if connected in a converse sense an enlargement of hum output will result.

Isolate the Output Valve

After establishing that all is well with the loudspeaker, the next operation is to isolate the output valve—including the loudspeaker—from the preceding stages. This is best done by disconnecting the coupling capacitor from the grid of the output valve in the case of a resistance-coupled amplifier, as shown in Fig. 2. The grid resistor must be left in circuit, of course, to provide grid bias for the valve. If hum is still in evidence, then it is obvious that the output stage is causing it—the valve proper may have a slight heater-to-cathode leak, or the cathode by-pass capacitor C1 may be low in capacity or leaking a little. If the output valve happens to be a pentode the screen decoupling capacitor C2—if one is installed—may be open circuited.

Checking in this manner by employing a substitute component soon pin-points the hum source. It may be found, however, that none of these suggestions effect a cure, in which case it can be safely assumed that the fault lies in the heater circuit. Some of the older-style receivers employ a centre-tapped heater winding on the mains transformer. This tapping is usually earthed to the receiver chassis, or to the negative H.T. line. The valve heaters are thus balanced to earth ; should, however, this balance be upset owing to a fault in the mains transformer, a very unpleasant 100 c.p.s. hum will emit from the loudspeaker. If the hum is suspected to be due to this cause it can frequently be minimised by removing the earth connection on the heater winding ; shunting the heater line with a 50-ohm wire-wound resistor of suitable rating, and adjusting an earthed tapping on this resistor for minimum hum (see Fig. 3).

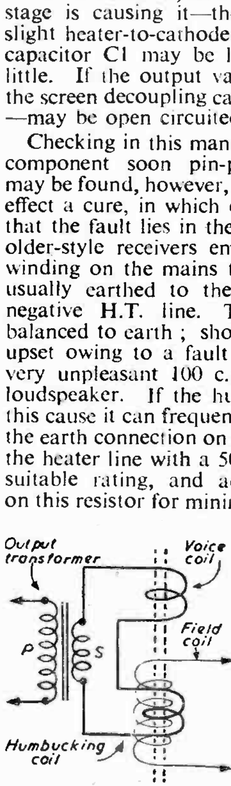

Fig. 1.—Showing the connections for a hum-bucking coil.

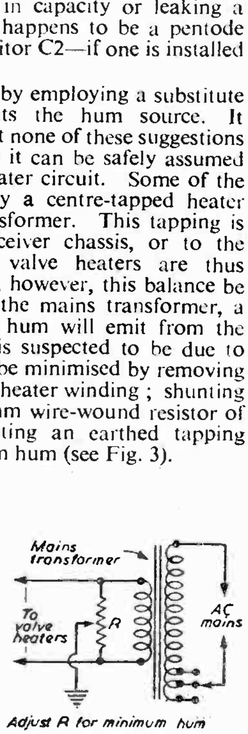

Fig. 3.—A method of balancing the valve heater circuit.

In home-constructed receivers this method of heater balance is rarely used these days. The usual procedure is to earth one of the heater lines direct to the receiver chassis; while this system is very effective with modern valves, a much lower hum level is often achieved in a circuit employing four-volt valves, by using the tapped resistor arrangement—in any case, all circuits which use a transformer for supplying heater power must either directly or indirectly have the heater line at earth potential.

Hum in the First A.F. Amplifier

The coupling being now reconnected and hum still prevalent, we can be fairly certain that it is

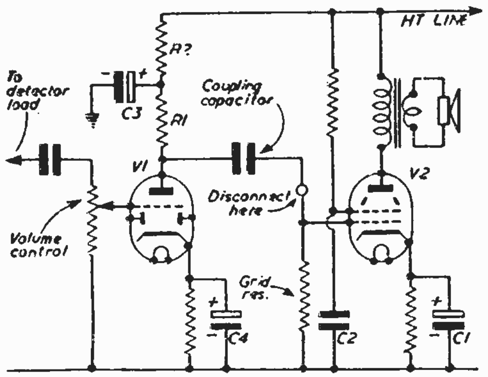

Fig. 2.—The output stage and first A.F. amplifier of a typical receiver.

being conveyed from the first A.F. valve (V1, Fig. 2) to the grid of the output valve (V2). The unwanted hum voltage causing the trouble must be developed across the coupling resistor R1. This, of course, may be prompted by faults similar to those which we have already considered. A diminutive heater-to-cathode leak in V1 will tend to produce hum to a larger magnitude than a similar fault in V2, owing to the lower signal operating level of V1. The same reasoning applies to inadequate decoupling. It is advisable, if hum is being introduced in this stage, to check on the anode decoupling arrangements comprising the resistor R2 and the capacitor C3.

The large majority of receivers use a similar mode of decoupling in this section, although the less expensive models tend to do without it by employing a higher value smoothing capacitor. Should the constructor come across a receiver of this nature which is prone to excessive hum, it is well worth while to go to the expense of fitting a resistor capacitor combination—for the resulting reduction in hum level far outweighs the cost of the components. The value of R2 should be in the region of 10 to 25 kilohms, depending on the available H.T. rail voltage, while C3 should be an electrolytic possessing a capacitance between 4 and 8 microfarads.

The grid circuit of V1 is remarkably susceptible to hum pick-up from any component or wiring carrying alternating mains current. Short-circuiting this grid direct to chassis will rapidly prove whether or not this happens to be the case. Earthing the metal shielding of the volume control, and screening the wiring associated with the grid circuit of V1 often alleviates hum due to this cause; although, in persistent cases, enclosing V1 in a metal shielding is sometimes the only satisfactory solution.

Hum of the foregoing nature is rarely introduced into the receiver in the stages preceding V1—the resulting hum is different in effect and will be fully considered later in this article.

Universal and D.C. receivers are not only more prone to hum troubles than A.C. ones, but the hum is a little more difficult to localise, since the valves are wired in series and cannot be removed from their sockets should this be necessary to facilitate isolation tests. The best way to commence is by isolating the receiver from the A.C. mains (A.C./D.C. types of receiver only) by a one-to-one mains transformer. The chassis of the receiver can then be earthed, and a quick check is available by short circuiting each valve grid in turn, working back from the output stage, until the hum is lessened or stopped when the section producing the hum is shorted.

It is important to remember that a coupling or input transformer may be picking up hum owing to its close proximity to the mains transformer or filter choke. A satisfactory cure frequently results by orienting one or other of the components to a "neutral" position on the chassis.

Earth tags which are secured to the receiver chassis by nuts and bolts—or rivets—are very prone to cause hum, particularly if the tag carries various wires, which may serve to earth one side of the valve heaters, grid return leads, etc. A slight D.C. resistance developing between the tag and chassis is sufficient to present an impedance to the A.C., and the resulting voltage—although of diminutive magnitude—is liable to create an exceedingly puzzling hum problem. The same applies to loose valve contact sockets, partially corroded connections, and the host of similar faults which inevitably develop in an old receiver.

Modulation Hum

Modulation hum, as its name implies, is caused by a hum voltage modulating the transmitted carrier and is, therefore, only audible when the receiver is tuned to a signal. Many home-built receivers, on first test, suffer from this complaint and, owing to its complicated nature, many tedious hours can be spent in localising the stage in which it is thought to originate. Before we go on to discuss means of curing a receiver so affected it will, therefore, be instructive to consider the actual cause of such a hum.

It is well known that the mains wiring functions quite satisfactorily as an aerial; in fact, at one time receivers were built with facilities for using the mains wiring in place of an aerial, by connecting one side of the mains through a low-value capacitor to the

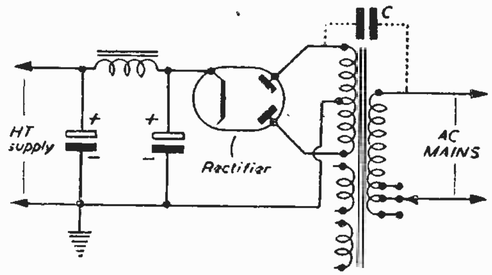

Fig. 4.—The power circuit of a normal receiver.

aerial input socket on the receiver. These days, however, this practice is not to be recommended owing to the increasing ratio of mains "noise" as compared with the signal.

Nevertheless, a certain amount of signal from the mains wiring does find its way into the receiver, but by a rather unorthodox entry. The circuit of Fig. 4 illustrates a typical H.T. supply to a receiver. It will, of course, be appreciated that the H.T. supply is virtually isolated from the mains owing to the effect of the mains transformer. From the signal point of view, though, the transformer yields very little impedance, brought about mainly by distributed capacity between primary and secondary windings —this is represented by C on the diagram.

Two voltages are, therefore, applied to the rectifier anodes, one at signal frequency and the other at mains frequency. A rectifier being a non-linear device tends to mix the two signals—similar to the function of the frequency changer valve in a superhet receiver—resulting in an output waveform consisting of the R.F. carrier modulated by the mains frequency.

On the face of it, this modulated signal would appear to end its life across the low reactance of C1. This, unfortunately, is not always the case, for C1—a high-value electrolytic capacitor—possesses an appreciable self inductance, which at the carrier frequency would appear as a considerable reactance. The same reasoning applies to the filter choke L1, which, although of high inductance, possesses quite a considerable self capacitance, with a consequent reduction in the impedance it offers to the R.F. carrier.

The filter capacitor C2 is again of similar characteristics to C1 and effects little attenuation at the carrier frequency. We can clearly see, then, that the filter circuit, which is admirably capable of removing the 50 c.p.s. ripple from the H.T. supply, can be remarkably unsuccessful so far as the high-frequency component is concerned.

Thus the hum modulated carrier is conveyed to the signal frequency section of the receiver via the H.T. rail. Here, it mingles with the signal received from the aerial, and is once again conveyed through the receiver, but this time via the normal channel. On reaching the detector stage, however, the hum voltages remain, plus, of course, the audio content of the signal; these are amplified and appear together at the loudspeaker.

It is, therefore, plain to see the importance of filtering any R.F. signal to prevent it from reaching the receiver by way of the mains wiring. The most apparent way of doing this is, of course, by the inclusion of an R.F. filter choke in series with the mains input lead to the receiver. Double-wound chokes are readily available for this purpose, specially designed to withstand the fairly high receiver input current without overheating or suffering any ill effects.

The large majority of mains transformers are furnished with an electrostatic screen between primary and secondary windings. This is capable of removing a large percentage of modulation hum owing to the effect it has in reducing the capacitance between the two windings. It is advantageous for the constructor to bear this point in mind, for some of the less expensive type of mains transformers are produced without a screen, and when employed in a broadcast receiver extreme difficulty is often experienced in making it free from hum.

A cure is usually quite easily effected in less severe cases of modulation hum by connecting a 0.01 μF condenser between the receiver chassis and each anode of the rectifier, or else a similar capacitor between chassis and each side of the mains input.

Little advantage is gained by shunting the electrolytic capacitors by one of a lower value in an endeavour to by-pass the R.F. at this point, for more often than not the inductance of the electrolytic in conjunction with the additional shunt capacitance forms a parallel resonant circuit at the R.F. frequency, and tends to aggravate more than cure the effect.

Open-circuited decoupling capacitors in the R.F. or I.F. stages of a receiver sometimes have the effect of producing modulation hum, and should be given due consideration in obstinate cases, particularly if hum is also heard on weak carriers. The same applies to heater-to-cathode leaks in valves associated with these circuits—A.C./D.C. types seem more prone to this trouble than do A.C. only ones.

After trying every available means of curing modulation hum, the constructor should not give up in despair, for a simple operation like shunting the aerial input coil with an R.F. choke might do the trick—on several occasions the use of this dodge has well rewarded the writer.

B.R.E.M.A. Chairman Re-elected

At the annual general meeting of the British Radio Equipment Manufacturers' Association in London on March 6th, the Executive Council of 12 member-firms was re-elected without change. The committee subsequently re-elected Mr. P. H. Spagnoletti, B.A., M.I.E.E., A.M.I.R.E., and Mr. E. K. Balcombe as chairman and vice-chairman respectively.

Mr. Spagnoletti, addressing the annual meeting, said that last year for the first time television had become a significant factor in the export figures, 6,000 receivers having been sold abroad. At home 782,000 television receivers were sold and production rose by 14 per cent. compared with 1951.

Production of radio receivers and radiograms was 1,228,000 sets, a fall of 41 per cent. compared with 1951. Home sales accounted for 789,000 sets and export sales for 523,000.

Taking sound radio and television together, the value of home sales fell by 11 per cent. and export sales by 4 per cent.

The association was responsible for 93 per cent. of the country's home sales and 94 per cent. of the export sales.

In a reference to the restrictions on hire purchase, Mr. Spagnoletti said: "That people in the lower income groups should be prevented by fiscal means from seeing the Coronation on TV is, I think, wrong."

The Annual Report of the association shows that during the year TV sets with 12in. tubes were again in the majority, although they represented only 60 per cent. of the December sales as compared with 85 per cent. of the sales in December, 1951. Second place was taken by 14in. tubes, representing 20 per cent. of the December sales.

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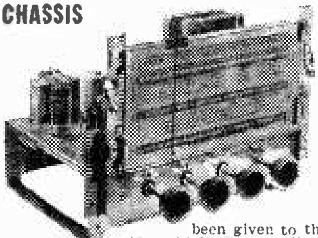

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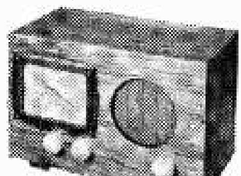

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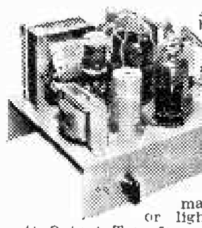

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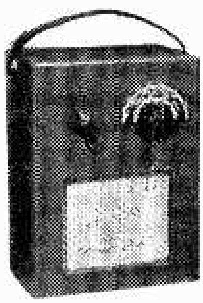

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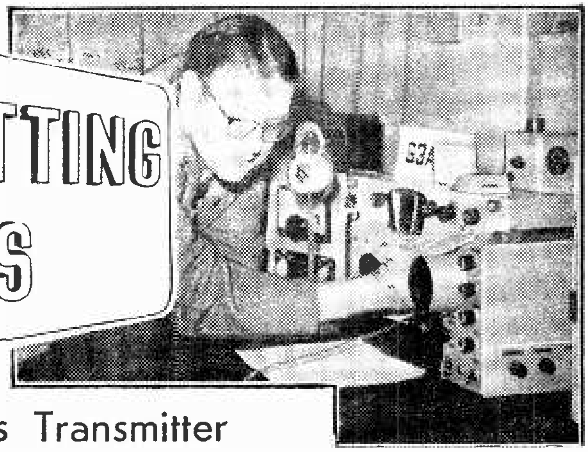
VOLUME CONTROLS CARBON.—5K, 10K, 25K, 50K, 100K, 250K, 500K, 1 meg., 2 meg., all less Sw., each, 2/6; as above S.P. Sw., each, 4/-; as above D.P. Sw., each, 4/6; Midgets, 25K, 50K, 100K, 250K, 500K, 1 and 2 meg. less Sw., 2/6; Wire Wound, 500 ohms, 2.5K, less Sw., 2/6.
CHOKES.—Midget, each 3/6; 80 m.a., 7/6; L.F. Transformers, 3-1, 3/6; Class B Driver, 3/-; Microphone, 60-1, 7/6; Output, 3 ohm, 4/6.
T.R.F., 8/6; Superhet Chassis (less valves, 2 v.), 12/6.
SYSTOFLEX. All sizes, per doz., 2/-; E.H.T. Cable, 36ft. Coil, 5/-; Co-Ax. Cable, per yd., 1/-; Screened Twin Feeder, per yd., 6d.
VALVE HOLDERS.—All types British, American and Continental 6d.—9d.; Co-Axial Plugs and Sockets, 6d. each; Knobs, various 5d. to 8d.; Spade Terminals, per doz., 2/-; Socket Strips, 2 and 4 way, per doz., 4/-; Tag Strips, 3 way, per doz., 4/-; Grid Caps, per doz., 6d.; Egg Insulators, small, per doz., 3/6; Stand-off Egg Insulators 3/6; Spindle Couplers, each 6d.; 1125 Receivers with Valves, each 9/6; 9.5m.m. Reels for Recorders, each 2/-; 8in. Speakers, 12/6; 5in. Speakers, 12/6; Metal Boxes, for Pre-amp., 1/3.
RECEIVERS.—1155 In perfect order, £8/10/0; Hallicrafter SX27, in perfect order, one only, £47 0 0; Scott, 5.6 to 16 meg., £19/10/0; B2, 50 to 170Kc., £12/10/0; Type 36 Transmitter, complete £25/0/0; Hallicrafter HT11A, £20/0/0; Loud Hailer, 12 v., 15w. Amplifier, complete with Valves, £5/0/0.
All types of British, American and Continental Valves. Transmitting and Receiving. Prices on application.
Metal Rectifiers, 230 v., 80m.a., each 5/6; Speaker Gauze, 1/6 per sq. ft.; Rotary Switches, from 1/6; Telephone Sets, each £1/5/0; Soldering Irons, 110 v., 8/6; Soldering Irons, 12 v., 6/-; Soldering Paste, 1lb. Tins, 2/6; Chassis made and drilled to specification. Metal Cabinets, 19in. x 12in. x 10in., 12/6; Suitable for 12in. Speaker. Various colours.

TRANSMITTING TOPICS



A Beginner's Transmitter

A SIMPLE 2-VALVE TRANSMITTER WITH VARIABLE FREQUENCY CONTROL

By T. Griffin (G3GUV)

MOST newcomers to amateur transmitting use crystal-controlled transmitters. After the initial thrill of making many contacts with such transmitters has subsided, however, the need is felt for variable-frequency control. It is for those who feel the same trepidation about making a V.F.O.-controlled transmitter as they felt about making their first superhet that this article has been written. The instrument herein described is a two-stage transmitter (V.F.O.-P.A.) operating "straight through" on the frequency range 1.715 to 2.0 Mc/s (the top band). It can be built into any of the T.U. type of transmitter tuning units (still available as war surplus) with much room to spare, or can be made up on a chassis as small as 6in. x 4in. x 2in. The full power input to the final stage permitted on this band is 10 watts. This is easily obtainable with the transmitter, using only a small, receiver-type power pack. No external source of bias is used.

If the unit is used as a V.F.O. to drive a higher-powered transmitter there is more than sufficient R.F. to drive any normal frequency multiplier stage. Because of this, loading on the V.F.O. may be made very slight. Listening to the 16th harmonic on the station receiver the note is T9X and is quite chirp-free. Drift is negligible after a warm-up period of 10 minutes. The beginner should find this transmitter, by virtue of its simplicity, an easy one to get on the air and, for the same reason, economical to make and to run.

LIST OF COMPONENTS	
C1—150 pF variable.	C7—100 pF mica
C2—300 pF silver mica	C8—250 pF variable
C3—2,000 pF silver mica	C9—0.01 μF
C4—2,000 pF silver mica	C10—0.01 μF
C5—100 pF mica	C11—0.01 μF
C6—0.01 μF	C12—500 pF variable
R1—50 K Ω	R2—30 K Ω
R3—22 K Ω	R4—2 K Ω
R5—22 K Ω	
M1—0-0.5 amp, R.F.	
J1, J2—Closed-circuit type jacks	RFC1, RFC2 Pie-wound S.W. R.F. chokes

The Circuit

As will be seen from Fig. 1, the oscillator is a series-tuned Colpitts oscillator (the writer hesitates to call it a "Clapp" because of the high value of series capacitance and correspondingly small inductance). One point of interest about the circuit is the high value of the fixed condensers needed to obtain the necessary phase-difference to obtain and maintain oscillation, C3 and C4. Their value is 2,000 pF. as opposed to the more normal 1,000 pF. It was found that 2,000 pF. is just about as high a value as it is easy to obtain consistent with the valve's oscillating. The result of using such a high value is: slightly less output from the valve with greater stability and a lesser value of inductance required to tune the top band. Output is still enough to drive the 807 to 10 watts input comfortably. Although the

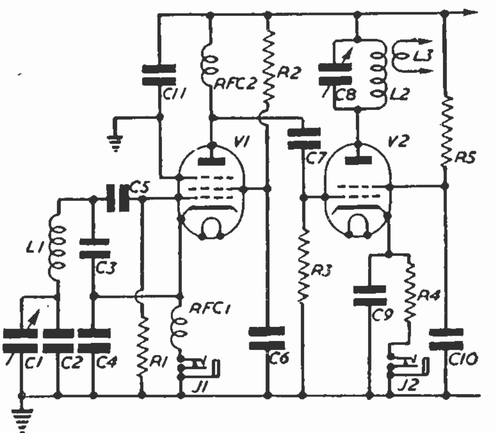
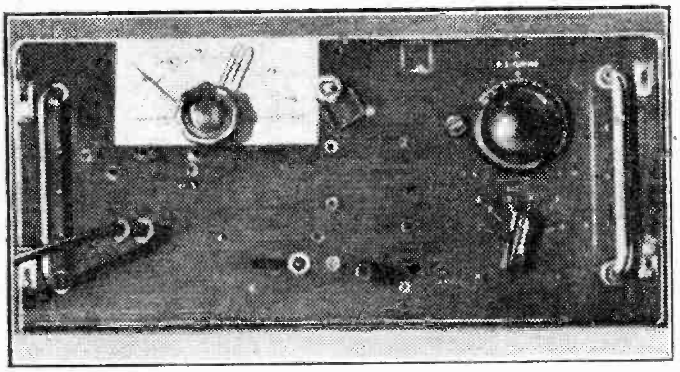


Fig. 1.—Theoretical circuit of the transmitter.

coil L is considerably smaller than the coil used in a true Clapp circuit covering a similar frequency range, it is still large enough to give the note a crystal-like quality.

Keying is in the cathode of the oscillator and the keying characteristics are good. While clicks are present in the output they are not noticeable at a distance and cause no interference to a broadcast receiver in the same room as the transmitter. If trouble from clicks is experienced, a 500 Ω resistor and 0.1 μF condenser connected in series and placed across the key terminals should minimise it or eliminate it completely.



A front view of the equipment.

Several types of valve have been tried in the oscillator position and it seems that any medium-high or high-slope pentode works well. The EF36, EF39 and KTW61 all work well in this position, but the 6SH7 was chosen because of its small physical size, so that trouble would not be experienced by the valve protruding too high to fit into the metal cabinet in which the transmitter is housed!

The 807 valve was chosen as the power amplifier because of the low amount of power needed to drive it and because it has an anode top cap. The latter enables the anode-tuned circuit components to be well isolated from the input circuit. As described, the P.A. should not need neutralising. If trouble is found from tuned-plate tuned-grid oscillations, and layout is different from that described, neutralising may be necessary. In such a case the P.A. tank circuit should be altered so that it conforms to Fig. 4. The neutralising condenser, N.C., consists of a well-insulated wire led from point X in Fig. 4 and twisted around the grid lead. No alteration to P.A. coil or condenser values is necessary, but a tapping should be taken from the coil as near to the centre as possible. This neutralising condenser may seem to be rather crude. It is—but it works well and it is certainly cheap! The method of neutralising adjustment is dealt with later. The output of the transmitter is taken via coaxial cable to the aerial tuning unit, Figs. 6 and 7. From these diagrams it will be clear that the tuned circuit, L5, C12, may be connected either in series or in parallel by connecting the crocodile clips to the appropriate points. Whether series or parallel connection is used depends upon the type and length of aerial used. Best results will depend upon individual experiment with both connections.

Construction

The construction to be described deals with the conversion of one of the T.U. units, but providing that the anode and grid circuits of the power amplifier are well screened from each other and from the oscillator, and that wiring throughout is fairly rigid, many other layouts are possible. The first stage in converting the T.U. unit is to take all components out and mount a piece of aluminium upon the struts which support the "M.O." and "P.A." tuning condensers and coils. This forms the chassis of the transmitter. It should have a 1⅛in. diameter hole cut out for the 6SH7 valveholder, the position of which is indicated in the layout diagram, Fig. 2. The aluminium screen from the T.U. unit should be cut so that one-half mounts above and one-half below the aluminium plate already inserted. The upper half is drilled out to take an 807 valveholder and this screen is positioned so that the valve sits comfortably in the position shown in Fig. 3. The other half of the

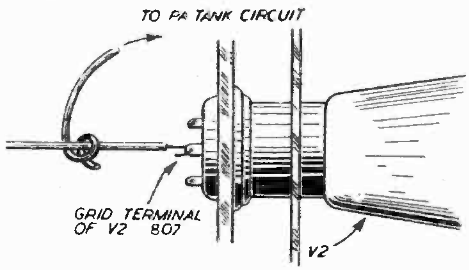


Fig. 5.—Details of neutralising condenser.

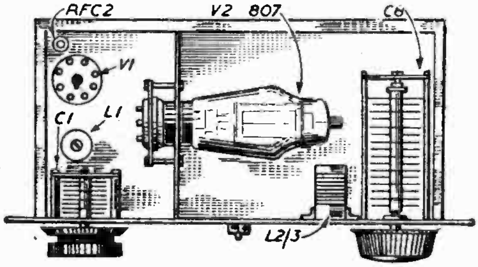


Fig. 2.—Plan view showing the layout.

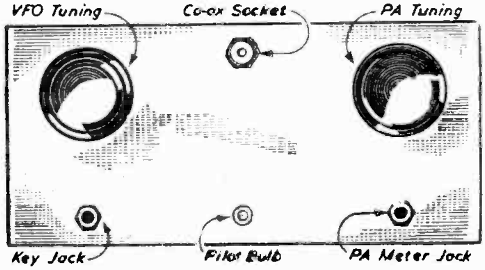


Fig. 3.—Panel layout and details.

screen is mounted immediately below the upper half. A 150 pF variable condenser (receiving type will do) is mounted in the position previously occupied by the M.O. tuning condenser. The vernier slow-motion drive may be retained, but if it is, the likelihood is that it will be too slow for normal operation. On the writer's unit direct drive is employed, no slow-motion drive being found necessary or desirable. The original P.A. tuning condenser and its dial are replaced in their positions and become the 807 P.A. tuning condenser assembly. Layout for the rest of the chief components and front panel layout are illustrated in Figs. 2 and 3, and need no comment. The aerial tuning unit may be built into any conveniently sized metal box. The coil from a suitable T.U. unit may be used in this unit, or one may be wound to coil data given.

Adjustment and Operation

With no connection made to the P.A. anode current meter jack, J2, power is applied to the unit. A key is plugged into J1 and depressed. A note will be heard on the station receiver somewhere near, or actually in, the top band. Adjust the number of turns on coil L1 until, with C1 fully in mesh, the frequency of the signal is 1.715 Mc/s. This should be checked carefully with the station wavemeter. It will be found that the whole of the top band will be covered with about 20 or 30 degrees of rotation to spare at the H.F. end, therefore the upper limit of the band should be carefully marked to avoid inadvertent out-of-the-band operation, and/or a suitable mechanical means of locking the rotation of this condenser at 2 Mc/s provided. Now plug into J2 a 0-50 mA or 0-100 mA meter. With key pressed, adjust the P.A. tuning condenser for maximum dip in P.A. anode current, and proceed in the normal way to load up the transmitter—first to a dummy load (a 25-watt electric bulb makes a good substitute for such a load) and, if all goes well, to the aerial. With 250 volts on the anode of the 807, the stage should be loaded until the P.A. anode current stands at, or just under, 40 mA. It should hardly be necessary to remind the user to take the usual safety precautions when handling P.A. circuits.

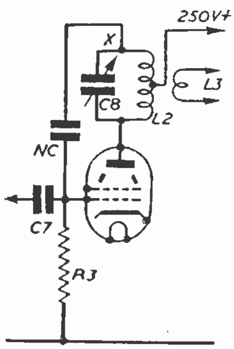


Fig. 4.—P.A. circuit using neutralisation.

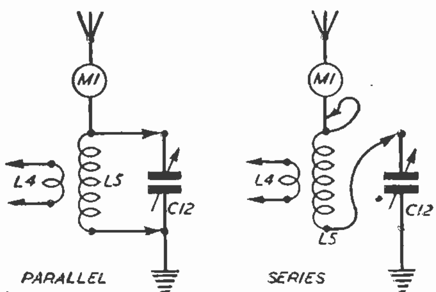
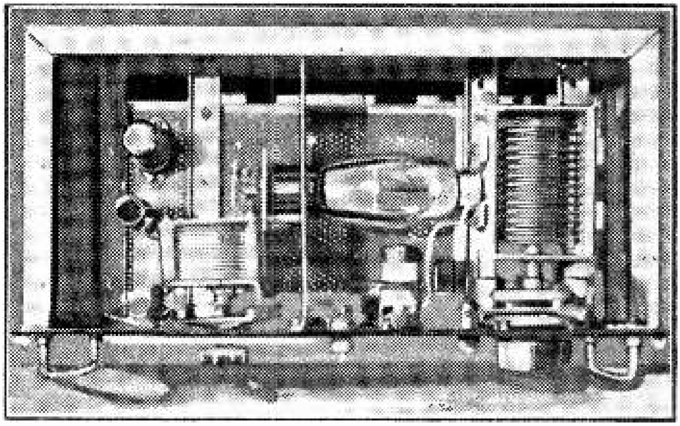


Fig. 6.—Aerial tuning arrangements.



Plan of the transmitter.

Neutralising the P.A.

If it is found necessary to carry out neutralising on the P.A. stage, the first operation is to disconnect the H.T. from anode and screen of the valve. Connect a suitable milliammeter (0-15 mA or 0-30 mA) between the bottom end of R3 and earth. With drive from the V.F.O. valve applied to the P.A., rotate the P.A. tank condenser until a dip in grid current is indicated on the milliammeter. Adjust the neutralising wire until the dip is no longer discernible, or until it is at a minimum. The wire forming the " neutralising condenser " should be of sufficiently stout dimension to remain securely in position when this adjustment is completed, and care should be taken that the free end is well insulated before reconnecting H.T. to the valve !

Performance

Many contacts have been made with this transmitter, using a " back-street rambler " of an aerial, and in every case tone reports have been either T9 or T9x. Quick change-over from send to receive has been obtained by using a separate receiving aerial and leaving the transmitter on while in the receive position (but without the key pressed, of course !).

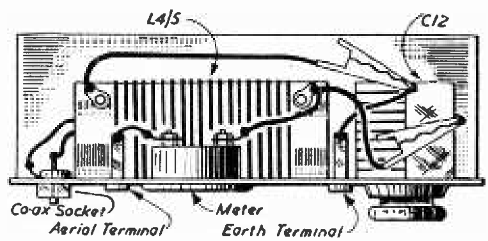


Fig. 7.—Layout and details of the aerial unit.

It should, perhaps, be appropriate at this point to include a reminder that while using such a transmitter as this, a very reliable (preferably crystal-checked or crystal-controlled) wavemeter is a Post Office requirement—one which will enable the operator to determine his frequency to within ±0.1 per cent.

To "net" the transmitter to a received signal without radiating from the power amplifier, a "blank" jack plug (one which has no connection made to it) should be inserted in the P.A. anode current meter jack. This stops the current from flowing through the valve by breaking the cathode connection to earth. The V.F.O. should *never* be adjusted from one frequency to another with the power amplifier in operation because of the irritating and unnecessary QRM caused by such a practice.

COIL DATA

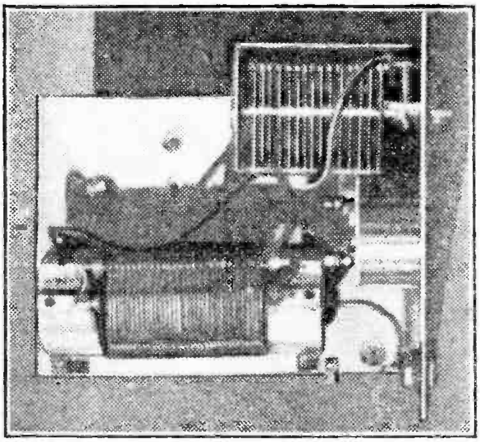
L1—55 turns 24 s.w.g. enamelled close-wound $\frac{3}{4}$in. former.

L2—40 turns 28 s.w.g. D.C.C. close-wound $1\frac{1}{4}$in. former.

L5—42 turns 28 s.w.g. enamelled space-wound 2in. former.

L3—4-turn link.

L4—4-turn link.



View of the aerial tuning unit.

The Properties of Radio Materials

AN important factor in the progress of radio communications has been the development of new materials and their use in new devices of improved performance. The principal classes of radio materials are conductors, semi-conductors, dielectrics and magnetic materials. Knowledge of the properties and behaviour of conductors is well advanced and suitable materials in this class are available for almost every required service. The properties of the other three classes of materials are not so well understood and a great deal of work remains to be done before their behaviour in all conditions can be completely predicted.

Radio Research Special Report No. 25, "Selected Problems in the Preparation, Properties and Application of Materials for Radio Purposes," has been produced by the Radio Materials Committee of the Radio Research Board. It is based on the work of several groups of experts who have studied the present state of knowledge of ceramics, organic polymeric dielectrics, magnetic materials and semi-conductors. The report is divided into sections dealing with these materials, each section outlining existing knowledge and stating the research problems which most urgently need attention if the material is to be fully exploited for radio purposes.

Ceramics

Ceramics are important in radio practice because of their great thermal and mechanical stability and because they can be made to combine properties that are essential to radio techniques. The literature dealing with these materials is already considerable but the potential uses are limited by the incomplete understanding of the physical factors which control their behaviour. Research on single crystals is needed to understand fully the structure and properties of substances like barium titanate, to develop methods of growing large crystals and to investigate the physical and chemical features to which they owe their ferroelectric properties. There is also a need to develop a theory to explain the behaviour of materials of this class and to study the effects of impurity on behaviour.

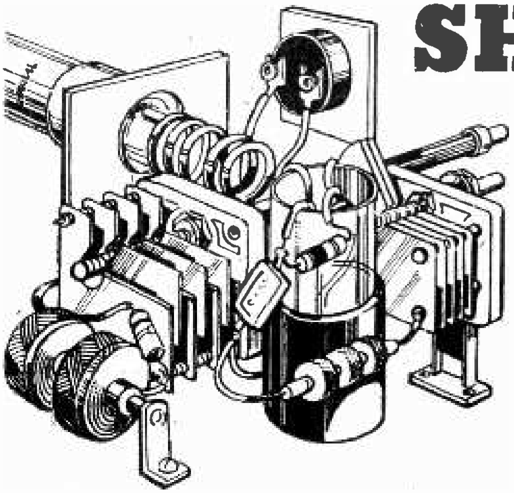
Organic Polymeric Dielectrics

Consideration is limited to a study of low-loss materials of good mechanical strength and unaffected by moisture, including types suitable for capacitor winding. These materials are normally moulded or extruded, and additional properties are usually required according to the use to which the material is to be put. The properties desired are dependent on chemical and physical structure and may sometimes be irreconcilable. However, polymeric compounds which possess the required physical properties will usually have a satisfactory electric breakdown strength.

The proposals for research in this field include the search for methods of synthesis or polymerisation which would give materials of improved mechanical properties and, where required, of higher dielectric constant. There is a need, in particular, for low-loss, non-polar thermosetting polymers so that full advantage can be taken of the better thermal endurance of thermosetting materials over thermoplastics. More information is also needed on the effects of water absorption and on the electrical losses arising therefrom.

Magnetic Materials

The features of magnetic materials which are becoming of increasing importance are their permeability at very high frequencies and their residual losses. There is also considerable interest in non-metallic materials, especially ferrites.



SHORT-WAVE SECTION

A VERTICAL FOLDED DIPOLE AERIAL FOR THE EXPERIMENTER

By A. W. Mann

THE folded dipole type short-wave aerial has been given a fair amount of space in amateur radio publications the world over.

Opinions differ concerning its merits when compared with other accepted types. In this article details are given which will assist the experimenter to make and erect a vertical folded dipole, which on test at the author's location, has proved to be a good all-round type from the full coverage point of view.

It is not claimed that it is an outstanding aerial or that it conforms to any text-book recommendations. The plain facts are that its general arrangement fits in with the materials available, and the facilities at the location specially laid out and solely intended for the erection of vertical types.

The materials, including wire and spreaders, made possible a wide-spaced folded dipole without cutting, and this being so it was decided to go ahead. Later the spreaders will be cut progressively so that the effects of a reduction in spacing can be noted. This will take time, but will no doubt prove to be of interest. The writing of this paragraph has brought to mind an idea which appears worthy of consideration, and it is hoped at some future date to further discuss the folded dipole.

Construction

As will be seen from Fig. 1, the general construction of the aerial is simple.

It is by no means a simple matter to arrange things so that the distances between F-A and B-C respectively are exactly equal; or to fit the terminal block and centre spreaders so that the aerial can be hoisted in place as a complete unit, with the stranded insulated wire used entirely free from kinks.

It can be done, however, if a long outside wall is available. Two suitable metal brackets are arranged so that the end spreaders complete with insulators can be rigidly mounted, the wire threaded through the insulators, and careful measurements taken to ensure that centre of the terminal block is equidistant from C and F.

This being accomplished, the insulated wire should be bound to the individual insulators with fine gauge copper wire, so that once set it remains so. Follow this by fitting the centre spreaders. Insulated staples will prove quite suitable for the purpose.

Points Worth Noting

The top and bottom spreaders to which the shell insulators E, F, D, C are attached by means of 16-gauge or similar solid copper wire in the form of loops with the ends bent across the grain of the wood, should be approximately 9½in. by 1in. by ¾in. The centre spreaders ⅝in. square and 8in. long. All spreaders, in the interests of weather protection, should be well painted.

The two centre spreaders are necessary in order to keep the two sides in alignment, and counteract the slight additional weight of the ribbon feeder.

The terminal block can be cut from any good form of insulating material 2½in. by ¾in. by ¼in. approximately, and according to the size of the terminal heads. It is suggested that the feeder should be run at right angles to the aerial for at least one foot and supported by a suitable wooden wall bracket, or some other means.

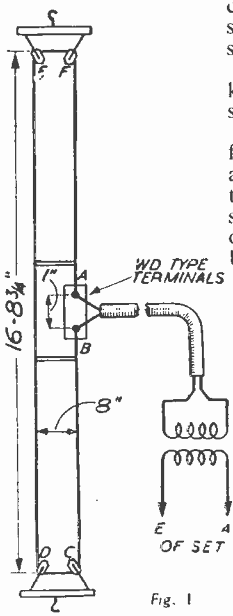


Fig. 1

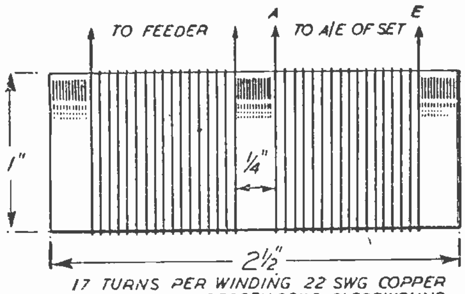


Fig. 2

Details of the folded dipole and of the matching transformer.

The Feeder

The feeder is of the 300-ohm ribbon type advertised at 9d. per yard, and sufficient will be required to span the distance between the aerial and receiver location. A little careful measurement is required, in order to keep the cost down. The end of the feeder should be looped, copper wire bound and soldered, and fitted under the terminal heads, the aerial loops made in the same manner being fitted to the shanks and held in place by a nut, and lock nut.

Matching

So far, the receiver used in conjunction with the folded dipole aerial, is an R1116A. In order to ensure a good match, the unscreened matching or coupling transformer was wound. Each winding is close wound, and consists of 17 turns per winding of 22-gauge copper enamelled wire. No earth connection is used with this receiver and the coupling points are as shown at Fig. 2. Paxolin former is suitable for the purpose.

Directivity

The author has noted in some short-wave radio publications that while folded dipoles are discussed, directivity is not mentioned. It may be that some doubt exists, and proof of this is rather suggested as in two separate and distinct magazines one experimenter remarks in one on noticeable broadside directivity, while in the other, much to his fellow-experimenter's surprise, endwise directivity is apparent.

There we have two conflicting opinions. As these are based on actual tests they are above criticism until proved incorrect. It was solely to check for myself that attention was focused on Folded Dipoles. Tests in that direction have not yet been carried out, and from past experience I know that for various reasons they cannot be hurried, nor can one afford to indulge in wild guessing tactics.

Previous Experiments

Older readers may remember pre-war discussions concerning directional aerial systems. The correspondence concerning it appearing in the May 22nd, 1937, and January 8th, 1938, issues being those in which the writer's comments appeared, and which they may care to re-read if available.

For the benefit of younger readers a brief résumé follows. During that period the writer concluded a three years' experiment in the development of a compact rotary short-wave aerial system. A repetition of some of the findings which these experiments brought about is noted in the VHF field, judging by certain experimenters' comments.

The aerial system used at my location was strongly directional, and during the initialt ests the resultant effects were very confusing. For example, when the system was orientated in a certain way strong signals and high gain resulted. This, by aerial rotation, could be controlled with a volume control effect. This left no doubt as to the fact that the gain was there. Sometimes, however, within a few hours the system had to be used in reverse in order to achieve like results. The explanation is simple. In one instance the signals were taking the short path, while in the other they were taking the long path around the world. A great circle map certainly helped.

It was also noted that variation in reception conditions played an important part so far as signal strength gain on rotation was concerned. This applied to all short-wave bands. These tests covering each band at the most suitable times of day and night.

Opinions were and may still be divided as to the suitability of 7 Mc/s., forty metres as a medium for directional reception. In my experience during the day and early evenings it proved to be most satisfactory, and 25 per cent. increase in signal strength on G and European phone transmissions was commonplace under average reception conditions. With a falling off of the latter, however, the gain was progressively less. In addition to rotation the system could be sharply resonated to the chosen signal. That incidentally accounting for my preference for aerial tuning devices.

Short-Wave Transmissions

Directivity tests on the short-wave broadcast bands after careful observation denoted that the orientation of the aerial had a marked effect on speech quality. Tuned to powerful European transmissions, an over-modulation effect could be produced at one particular point of travel during rotation, clearing up gradually to normal as the full circle was traversed. Quite 'woofy' speech effects being apparent.

Efficient Aerials

The importance of an efficient aerial even when the receiver used is of the modern communications type does not appear to be fully appreciated. In those days, however, with less efficient receivers the extra gain, be it but little, was fully appreciated when stations like VK2ME using comparatively low power were at times not so well received.

The foregoing remarks are intended to draw attention to the fact that when dependent on the radiated signals of transmitting stations in the determination of directivity one has to contend with a fluctuating medium. Test conditions may change slowly, or at times with drastic suddenness, followed by a complete fade-out. Short-wave propagation phenomena must therefore be taken into account, while carrying out tests.

Possibilities

The aerial described and discussed in this article, while possessing some measure of directivity, is not a directional aerial in the generally accepted sense of the term.

It is, however, worth considering as a basis of experiment. There is ample scope for a series of experiments with matching transformers both screened and unscreened.

Those who have facilities for horizontal érection will no doubt find it more efficient due to a more favourable relation to ground than in the case of the vertical, unless a forty-foot mast is available. For vertical erection the unit should be arranged broadside with side E-D uppermost.

While the test receiver used by the author was an R1116A there is no reason why it should not be tried out with other types, and recognised methods of coupling as associated with doublet aerials according to the type of receiver it is desired to use.

There are, it is admitted, more efficient methods of folded dipole construction, which at the same time necessitate a greater outlay. My purpose here has been to show how to make one at low cost-using materials common to experimenters' workshops.

80 ohm CABLE COAX

STANDARD ¼in. diam.
Polythene insulated.
NOT EX. GOV.
10d. per yd.
COAX PLUGS, 1/2 each.
SOCKETS, 1/2 each.
LINE CONNECTOR, 1/2.

BALANCED TWIN FEEDER, per yd., 6d.
TWIN SCREENED FEEDER, per yd., 1/-.
RESISTORS.—All Values, ½ w., 4d.; ½ w., 6d.; 1 w., 8d.; 2 w., 1/-.
WIRE-WOUND RESISTORS.—Best make Miniature Ceramic Type.—5 w., 15 ohm to 4 K., 1/9; 10 w., 20 ohm to 6 K., 2/3; 15 w., 30 ohm to 10 K., 2/9; 5 w. Vitreous, 12 K. to 25 K., 3/-.
W/W POTS.—T/V Type Pre-Set. Miniature. Fitted knobs knurled and slotted. 25, 50, 100, 200, 500 ohm, 1 K., 2 K., 2.5 K., 5 K., 10 K., 15 K., 20 K., 25 K., 30 K., each 3/-.
10 K., 25 K., Colvern short spindle, 3/6.
2 K. Heavy Duty. 5 watt, lin. spindle, 4/6.
COILS.—All ranges Wearite "P," 3/-. Osmor Midget "Q," 4/- each.
ELECTROLYTICS.—New stock.
8/450 v. B.E.C. Midget Tub, 2/6.
8/500 v. Dubilier Drilitic Tub, 3/-.
16/450 v. B.E.C. Med. Can, 3/-.
16/450 v. T.C.C. Small Can, 3/6.
16/500 v. Dubilier Drilitic Tub, 4/-.
8+8/500 v. Dub. Can, 4/6. Ditto Tub, 4/6.
8+16/450 v. B.E.C. Midget Tub, 5/-.
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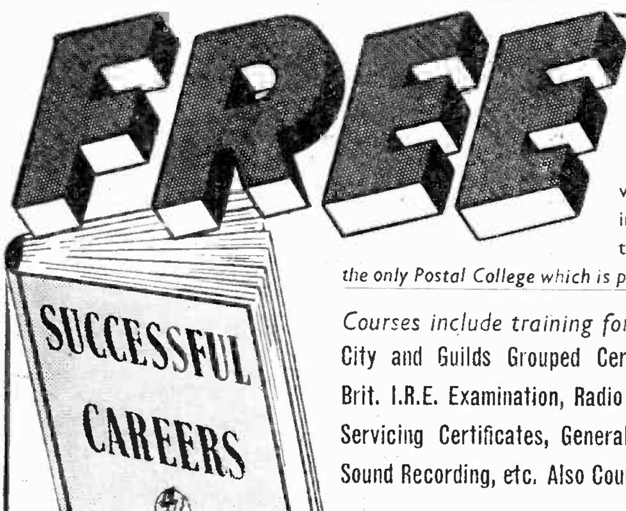

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The Travelling Wave Valve

THIS type of valve was invented in 1946 and since then much research has been done both in the design and application fields. Since its origination, however, travelling wave magnetrons and klystrons have been developed, which indicates that by the invention of such a valve microwave research will be carried out on a much larger scale.

The travelling wave valve can best be described as follows. First, there is a wire helix, usually of copper-plated tungsten wire, the plating to reduce the R.F. losses. This helix is assembled so that the electrons emitted from the electron gun are controlled and directed through the centre of the helix to a collector electrode. The electron gun does in many respects resemble that of the gun used in the electrostatic cathode-ray tube, wherein there is a heater, oxide-coated cathode and various anode cups with apertures in their centres. These anode/anodes are operated at their specified voltages so increasing the velocity of the electron stream. The collector plate, however, is located at the opposite end of the tube to that of the electron gun (see illustration) and acts as a collector of energy which can be transferred to the exterior circuitry.

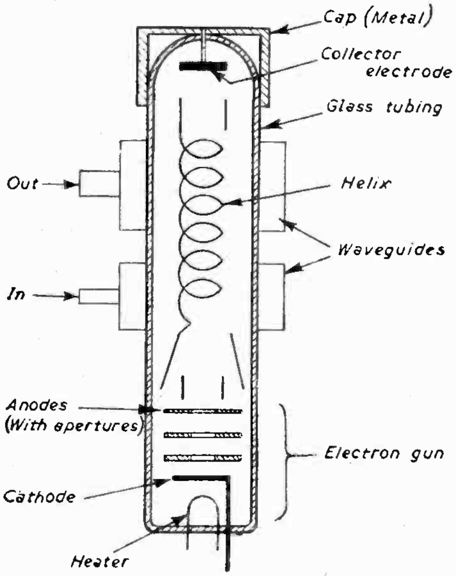


Diagram of the valve described in these notes

The whole assembly is located in precision bored glass tubing which is, in turn, exhausted to a high degree of vacuum. Basing of such valves depends at present on the requirements of such research organisations or the like that are using them.

When in use, these valves are fitted into suitable waveguides, one being for the input whereas the other for the output. To appreciate the make-up of such a tube the reader is referred to the illustration, this being a schematic drawing of such a valve.

Uses

In this type of valve, the signal or waveform that is to be amplified is fed round the helix wire and at the same time, however, the electron beam from the gun is directed through the centre of the helix turns, both the beam and the signal being in the same direction. The signal travelling round the helix creates more or less a magnetic field which interacts with the electron beam. By so doing, the beam can be said to be modulated which increases in amplitude as the beam passes through the helix turns. In other words, the signal has been amplified by the time it has reached the collector plate, which, as mentioned earlier in this article, is passed on to the external circuitry.

Furthermore, it may be as well to mention that such valves have been developed for bandwidths of many thousands of megacycles. Such valves, therefore, will undoubtedly play an important part in the development of microwave radar, television and communications of the future.—E. G. BULLEY.

On your Wavelength

by THERMION

The Coronation

AT a recent meeting of the Radio Industries Club, S. J. de Lotbiniere, head of Outside Broadcasts of the BBC, outlined the plan of the BBC in connection with the Coronation and he also dealt with the problems with which they had to contend. The listening and viewing audience at the Coronation will probably greatly exceed the previous Coronation.

The viewing will be smaller than the listening audience and this great national event will go down in history as the first Coronation to be televised. What a pity it is that some method of recording the ceremony, apart from filming, has not been produced in time.

Future generations will not be in any doubt as to what the ceremony looked like, whereas until the invention of the camera we had to rely upon written descriptions, not only of the scenes but also of the people. No one really knows, for example, what Elizabeth I really looked like. The portrait painters of the period naturally flattered their patrons. They would naturally leave a wart off the nose and forget to paint in the tell-tale crow's feet which spell the departure of beaux feet.

According to " Lobby " there will be 20,000,000 viewers and rather more than that number of listeners. I think his estimate of the number of viewers is on the high side, because it means that there will be about 10 people looking in to every receiver. My guess is that about 10,000,000 people will view the Coronation ceremony and 30,000,000 will listen in. Of course he may have included the overseas coverage. Incidentally, this is the first occasion that television cameras have been used in Westminster Abbey. Her Majesty is to broadcast to the Commonwealth at 9 p.m. on June 2nd.

The R.E.C.M.F. Exhibition

THE Radio and Electronic Component Manufacturers Federation holds its annual exhibition on April 14th. This is an exhibition I always attend with nostalgic interest because here are all the interesting bits and pieces spread out for public inspection, and which often are not seen at Earls Court. My mind always travels back to the very first component exhibition of all when only about a dozen exhibitors supplied the bits and pieces for avid amateurs. There were very few complete receivers on the market and practically everyone who could use a screw-driver and a soldering-iron built his own receiver, only to pull it to pieces each week as journals described additions and improvements. The industry was built by amateurs and component manufacturers who supplied their needs. The number of firms now catering specially for amateurs has shrunk back very nearly to what it was, and I am glad to say that they are all doing a thriving business. One good old firm that has stuck to the constructor market although its business in other directions has expanded enormously, is the Telegraph Condenser Co., Ltd., familiarly known as T.C.C., among constructors. One of their exhibits at the R.E.C.M.F. exhibition which I am keenly looking forward to inspecting, and which is bound to attract considerable attention, is their new range of tantalum electrolytic condensers.

The need for an electrolytic condenser capable of working in extremes of temperature ranging from −50 deg. C. to +100 deg. C. has become increasingly apparent. It is also desirable that this requirement be achieved without increasing the physical size above that of the smaller electrolytic condensers now available.

After extensive research T.C.C. have successfully produced a tantalum electrolytic condenser of unique construction. This little known natural element possesses several characteristics which lend themselves admirably to this particular use, viz., inherent inertness and freedom from corrosion. These two features increase the working reliability and the shelf life of a condenser. The latter is such that a condenser can be put into immediate operation without preliminary re-ageing.

An important feature of the T.C.C. tantalum condensers is the substantially neutral electrolyte which they contain. This means, in effect, that were they to suffer mechanical damage no corrosive injury would be done to other components or to the chassis itself.

At this stage they are showing an 8 μF 100 volt D.C. working condenser in an aluminium tube, the ends of which are spun on to Neoprene bungs, and having tinned copper wire terminations.

The insulation resistance of these condensers compares favourably with that of a paper dielectric condenser, and their power factor is approximately .02 at room temperature.

Radio in Schools

I HAD a letter from a schoolmaster the other day asking me to outline a course of practical instruction for scholars. I am very glad to know that so many schools in this country now include such a course in their curriculum. In fact, there are now some hundreds of schools teaching radio theory by practical instruction. The schoolmaster tells me that the only criticism he has heard of such courses is that it tends to attract scholars away from other courses. In one school the radio course finished the art class—and a good thing too !

The best way of teaching radio is by means of a course of practical instruction so that the pupil learns as he listens. That is the basis of the new series for beginners commencing in this issue. The experienced will turn aside from those pages of course, but it must be remembered that every year there is an influx of newcomers to our hobby and they must not be neglected.

Some schools have radio clubs, which meet for lectures once a week in the school workshop.

A Perso

A COMPACT A.C. SELF-CONTAI

By "Cons

THIS circuit was evolved for use in a small study-bedroom, and was required to supply a fair range of the BBC transmissions at comfortable volume. It is in the main a conversion of the 1135A amplifier, which is in plentiful supply, with valves (EK32, EBC33, EL32) or without. Not many extra components are required, and the excess resistors, condensers, valve holders, etc., can be absorbed into the "spares-box." The total cost, including cabinet and aerial wire, is about £4.

The tuning circuit consists of a Denco Maxi Q coil, range 200 to 580 m., with reaction winding, chassis-mounting type, tuned by a series of trimmers. Four

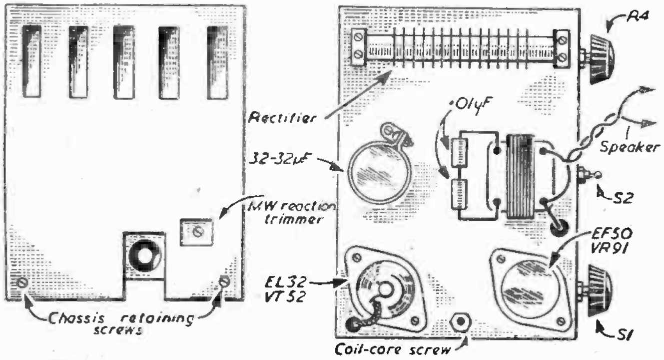


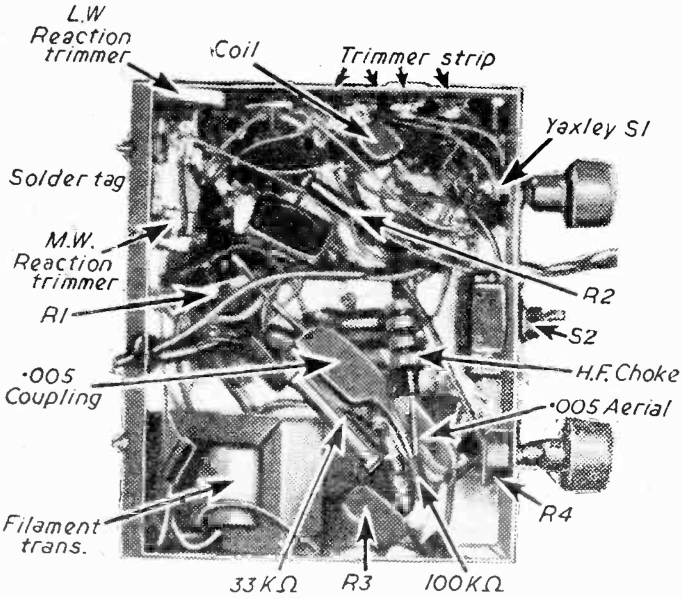
Fig. 2.—Details of the chassis.

of these are mounted on a single strip along one side of the chassis, as shown in the illustration, and with suitable parallel condensers, cover the medium-wave band. The choice of values for these parallel condensers depends on individual requirements; those quoted cover 194 m. (Third) to 341 m. (Wales), with no parallel condenser, 340 m. to 420 m. with 68 pF, and 400 m. to 470 m., with 100 pF, thus being able to obtain all the BBC medium-wave stations.

These four trimmers are connected to the first four contacts of one pole of a six-way, two-pole Yaxley switch, S1. If reception of the Light programme on 247 m. is good, the remaining two contacts may be connected to two similar trimmers, and the set used for medium-waves only. As shown, position five receives the Light on 1,500 m., the second pole coming into operation to introduce extra capacity into the reaction circuit. Also the aerial is transferred to the grid end of the tuning-coil by the switch S2, instead of being connected to the aerial winding. Due to variations in individual wiring and stray capacities, the necessary value of the tuning capacity may vary by ± 100 pF, or so, and thus the stated value should be tried and varied for maximum volume before finally soldering the condenser block in position.

The dust-iron core of the coil is adjusted to give the required minimum wavelength, and selectivity, in position one of S1. With the trimmer fully open, and the core partly out of the coil, the Third can be received on 194 m., and the West on 203 m., obtained by a fair closing of the trimmer. Having obtained the desired conditions here, the core is locked, and not further altered, tuning being quite, or very sharp, over all the rest of the band.

Medium-wave reaction is controlled by a 40 pF, trimmer accessible through a hole in the back of the cabinet. It is set to a level convenient for use over the whole band tuned, and should be quite smooth. The 500 pF trimmer for long-wave reaction is reached through a hole in the side of the chassis, and has enough range to render "trial and error" of the remaining 2,500 pF condenser-block unnecessary.



View of the underside with main components identified.

·al TWO

·NED LOUD-SPEAKER RECEIVER

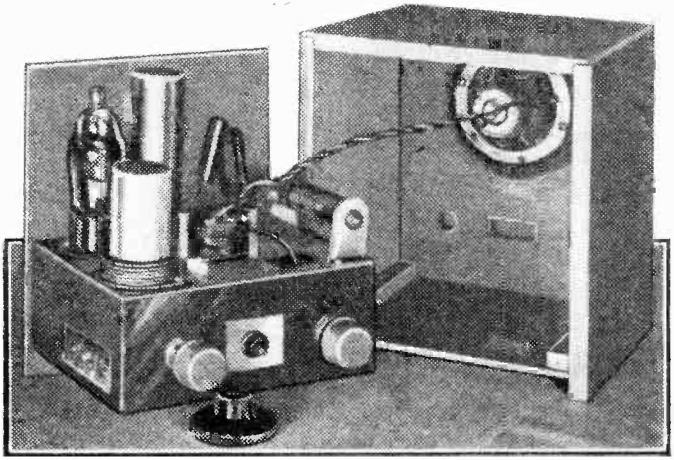
ructor"

A 3in. aluminium-cone moving-coil speaker is used, giving excellent volume and response. The excess "top" is removed by having a .005 μF condenser in parallel with the output transformer primary. Actually, this capacity is provided by joining two .01 μF condensers from the unit in series. If a paper-cone speaker is used, this value would probably need to be reduced. The output transformer is the microphone input transformer from the unit, having its primary connected to the speaker, and its secondary in the anode circuit of the EL32. The primary of this transformer is centre-tapped, but no difference in volume is apparent whether half or all the winding is employed.

Feedback

Feedback is taken from the speaker circuit and used to control the volume. The advantage of this is that it tends to smooth the reaction setting for the band. If reaction is advanced to a point on the verge of oscillation for the lowest wavelength tuned, the quality of this station will be very harsh. Yet, if reaction is decreased here, then it may well be too little for the highest wavelengths. This negative-feedback control overcomes this difficulty. Reaction is advanced to nearly oscillation at the minimum wavelength, regardless of quality, when the volume of the station will probably be more than is normally required. When the potentiometer R4 is varied to reduce the volume, it also permits a certain amount of feedback, and hence improves the tone at the

(*Concluded on page* 298.)



The complete receiver and cabinet.

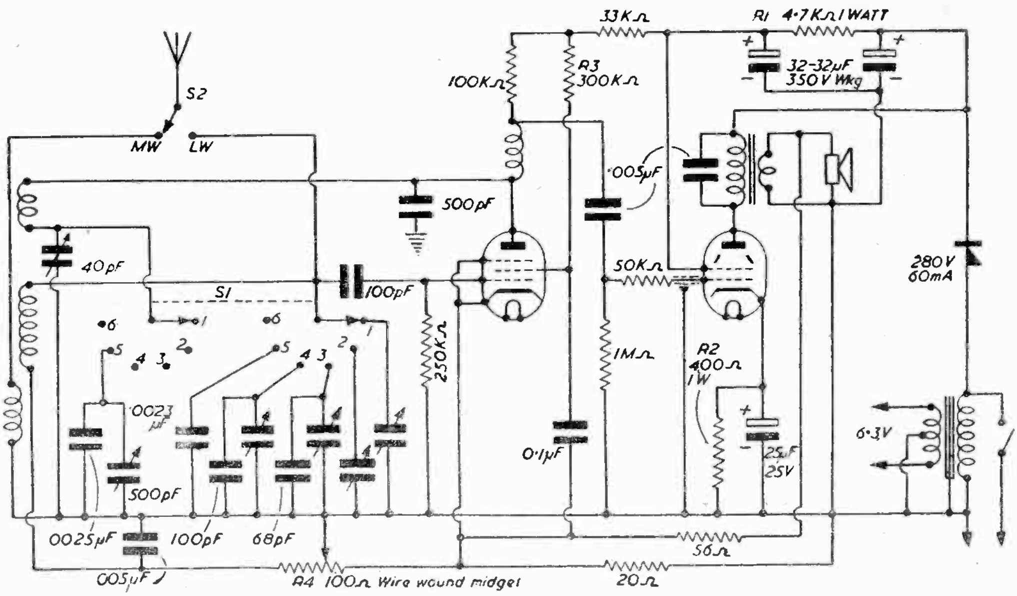


Fig. 1.—Theoretical circuit with all component values marked.

AERIAL HINTS

SOME SUGGESTIONS FOR USERS OF MULTI-BAND RECEIVERS

By W. J. Delaney (G2FMY)

"I HAVE bought an all-wave receiver and should be glad if you could tell me the best type of aerial for maximum performance on all bands." This is a common type of query which is often put to us, but unfortunately it does not lend itself to a direct reply. First, it is necessary for the listener to be prepared to accept the fact that it is practically impossible to erect any sort of aerial array which will give *maximum* performance on all bands. A series of aerials may be slung up and connected to a switching device or matching transformer whereby the required aerial may be connected to the receiver, and this form of array was, at one time, on the market. Unfortunately, however, the unused aerials will affect the one in use and give some falling off in performance. Even if a single wire is cut into lengths and the shortest portion used for the short-waves and so on, the same remarks apply. What, then, can the listener do in such cases?

Selected Bands

Probably the most effective answer is to take the receiver and decide which particular waveband is to be the most used. For instance, if the listener has a naval inclination or background he may prefer to do most of his spare time listening on the trawler band. Alternatively, he may be interested in a particular language and prefer to pick up the loudest station from that particular country, irrespective of the wavelength. Having decided on the wavelength, a temporary aerial should be cut for the middle of that band and hung in a convenient position. Its performance on the other bands on the receiver may then be checked, and if it is found that the receiver performance satisfies the listener the aerial may be made permanent. This is undoubtedly the most satisfactory plan to adopt, but, unfortunately, the performance on the other bands may not prove satisfactory. What is to be done then? A second choice of waveband should be made and the length of aerial calculated for this. An aerial cut midway between the two lengths should now be tried to see if this will effect a suitable compromise on both bands, together with a satisfactory performance on the remaining bands. If it is found that performance falls off too much on the preferred band, then the aerial should be adjusted to come nearer to the length first selected, and so on. Proceeding in this way, it is usually found possible to erect a single wire which will give a good all-round performance with the maximum results on a specific band.

All-purpose Aerials

Where, however, no particularly good response is required on one band, but the receiver is to give a good performance on all bands, a somewhat difficult problem is presented. If there is plenty of space available in the garden, three or four aerials may be slung between suitable masts and brought to a selector switch via coaxial feeders. Terminating the ends of the coaxial on a selector panel, the receiver may be plugged into the required socket and that aerial used, leaving the other aerials unconnected. It will depend upon the directions in which the aerials run whether they may be short-circuited to earth to avoid absorption effects. Again, trial and error will have to be adopted to ascertain the effects of leaving the unused aerials "in the air" or earthed.

The majority of short-wave stations to-day use the mast type of radiating aerial, and the BBC have also adopted this type of transmitting aerial for their medium-wave stations. Certain Continental stations on the medium waves also use this type of aerial, and, therefore, a vertical aerial is necessary at the receiver site to gain the maximum effects from this type of transmission.

Vertical Aerial

Fortunately, a vertical aerial does not call for a long garden and massive poles, and it is not necessary to erect a mast on the house in the majority of cases in erecting a good all-round vertical aerial. Although height still remains the most important feature of the aerial, the length is not so critical, and the only point which seems to affect this type of aerial is the position of the receiver and, incidentally, the lead-in. If this is on a ground floor, the aerial follows the lines of the Marconi aerial, a "reflection" being found in the earth. If the receiver is situated on an upper floor, however, this effect is rather lost, although if a rising water main is handy, the connection of the earth terminal by the shortest direct route to this will tend to overcome the lack of "capacity earth." A vertical aerial should be suspended at least 18in. away from the wall, and should not run closer than that distance from a rainfall- or drain-pipe. The upper end may usually be attached quite easily to a short length of wood screwed to the wooden board supporting the roof guttering, and the lower end may be held out from the wall by a similar piece of wood fitted to the window.

If the listener lives in flats or a house where access cannot be gained to the gutter, the aerial will have to be kept indoors, but, again, a vertical wire is preferable to one which doubles back on itself in order to follow a picture-rail or similar support. If there is a staircase available, the aerial may be supported between the banisters or otherwise kept in a vertical position if possible avoiding a right-angle bend where the lead-in runs off to the receiver. Try, as far as possible, to let the aerial run straight up from the receiver aerial socket or terminal. In some cases it may be found that a length of wire reaching from the aerial just up to the picture-rail proves adequate for good general all-round performance. Much depends, of course, upon the type of receiver in use,

(*Continued on page* 278.)

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DESIGNING METERS

Specially written for the Beginner, this short series deals with the use of various types of moving-coil meter. Advice is also given in the choice of meter, and full calculations are given to cover the use of meters as voltmeters, ampere and milliampere meters, and ohm meters.

IN these days of government surplus there is very little excuse for the radio amateur not having a multi-range meter that will measure D.C. voltage and current. Such instruments are essential equipment for the amateur constructor.

In the design and use of a meter it is important that the amateur has a knowledge of Ohm's Law. This law of nature was named after Professor Ohm, of Munich University. It states briefly that the current flowing in a circuit is directly proportional to the applied voltage, and inversely proportional to the resistance. This statement then gives us three formulæ E equals I × R, I equals $\frac{E}{R}$, R equals $\frac{E}{I}$, these three forms should be learnt and remembered as they form the very back-bone of electrical calculations.

The moving-coil voltmeter is essentially a current meter with a resistance in series; for instance, if the movement is 10 mA., full-scale deflection, and the meter is required to read 0-10 volts, then a series resistor will be required to drop the current at 10 volts to 10 mA. By Ohm's Law R equals $\frac{E}{R} = \frac{10}{.01} =$ 1,000 ohms. If the same meter is required to read 100 volts full scale, then the resistance required will be $\frac{100}{.01} = 10{,}000$ ohms. Studying these, we will see that for every volt 100 ohms is required to be added, so the meter with a current drain of 10 mA. full-scale, is known as a 100 ohms per volt type. Again, if the meter movement is 1 mA. full-scale, then it will make a voltmeter of 1,000 ohms per volt. The higher the ohms per volt the less will be the current drain in a circuit. Looking at Fig. 1 we see two resistors of 100,000 ohms in series with 200 volts applied. By

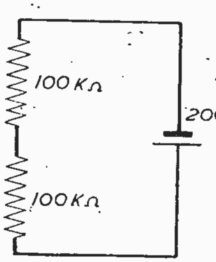

Fig. 1.—Diagram to explain voltage drop across two resistors in series.

simple calculation it will be seen that the current in each is 1 mA., and the voltage drop will be 100 volts across each. If we try to measure the voltage with a meter of 100 ohms per volt, a reading on the 100-volt scale of about 20 volts will be obtained. If a meter of 1,000 ohms per volt is used it will give 66 volts on the 100-volt scale and 80 volts on the 500-volt scale. It will be seen that the lower the current drawn, the more accurate will be the reading, but that the voltage will never be the same as that by calculation. This is not because calculation is at error, but because the meter draws a current and upsets the circuit. There are, on the market, several cheap testmeters of the moving-iron type that draw a current of 30 mA. and have a resistance of only 33 ohms per volt. These meters are of very little use in radio experimental work, but owing to the very high current drain will give a very accurate indication of the condition of a dry H.T. battery.

The writer has used meters with a full-scale deflection of 10 mA. for multirange meters with a fair degree of success, but has found the readings too far off the mark with resistance capacity, amplifiers to be more than a very rough indication. For general purpose work a meter of 1,000 ohms per volt is very good, but one of 10,000 would be much better, but then the cost of the movement would be very much higher.

Examples

As an example of calculations we will assume that a meter of 2 mA. F.S.D. (full-scale deflection) has been obtained, and the resistance is 100 ohms. The voltage readings required are: 0-2, 0-5, 0-10, 0-20, 0-50, 0-100, 0-200, 0-500 volts. If the arrangement of Fig. 2 is used, the resistors can be of lower wattage rating and, therefore, will cost less; also, if a resistance on a low-range is overloaded the accuracy of all the ranges will be impaired, and the cost of repair will be higher. The resistors required for a series chain will be 900 for the two-volt range. It will be seen that a total resistance of 1,000 Ω is required, but that the meter has a resistance of 100, which leaves 900 for the resistance. The five-volt range will require an extra 1,500 ohms, the 10 volt a further 2,500, whilst the 20 another 5,000. This makes the highest resistance required that between the 200 and 500 scale, namely 150,000 ohms. The heat dissipated by a resistor is rated in watts, and can be calculated in three ways from Ohm's Law. First, it may be explained for those who are new to radio, that if a pipe has a 1in. bore it will pass 1in. of water irrespective of the pressure, but if the pressure is increased the rate of water will increase. So that at a pressure of 10 lb. per square inch we will only get half as much as at

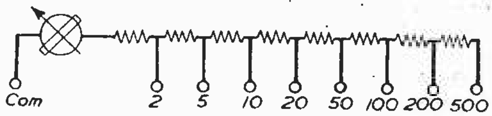

Fig. 2.—Series resistors arranged to give various voltage indications.

20 lb. per square inch. This means that we will be getting so many gallons per minute, and at double the pressure, twice as much. This " gallons per minute " in electrical work is an amount of energy, and since energy cannot be destroyed, but converted from one type to another, we get a quantity of heat. This heat is calculated by multiplying the current (I) by the voltage (E). The three formulae are, W equals EI; W equals $\frac{E^2}{R}$ (the small figure ² indicates

that the number is multiplied by itself, and is called squared), the third form is I^2R (I squared R).

The easiest one to use in this case is EI, as we know the voltage and the current of the meter. It is always easier to do one calculation than two, as would be the case if either the other two forms were used. On the highest range E equals 300, and I equals .002 (note here that the calculations must be carried out in volts and amperes), so W equals EI, equals $300 \times \frac{2}{1,000}$. This is rather less than one watt, so a rating of one watt would be in order. The next lowest resistor, the one between the 100 and 200 ranges, will be $100 \times \frac{2}{1,000} = 0.2$ watts. One of ¼-watt rating would be suitable here.

Taking the case of a meter with a separate resistor for the different ranges, the highest would have to have a rating of $500 \times \frac{2}{100} = 1$ watt. This rating would leave no margin for overload, so one of $50 \times \frac{2}{1,000} = 1/10$ W., so one ⅛ W. could be used.

Tolerances

A word about accuracy here would not be amiss. The normal resistor is usually of 20 per cent. tolerance, and is of little use for use with a meter. Those with a silver band are an improvement, as they are 10 per cent., but for general purpose work those with a gold band are better, as they are 5 per cent. There are closer tolerance resistors made, but they are a little expensive. Where the fourth band is coloured yellow the tolerance is 4 per cent. ; orange, 3 per cent. ; red, 2 per cent. ; and the 1 per cent. are in brown.

The firms of Dubilier and Erie make some very good high-stability meter resistors. Erie make them to 2 per cent., whereas Dubilier make them to 1 per cent. as a general rule, but can supply them as close as 0.1 per cent. to special order. It should be pointed out, however, that it is no use expecting an accuracy to the same degree as the resistors, if the meter is not of a higher degree of accuracy, i.e., it is a waste of money to buy 1 per cent. resistors for a meter that is only accurate to 2 per cent.

The meter can be made to a very high degree of accuracy by the use of 20 per cent. carbon compound resistors if the experimenter has access to a very high-grade meter such as a Western Sub-Standard. The resistors chosen should be slightly low, not more than 10-15 per cent. ; the voltage applied with the standard meter in parallel, and the resistor filed to increase its resistance until the readings on the two meters are the same.

Current Meters

Another type of meter in the lab. is the current meter. It is no use trying to read 100 mA. on a 0-1 meter or 1 mA. on a 0-100 meter. It is always as well to use a meter of as near a full-scale deflection as the current to be read. This means that the range should be higher than the current, and not the other way round. It is very handy to have a current meter apart from a voltmeter, although the two can be made in one combined instrument, but remember that no matter how many ranges a meter has, it can only be in one place at a time. If the current range of a meter is to be extended, then the surplus current must be by-passed by a shunt. For example, if the movement is 0-10 and 100 mA. is to be read, then the shunt must carry nine times the current of the meter. This means that it must be one-ninth the resistance of the meter. The formula for the calculation of the resistance of a shunt is : Rs equals

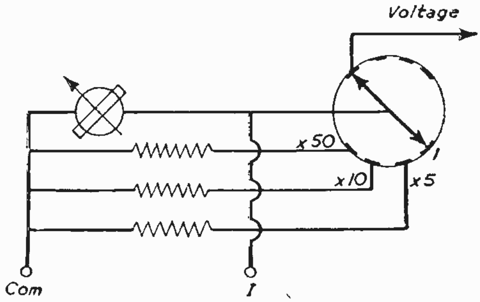

Fig. 3.—Circuit of a current meter to give different ranges by means of a selector switch.

$\frac{Rm}{N-1}$, where Rs is the resistance of the shunt, Rm that of the meter, and N the multiplying ratio. The resistor can be made up from resistance wire, which can be obtained from almost any firm of radio engineers. The length of wire to give the required resistance is calculated and about 10 per cent. added. This is then wound on to a former and connected across the meter, as is shown in Fig. 3. The switch used is of the wafer type, and the voltage range taken to the resistor chain by one of the contacts. This reduces the chance of errors in voltage readings. The idea of the shunt resistor being too high is so that it can be brought down with a shunt. It is essential that a good current meter is used for calibration. The shunt is shunted by a length of finer resistance wire and this is adjusted by trial and error until the readings on both meters agree. The second length of wire is then wound on a former with the first and wired in parallel with the first-made shunt. By this method it is possible to make a shunt of very high accuracy.

(To be continued.)

AERIAL HINTS

(Continued from page 274.)

but as an indication of the efficiency of this type of aerial it may be mentioned that I have worked a number of American amateurs with an AR88 using a 4ft. wire hanging as above described, the results being better from a signal-noise point of view than switching the receiver to the transmitting aerial.

Materials

The only remaining problem is that of the material to be used for the aerial, and in this connection it is hard to beat the multi-strand copper wire made specially for the purpose. It should be remembered that R.F. currents travel on the surface, and therefore you need as large a surface as possible, with the minimum of skin resistance. Obviously, a highly polished tube would be ideal but unwieldy and impracticable except for the ultra-short wavelengths. Stranded wire offers a larger surface aerial than the equivalent thickness in a single wire and will probably offer less overall weight.

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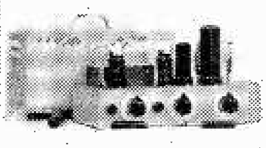

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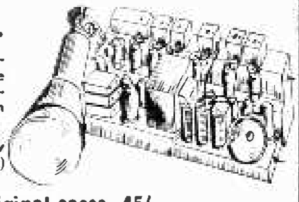

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A 27 Mc/s Frequency and Signal Strength Meter

A VALUABLE ACCESSORY FOR THE RADIO CONTROL ENTHUSIAST

By F. J. Rayer

BY means of this unit the frequency and output of model-control transmitters may be checked. Most such transmitters are of the tunable, self-excited type, and some method of frequency-checking is then essential. Apart from this, the meter can serve the useful purpose of indicating the strength of the signal actually radiated. The efficiency of various transmitter aerials can therefore be determined at once, as can the result of modifications to the transmitter.

With the usual type of carrier-wave transmitter, the signal strength may be read by connecting the "output" leads shown to a moving-coil meter. If the transmitter employs modulated tones, these may be heard by adding a pair of headphones in series with the meter. An exact check on the manner in which the transmitter is functioning can therefore be maintained at all times.

When the unit is used near the transmitter (as for frequency checks) no aerial need be used on it. At greater distances, a short aerial is added to increase signal pick-up. Field-strength tests may conveniently take place at 20yds. to 30yds. from the transmitter, and a self-supporting aerial 1ft. to 3ft. long can be used for this purpose. The exact length of the aerial is in no way critical, but dial calibrations will only hold good for one particular aerial. In addition, tuning becomes less sharp as the length of the aerial is increased. Because of this, it is recommended that the dial be calibrated with a very short aerial (or no aerial at all). These readings will then form an accurate frequency-check at short range. For field-strength measurements at a distance, a longer aerial can be used, and the unit re-tuned for maximum output, as shown by the meter.

As an aid to this method of use, a plug of suitable size is secured to the tuning condenser. A length of aerial tubing can then be fitted at once, when required. The 1ft. long aerial sections offered by numerous advertisers are particularly convenient, since an aerial of any length can be built up, and will be self-supporting.

The output of the unit drops to about 10 microamps. at 30yds. and this should be kept in mind when selecting a moving-coil meter for use with it. However, various ex-service and other movements with a full-scale deflection of 50 to 100 microamps. are easily obtainable, and will serve admirably.

Details of Construction

The unit is built up upon a plywood base 9in. by 3½in. None of the dimensions is critical, but the tuning condenser must be operated through some form of insulated extension spindle at least 2in. long, to avoid hand-capacity. A dial marked 0-100 or 0-180 degrees is also required, and the whole should be locked up firmly so that calibrations will hold good. A pointer may be formed by cutting a suitable bracket and bending over a point on this. No reduction drive is required.

Other details are clear from the diagrams. It should be noted that the terminal used as a junction for diode, .001 μF condenser, and one output lead, is *not* in contact with the butterfly condenser rotor.

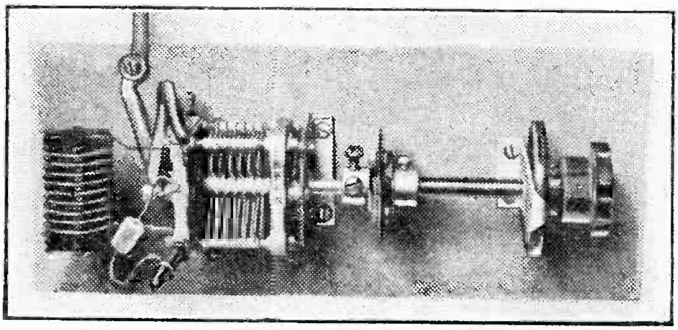
A self-supporting coil is not used, since calibration will be upset by any change in the spacing of turns. A ribbed, threaded former was used, and measures 1in. in diameter across the ribs, which are so threaded as to give 8 turns per inch. With this former, 9 turns of 20 S.W.G. tinned copper wire are required.

If a self-supporting coil is made, approximately 12 turns will be required. With a plain, non-ribbed type of former, 7 to 8 turns are required. So long as coil and condenser can be tuned to 27 Mc/s (approx. 11.11 metres), the exact form of the coil is unimportant. It should, however, be so made that its characteristics cannot vary.

Calibration

Several methods of calibration exist. If a crystal-controlled transmitter is available, the unit can be calibrated from this by turning the control knob until the meter shows maximum deflection. If the meter pointer moves backwards, the two leads from the unit should be reversed. The dial-reading should be noted down for future reference.

If a model-control receiver known to be on correct frequency is available, with a self-excited tunable transmitter, then the transmitter should be tuned for maximum receiver response. The unit should



The completed meter.

then be tuned accurately to the transmitter signal, and the dial-reading noted.

If a signal-generator tunable to 27 Mc/s or a harmonic thereof is available, the unit may be calibrated from this. If no such equipment is available, it is possible to have the unit tuned by suppliers of model-control equipment. An alternative is for the user to purchase a piezo-electric crystal and wire up a simple oscillator, using this. The crystal should operate upon some harmonic of 27 Mc/s (crystals for the latter frequency not being available), as, for example, 9 Mc/s. Such an oscillator need consist only of the crystal, valve with holder, and tuned circuit. The latter is adjusted until a drop in anode current shows that oscillation has begun. The unit may then be calibrated by bringing it near the oscillator tank coil, and noting down the 27 Mc/s dial-reading.

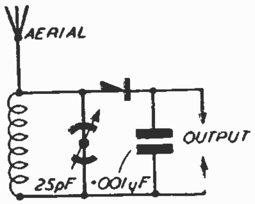
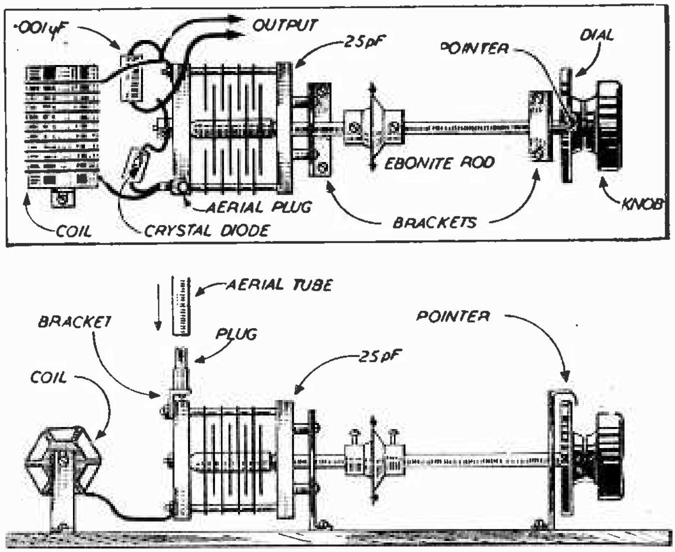


Fig. 3.—Theoretical circuit of the meter.



Figs. 1 and 2.—Two views of the unit to show layout and wiring.

Once the unit has been calibrated by any of these methods it may be used to set transmitters or receivers to the correct frequency. To do this, the unit should be tuned to the dial-reading which indicates 27 Mc/s. The transmitter is then tuned until the meter pointer rises to the highest reading which can be obtained. The receiver is then tuned to maximum response.

For signal-strength measurements, the reading of the meter pointer should be noted. Changes to the transmitter, or its aerial system, etc., can then be made, and the meter reading again noted, to see if any improvement in the strength of the radiated signal has taken place. In some cases it will be found that quite slight changes in the transmitter, or its aerial, may bring about a worth-while improvement.

Receivers employing a detector in violent oscillation will give a reading on the signal-strength meter at short range. To avoid confusion from this fact, the unit should be kept a few yards away from any such receiver when the latter is in use.

News from the Clubs

MIDLAND AMATEUR RADIO SOCIETY

Hon. Sec.: P. L. Hunt, G3FWB, 39, Antrobus Road, Birmingham, 21.

AT a recent meeting of the Society a discussion on "Modern Trends in Amateur Radio" was organised, members present taking part: this was much enjoyed.

Meetings of the Society are held on the third Tuesday in the month at the Imperial Hotel, Birmingham.

SOUTH MANCHESTER RADIO CLUB

Hon. Sec.: M. Barnsley, G3HZM, 17, Cross Street, Bradford, Manchester, 11.

MR. F. HUDSON has resigned his position as Hon. Sec. and this position has been taken over by Mr. M. Barnsley.

The Club station is active on alternate Fridays to the lecture nights on 3.5 Mc/s.

GRAVESEND AMATEUR RADIO SOCIETY

Hon. Sec.: R. E. Appleton, 23, Laurel Avenue, Gravesend, Kent.

AT the annual general meeting held in January, E. C. Woods (G3FST) was elected to succeed E. J. Parker (G3EJK) as Chairman for the ensuing 12 months.

R. E. Appleton (unanimously re-elected Hon. Secretary) gave a brief summary of the Club's activities during the past year. Membership had risen by 20 to 51 members, and the financial position was satisfactory.

Every effort would be made in the near future to get the Club station on the air, at 66, Burch Road.

THE EAST SURREY RADIO CLUB

Hon. Sec.: L. G. Knight, Esq., Radiohme, 6, Madeira Walk, Reigate, Surrey.

THE annual general meeting was held at Club headquarters, the British Legion H.Q., Redhill. Officers for the coming year were elected, the treasurer's report was adopted and the secretary's report on past progress and future activities was appreciated by the many members present.

The Club is open at 8 p.m. on Mondays for Morse practice lessons and on Thursdays for practical radio work. Monthly meetings with a lecture or demonstration are arranged. New members will be assured of a warm welcome.

COVENTRY RADIO CONTROLLED MODELS SOCIETY

Hon. Sec.: Mr. P. Haselock, 25, Wainbody Avenue, Coventry.

THE above Club has been formed to promote interest in radio control of model aircraft, boats, etc.

There is a lively nucleous of 12 paid-up members, and from the interest shown by "other parties" it appears that expansion will be rapid.

Meetings have been arranged for the first Wednesday of each month, at 7.45 p.m., at the headquarters of the Royal Air Force Association, Coventry Branch, 78, Holyhead Road, Coventry.

Annual subscription has been decided at 10s. 6d. per member, which will cover hire of meeting place, etc., and all Club expenses.

Using A.F. Transformers

SOME DETAILS ABOUT A FORM OF COUPLING WHICH IS NEGLECTED IN PRESENT-DAY EQUIPMENT

By N. H. Crowhurst

IT is surprising to find so many otherwise knowledgeable people still prejudiced against the use of A.F. transformers. The author mentioned this point to a senior BBC engineer a few days ago, who endorsed his impression. Apparently this engineer frequently meets audio enthusiasts who tell him they have an amplifier or receiver that originally contained A.F. transformers, which they have now replaced with complete resistance-capacitance coupling arrangements, and "it now sounds much better." The man from the BBC usually responds by asking them if they know how many A.F. transformers BBC programmes pass through before they leave the transmitter. Saying "No," they wait for an answer, probably expecting quite a low figure; when our friend from the BBC tells them that there are literally dozens, and maybe hundreds in some cases, they are obviously staggered, because it is quite well recognised that BBC programme quality is among the best in the world.

Some readers will respond at this point: "Ah, yes, but BBC transformers are in a special class, high-quality jobs that cost more than is economic for commercial equipment or kit-built gear." While the BBC transformers are undoubtedly more costly than would be economic for general use in receivers and amplifiers, it is not true that such high cost is necessary to achieve results comparable with and in some instances better than circuits that avoid the use of transformers. Some of the prejudice against A.F. transformers is probably due to the fact that most people judge results solely by listening to the amplifier, usually because they have not the equipment available to find out in just what way it falls short of a desired standard.

The author is in entire agreement with the principle that the results heard are the final criterion; but from the development viewpoint measurements have been essential to the improvement of circuits technique so we can get better results to which to listen.

The author suggests that the basic reason for the unpopularity of A.F. transformers is that their misuse can have worse results than similar misuse of other coupling circuits. In other words, if wrong resistor values, or other components, are put into circuit, the detrimental effect on quality in a transformer-coupled arrangement is greater than for a similar error in component values using resistance-capacitance coupled circuits.

This, of course, was one of the arguments against the use of tetrodes and pentodes in their early days, used by the enthusiasts who advocated sticking to the good old triode; but although there are some, including the author, who advocate triodes, or triode-connected valves, as being the best proposition (in some cases at least) where quality is the first consideration, *for an output stage*, most of us have come to accept the A.F. pentode as the best kind of valve to use for low-level input stages to get high gain quickly. Many go further and advocate, on the grounds of economy, the use of pentodes and tetrodes for output stages, with carefully chosen circuit values and a liberal supply of negative feedback, in order to get the best possible quality from them. Indeed, there is only one feature in which the bulkier, more costly and less economic triode output circuit can really improve on a well-designed pentode or tetrode circuit: that is its overload factor—the rate at which distortion sets in after the rated output is exceeded. If it can be guaranteed that peak outputs will never exceed the rated output, then the tetrode or pentode type output circuit is undoubtedly the best proposition.

No one grumbles about having to be fussy with the correct optimum load, or using appropriate screen feed values, biasing, etc., to get good performance from these valves. Then why not be prepared to go to a little trouble to get the best performance from A.F. transformers in circuits where their use can effect a saving, or provide other advantages?

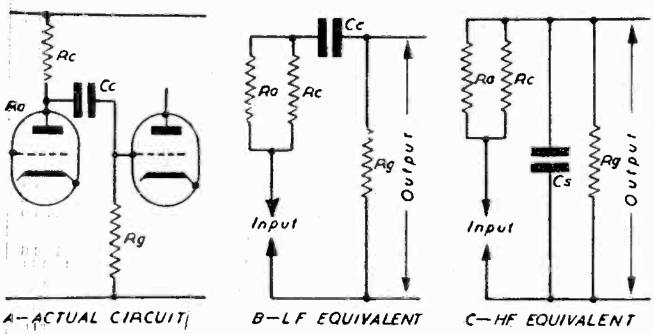


Fig. 1.—Resistance-capacitance coupling circuit and equivalents for L.F. and H.F. response. (a) Actual circuit. (b) L.F. equivalent. (c) H.F. equivalent.

R.C. Coupling—the Whole Story

For the moment consider the simple resistance capacitance coupling circuit. Even in this arrangement there are two impedances of importance: the source impedance and the load impedance. Fig. 1 illustrates this fact: for determining the L.F. response, the critical factor is the relation between reactance of the coupling capacitor and the combination of source and load impedance in series; for the H.F. response the critical factor is the reactance of the total shunt capacitance (including the anode capacitance, capacitance to earth of the coupling capacitor, and the grid input capacitance of the following stage) relative to the parallel combination of the source and load impedances.

Thus, merely for computing response itself, it is not sufficient to know just one resistance value ; even the sum of the values only gives the L.F. response—the H.F. response requires to know the parallel combination of resistances. This is not all ; distortion must be considered. This is dependent not only on the load resistance presented to the anode of the preceding stage, but also on any reactance that may appear in this load. In the middle of the frequency band the load resistance is effectively the anode resistor and grid resistor in parallel—yet another combination. The coupling capacitor can introduce reactance at the low frequencies, or the shunt capacitance at high frequencies. Either of which may cause distortion due to the load line becoming elliptical as well as departing from optimum slope.

So there is more to think about in R.C. coupling than is usually realised.

Transformer Coupling

The reason why resistance-capacitance coupled circuits are usually preferred to A.F. transformers has already been suggested—that bad choice of values does not usually produce such obviously bad results as can occur when an A.F. transformer is seriously misused.

Perhaps the first thing to emphasise is that transformers cannot do anything to the performance that cannot be explained in terms of fairly simple circuitry. There is a prevalent impression that transformers introduce inherent distortion. In point of fact, the waveform distortion directly due to any audio transformer, used under even approximately its correct conditions, is considerably less than is introduced by a valve operating correspondingly close to its correct optimum load.

A valve causes non-linear distortion at all frequencies to some extent, whereas a transformer only causes its non-linear distortion to any appreciable extent at the low frequencies ; so when a transformer can be used to get additional gain in place of valve amplification as the alternative, the transformer is inherently better, except possibly at the extreme low frequencies, provided it is correctly used.

As with the simple resistance-capacitance coupling, however, the reactance introduced by the transformer as part of the anode load of the preceding stage at either end of the frequency response may also cause distortion, not because of the transformer's own non-linearity, but due to the preceding valve characteristics.

Transformers increase the possible range of variety in frequency response, particularly at the low and high frequency ends. At the low-frequency end a parallel-fed transformer can be represented, as shown at Fig. 2(b) : the coupling capacitor with the primary inductance can form a resonant circuit, in which the A.C. resistance of the valve paralleled with the coupling resistor are effectively in series, so increasing the combined parallel resistance will reduce the tendency to peak ; while any resistance loading connected to either primary or secondary of the transformer, after the coupling capacitor, is effectively in parallel with the resonant circuit, so a higher value of resistor here will increase tendency to peak, while a lower value decreases it.

In speaking of a tendency to peak and of the circuit as a resonant one does not mean that the circuit will necessarily produce a low-frequency peak ; this depends on the relative values, both the resistance combinations already mentioned, and the value of coupling capacitor and primary inductance. The only one of these that cannot be changed simply is the primary inductance, so there are three possibilities of adjustment to avoid a low-frequency peak. At the other extreme, far from the tendency to peak, the response can be better visualised by comparing the circuit with the resistance-capacitance circuit. The transformer inductance produces a shunt effect compared with the parallel combination of all the resistances in circuit, while the coupling capacitor is in series in much the same way as it is in the simple R.C. coupling arrangement. This is illustrated by the rearrangement at Fig. 2(c).

Turning to the high-frequency response, which is the one most often misunderstood, the arrangement is shown at Fig. 2(d). Here the leakage inductance between the windings tends to resonate with the secondary winding capacitance, which includes the grid input capacitance of the following stage. In this case any resistance connected across the secondary is in parallel with the tuned circuit, while the source

(*Continued on page* 289.)

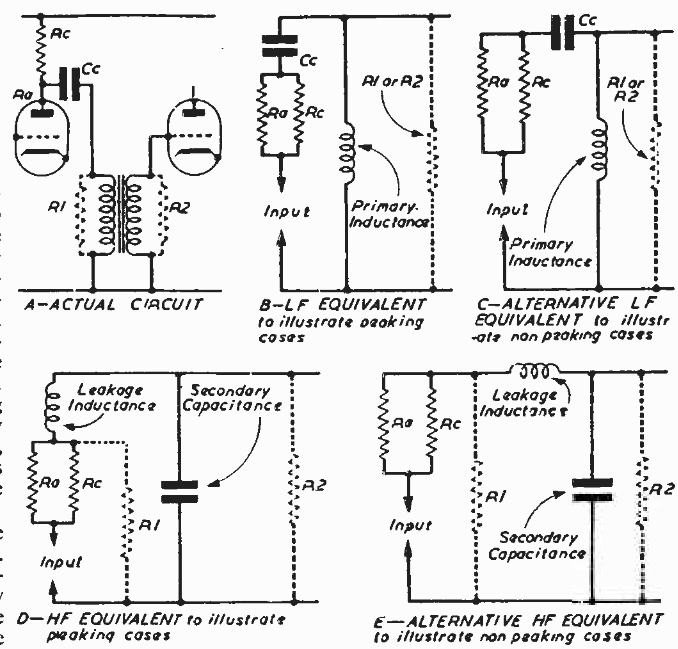
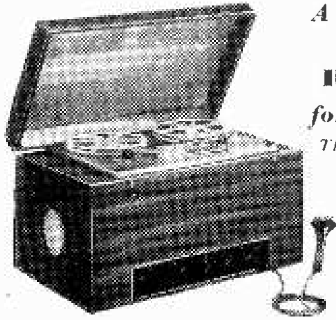


Fig. 2.—Parallel-fed interstage transformer-coupled circuit and equivalents. (a) Actual circuit. (b) L.F. equivalent to illustrate peaking cases. (c) Alternative L.F. equivalent to illustrate non-peaking cases. (d) H.F. equivalent to illustrate peaking cases. (e) Alternative H.F. equivalent to illustrate non-peaking cases.



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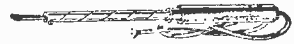

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(*Continued from page* 286)

resistance consisting of the A.C. resistance of the preceding stage in parallel with its coupling resistor is effectively in series with the tuned circuit. If a resistor is connected across the primary of the transformer this also contributes as part of the parallel combination making up the series damping resistor in the equivalent circuit. When the circuit values represent conditions far from resonance, the arrangement of Fig. 2(c) is simpler to understand, wherein the leakage inductance causes loss by combination with the series combination of resistance values, while the shunt capacitance combines with the shunt combination of resistances. When this condition applies, one of these elements, leakage inductance or winding capacitance, always produces considerable attenuation of high frequencies before the other one starts to.

Circuit Juggling

From all this it is evident that the available circuit quantities can be varied in a wide variety of ways so as to get the best out of any individual transformer design as regards frequency response. For example, a resistance connected across the primary of the transformer will have the effect at once of cutting down the tendency to peak at low frequencies, whilst pulling up the high frequencies. In addition to this fact, the comparative effect of varying the circuit resistances in primary and secondary circuit on the response at the low- and high-frequency ends is invariably quite different ; for example, varying the primary circuit resistance may have more effect on the bass than on treble response, while varying the secondary circuit resistance will have more effect on the treble than on the bass response.

Of course, a well-designed transformer has its internal component values arranged to suit the circuit for which it was designed without any such juggling.

Another place where resistance can be added is in series with the primary. This position may be of service where the A.C. resistance of the preceding stage has too low a value, so that increasing the coupling resistor even indefinitely would not achieve the desired result. Under such circumstances, the series resistor in the primary circuit, as well as producing the necessary effect upon overall frequency response, may help to prevent the reactance components appearing across the anode load from causing distortion at low or high frequencies.

Perhaps the foregoing discussion makes the problem look a little complicated or overpowering, but this is the most difficult possible case of transformer design or circuitry. A parallel fed interstage transformer may involve all the considerations just mentioned at once, so can require quite a bit of circuit juggling to get the best values if it has not been designed for any specific circuit, or is used in some other circuit. Nevertheless, an interstage transformer can often contribute a very useful degree of stage gain, or enable a smaller or less expensive valve to provide the necessary swing for a long grid-base output stage.

Sometimes difficulty is encountered in providing sufficient swing for output valves because of low H.T., as in A.C./D.C. types equipment, and the way of overcoming this without the use of transformers may involve an extra stage of push-pull, while the use of a transformer might completely eliminate these two extra valves so the previous single-ended stage could drive the output valves direct.

Where to Use Transformers

For most applications input and output transformers are almost unavoidable, but are often incorrectly used, causing distortion or poor response. In the case of input transformers, the low-frequency end consideration is simpler than the parallel-fed interstage case just considered, because it is simply due to the primary inductance, without any series capacitor, so attention can more simply be directed to achieve the correct high-frequency response without needing to worry about the combined effect on low-frequency response.

In output transformers the arrangement is reversed, because they act as step-down instead of step-up transformers. Fig. 3 shows an actual circuit together with the necessary equivalents for low- and high-frequency response. The low-frequency response is determined purely by primary inductance in combination with the A.C. resistance and load impedance of the valves. Usually, however, more important than the response at low frequencies is the possibility of distortion, due to the reactance of primary inductance. This is especially true in the case of triode type output valves.

In pentode type output stages primary inductance can produce only low-frequency loss, because the A.C. resistance is very high and the pentode does not mind a shunt reactance to its optimum load.

For the high-frequency response, although measurements are usually taken with the equipment loaded by means of a non-inductive resistance, practical operation is with the equipment connected to a loudspeaker, which behaves far from a non-inductive resistance. The loudspeaker inductance towards the high frequencies in conjunction with the leakage inductance of the transformer (which usually has negligible value in comparison, even in the cheapest form of output transformer) produce a rise in load impedance at the high frequencies. In the pentode or tetrode type output stage this can cause considerable distortion as well as over-accentuation of these frequencies. The best remedy is to connect a suitable capacitor across the primary of the transformer. As artificial shunt capacitance is often required in this way, the primary capacitance of an output transformer is usually unimportant for the simple reason that more has to be added to it anyway.

The next problem where transformers can be very useful, but where they are often avoided, either because a suitable design has not been chosen or through insufficient knowledge of how to apply them, is in the drive stage for a Class B type output where the output valves require to be driven into the positive grid region. For this application the coupling transformer usually has to be of the step-down type instead of the step-up provided by other types of interstage transformer. This is to provide a low source impedance for the output valve grids so that the short bursts of grid current do not cause distortion to the waveform as the grids run positive.

A misleading statement that has often appeared about drive transformers is that the *secondary* resistance must be very low, because of the grid current drop it will produce. For this reason some designs have devoted most of the winding space to the secondary winding, resulting in a primary winding of unnecessarily high resistance because of the fine gauge wire with which it must be wound to get it into the small remaining space. The mistake is that increasing primary resistance increases the effective drive resistance or impedance from the viewpoint of the transformer, and so is as bad as increasing the secondary resistance. From the viewpoint of winding distribution, the usual rules about economic distribution of the losses apply in the case of a drive transformer the same as they do in the case of the output transformer for a Class B type amplifier.

To obtain a low drive impedance for the output valve grids, as well as having an actual step-down ratio, the source resistance on the primary side should be low. For this reason low-impedance valves are used in the preceding stage. This means that, although the transformer is working as a step-down, which would normally make it conform to the equivalent circuit of Fig. 3(c), the relative impedances connected to it are low on the primary and high on the secondary (except for the grid current pulses which impose an instantaneous lower value of impedance), so the equivalent circuit for high-frequency response is still similar to that of other interstage or input transformers, shown at Fig. 2(d).

Because of the exceptionally low primary impedance, and the fact that the transformer acts as step-down, producing a low leakage inductance from the viewpoint of the secondary, the circuit usually has a very strong peak in its response a long way above the normal audio range, which can give rise to parasitic oscillation at a radio frequency. Increasing the leakage inductance in the design is not a permissable remedy because this increases the source impedance of the output valves' grids at the high frequencies and thus produces distortion up there. The transformer must be designed in accordance with the usual practice for drive transformers, with a low leakage inductance, and to prevent parasitic oscillation, a resistance across the secondary, connected from the grid pin of the valve to the cold end of the secondary, will produce a satisfactory high-frequency response and avoid parasitic oscillation.

This will also improve waveform throughout the range, provided the power available from the preceding stage is adequate to feed the maximum voltage swing into the value of resistor used, at the same time giving the maximum grid current required by the output valves.

Correct use of a drive transformer in this position will give better drive for the output valves, particularly at the low frequencies, than the bridged choke arrangement that has tended to replace it in recent years, using cathode coupling so the drive stage acts as a cathode follower. The latter procedure is wasteful of available gain and also of H.T. supply power, economy of which is usually the purpose in using a Class B type output.

One more reason why A.F. transformers continue to be shelved, where any alternative circuit is at all possible: many transformer manufacturers seem to be very reticent at giving any circuit details for the operation of their components. This fact, in conjunction with experience of improved results by eliminating transformers, has produced the false impression that circuits without transformers are always inherently better than circuits using transformers.

It is believed that many transformer manufacturers do not issue more information about the performance of their products for the simple reason that they do not know more about their performance than most of the people who might use them—if they understood them better. Transformers are no more than a means of livelihood to the sales manager and directors, while from the production angle they are just so many turns of wire on a bobbin with a suitable core wrapped round it.

In making this general suggestion about manufacturers, the author would like to exempt several of the more reputable manufacturers, who have given him excellent assistance in compiling the appendix for his Audio Handbook No. 3, "The Use of A.F. Transformers."

This article has been written because the author believes in using the right component in the right place. For very obvious reasons one would not use a PX4 to serve the purpose of a germanium diode, simply because the crystal and cats'-whisker went out years ago. Then why adopt elaborate means to avoid the use of A.F. transformers, when in some circuits a good A.F. transformer really does provide the best arrangement?

In the earlier days when most of the prejudice against A.F. transformers started, even input transformers were comparatively bulky, but the modern

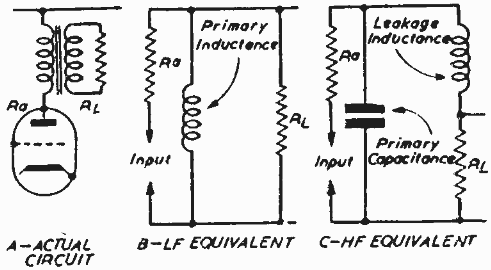

Fig. 3.—Output transformer circuit and equivalents. (a) Actual circuit. (b) L.F. equivalent. (c) H.F. equivalent.

miniature input transformers, for example, having dimensions within ¾in. in all directions, not only are much smaller than their earlier prototypes, but actually are capable of considerably improved performance all round. This is also true of interstage and other types of transformer. Some of the earlier designs with multi-sectionalised bobbins represented considerable amount of effort on the part of designers, to achieve what was, for the materials then available, a really good response. Cheap components in those days certainly could give only very poor results, but modern components employing small cores of high-grade material excel even the best performance produced by the expensive earlier methods, and are well worth considering in quite a variety of circuits.

So why not take A.F. transformers off the shelf and give a useful range of components their rightful place in audio and radio circuitry?

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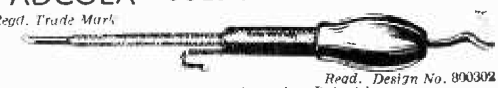

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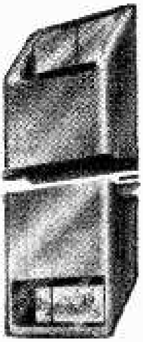

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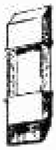

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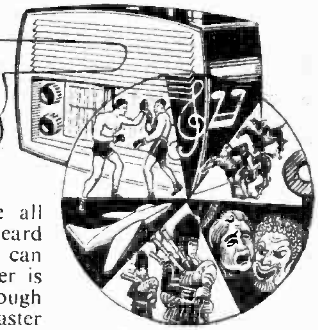


By MAURICE REEVE

THE *Daily Mail's* National Radio Awards for 1952-53 came just too late for comment last month, but I think they are sufficiently interesting to find inclusion here. They were: personality of the year, Gilbert Harding; outstanding actor, Howard Marion-Crawford; actress, Gladys Young; musical entertainer, Tom Jenkins; most entertaining programme, Educating Archie; most promising new programme, the Al Read Show.

Why not the most outstanding comedian and comedienne, serious musician, talker, announcer and, perhaps, others as well? The selection of candidates and shows places the accent for radio excellence entirely on its lightest side, which seems hardly fair to either a large number of outstanding radio artists or to multitudes of listeners.

The selection of Gilbert Harding will meet with few critics. Since the departure of Stewart McPherson he has had no serious rival, though the two worked in different channels, as well as Twenty Questions, etc. Harding's seeming "rudeness" and testiness—McPherson, too, often took his kid gloves off—has great entertainment value: neither man sounds as though he suffers fools gladly. All of us will hope he wears his honours lightly; for my part I further hope he will one day comment on a cricket match, an assignment that McPherson dreaded and successfully avoided.

Music

Serious music has been rather neglected in these columns lately. I recommend to those readers who have not yet "turned him on," Frederick Gulda, a young Viennese pianist of outstanding promise and already considerable achievement. I heard him play two Beethoven Sonatas and that master's fourth concerto. Although undeniably cold in the more tender and lyrical passages, and given to too strict a tempo, his playing has a spaciousness and breadth which promise the biggest future.

The Friday evening recitals, which included Gulda, vary in standards of performance, but one is always certain of hearing programmes chosen with the utmost catholicity of taste and for most instruments. Andre Gertler and Frederick Stone made a good violin and piano sonata team, whilst Simon Goldberg and Ernest Lush were even better, their Brahms in A being particularly fine. Marie-Thérèse Fourneau, a colourful pianist, played an original programme of Weber's little-heard A flat sonata (I last heard it played by Busoni many years ago) and some Fauré pieces. All Weber is delightful, but I didn't think the Fauré worth the effort. And, lastly, Thelma Reiss and Frederick Stone teamed up in 'cello and piano works.

For Shaw Fans

Two performances of "Man and Superman" and two of "On the Rocks" in about ten days was rather too much, even for Shaw fans. The former can, of course, like all masterpieces, be heard when and where we can get it. But the latter is not great Shaw, though we are told the master had a special fondness for it. John Clements and Kay Hammond gave as much of their superb West-end production as the medium permitted in The Stars in Their Choices series, whilst Howieson Culff, Lydia Sherwood, Elizabeth Lowder, Ellen Pollock and others almost stranded the good ship Shaw on the rocks. It lacks the irrepressible and never fading qualities of "Man and Superman," brilliant, sparkling wit and pungent philosophy, wedded in superb language and stagecraft; in fact, it teaches without often entertaining.

The Stars in Their Choices

The "stars" have some weird and wonderful "choices" in this series. Claire Bloom's was "The Witch" by Wiers-Jenssen, both play and author being unknown to me. Ian Hunter's was "The Faithful Heart" by Monckton Hoffe, and Richard Attenborough's "The Golden Boy" by Clifford Odets.

"The Witch" was gruesome and chilling in the extreme, and "The Faithful Heart" sentimentally pleasing. In this, when Waverley Ango confronts the "result"—twenty and charming—of an early love affair, we nearly had to furtively use our handkerchiefs and twiddle about with the knob. "The Golden Boy," an American story of a young Jewish violinist of promise who turns boxer in a search for a quick Golconda. But on the eve of his world title fight, both he and his floozie—who was also floozie to others as well—are killed in a motor smash. Whether they were doing "90" or "100" wasn't clearly stated. Everyone was more brutal and sadistic than everyone else, and Richard Attenborough did his best, with some success, to be as brutal as the others.

"King Monmouth" and "Cakes and Ale" emphasised the superiority of plays *qua* plays, over-dramatised stories as dramatic entertainment. Maugham's most delighful story lost most of its piquancy in dramatic form, and Joyce Barbour as "Rosie" seemed hopelessly miscast.

New T.C.C. Condensers

T.C.C. announce the introduction of several entirely new and interesting condensers. Amongst these are the following, illustrated below :

High-voltage Type CP561

This is a new range of paper dielectric condensers, which is intended for use in E.H.T. supplies for the largest cathode-ray tubes.

The unique construction includes a moulded case, stud mounting and a flexible connection. The special impregnating compound has outstanding properties which prevent ionisation, and thereby increase the working life.

As there are no metal parts at the high potential end of the condenser, corona losses due to external discharge are virtually eliminated.

Sub-miniature Electrolytics for Use in Hearing Aids

These diminutive tubular condensers are the smallest electrolytics ever made and have been specially designed for use in miniature hearing aids where every component is of necessity scaled down to the smallest possible size.

The improved construction has resulted not only in a spectacular reduction in size but also in an efficient condenser which has successfully undergone a series of very extensive and stringent tests over a long period.

Only two capacity values are available at the moment : 6μF for 3-volt D.C. working and 8μF for 6-volt D.C. working, but more will be added as and when the demands of manufacturers become apparent.

A feature of the construction is the plug-pin which forms one of the terminations, enabling them to be incorporated quickly and easily into an assembly.

Hi-K Ceramic Disc Condensers

This new addition to the existing range of Hi-K ceramic condensers has several uses, including de-coupling in television receivers and spark suppression in small electrical apparatus. They can also be used as alternatives to the ordinary mica condensers in positions where changes of capacity due to variations of temperature coefficients are of no importance.

These Hi-K discs are at present available in two sizes, approximately 10 and 20 mm. diameter, and in a range of values from .001μF to .02μF at working voltages from 500 volts D.C. to 4,000 volts D.C. A special non-cracking, heat-resisting protective coating is applied as a standard finish.

Close-accuracy Plastic Film Condensers

This special range of plastic film condensers has been evolved from the existing "Plastapack" series in order to meet the exceptionally critical conditions encountered in reference standards and tuned filters for carrier telephony.

For capacity values above .02μF a tolerance of $\pm$1/8 per cent. can be guaranteed.

The insulation resistance is greater than 250,000 megohm-μF, and the power factor .0005. Another important feature is the excellent stability of capacity, which is better than 0.1 per cent. In order to maintain these outstanding characteristics, the working temperature is limited to 60 deg. C. (maximum).

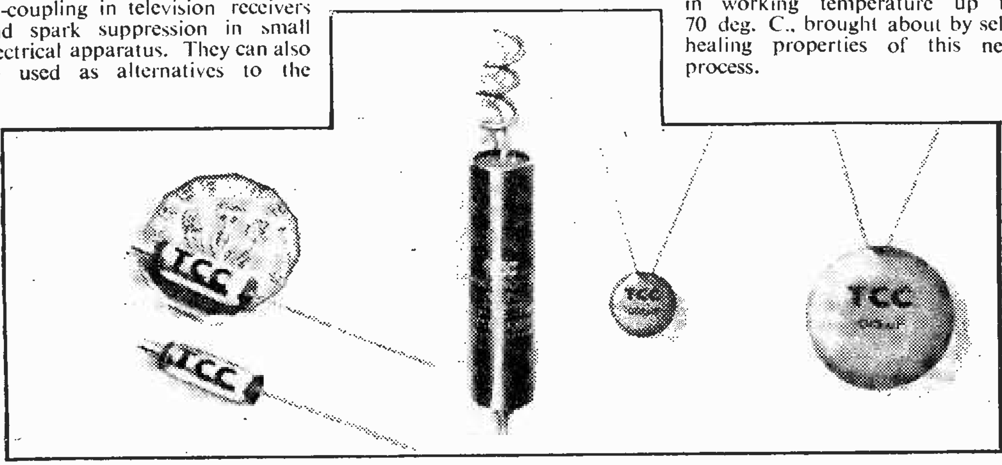
The condensers are available in two forms : in rectangular metal cans and aluminium tubes.

Metallised Polystyrene Condensers

The excellent electrical properties of the plastic film condenser are already well known, these condensers being unsurpassed for high insulation resistance and low power factor. Due to the low permittivity of the dielectric, these condensers were somewhat larger than a condenser of the paper dielectric type having equal capacity.

T.C.C. have now developed a method of metallising Polystyrene film which enables the size of a condenser to be reduced to a point where it compares favourably with its paper counterpart whilst retaining the excellent electrical characteristics associated with the plastic film condenser.

The immediate advantage gained is the increase in working temperature up to 70 deg. C., brought about by self-healing properties of this new process.



Three of the new T.C.C. condensers described above.

OPEN TO DISCUSSION

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Aerial Improvement

SIR,—Being one of the unfortunates who cannot get more than 25 feet of wire in the air with a down lead of 15 feet, I was very interested in the recent articles by G3BHJ, on centre-loaded and end-loaded antennæ.

Acting on the information contained in the earlier article, I have inserted at the "knee" of the inverted "L" a coil of 48 turns on a 3in. former (paxolin) making a grand total now of 77 feet. The improvement in reception and transmission on "Top Band" is quite amazing and I can thoroughly recommend BHJ's idea to anyone in similar restricted circumstances.—R. G. H. BAKER (G3IRB, W.13).

Modifying 1155Rx

SIR,—It is fairly simple to make the following modifications to the 1155 receiver.

(1) To receive Radio Eireann, fit a three-pole two-way switch on the top left-hand corner of the front panel. The aerial can then be switched to the grid of the first I.F. valve.

(2) To minimise frequency drift, fit a voltage regulator valve VR150/30 in the base near the last I.F. valve. This base formerly held a D.F. valve. First remove all the wires to this base, noting that pin 7 is L.T.+. Then wire pin 2 to H.T.—, and pin 5 to the earthy end of a 3,300 ohm, 1-watt resistor wired between H.T.+ and the 22k resistor feeding the 6K8 oscillator section. The striking voltage of 185 volts will thus be obtained.

An 8-pin Jones plug and socket and two 4-core leads can be made into a very useful lead for operating the set on the test bench, away from the power pack.—T. G. BELL (Manchester).

Hi-Fi Amplifier

SIR,—We feel that we cannot let the letter by Mr. J. Vosper go without comment. He says he has heard amplifiers of this type, but as this seems to be quite a new design as far as the tone controls are concerned, we doubt very much if he has heard one in the same class. It has one thing in common with the Williamson that very few so-called Hi-Fi amplifiers have, and that is a circuit for the restoration of the cut of the bass that is made during the recordings. This type of tone correction, or bass restoration, is not new to PRACTICAL WIRELESS, by any means, it was used in the Low Power Hi-Fi Amplifier, an amplifier which I have heard on several occasions referred to as the "Poor Man's Williamson."

Another point, or delusion of Mr. Vosper is that High Fidelity must cost a vast amount of money. One of the main components is the output transformer, and the fact that this is potted, does not cause an improvement in reproduction. It is the amount and quality of the iron that matters. It is generally recognised that the ear cannot detect distortion below 8 per cent. by voltage. That is .64 by volume: the Single Ended Hi-Fi Amplifier on the other hand has a voltage distortion of 2 per cent. This is high compared with the Williamson and the Leak with their 0.1 per cent., but it is only 0.04 per cent. by volume of the total output, and 1/16th of the lowest amount of distortion detectable by the average person. One thing that we do agree on, however, is that a good speaker is essential. We consider that the Single Ended Hi-Fi represents an outstanding example of a design that, when properly constructed, is the best obtainable at the price.—J. S. KENDALL (Kendall & Mousley) (Tipton, Staffs.).

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

Pocket Super-regen.

SIR,—I was very pleased to see E. G. Bulley's article on super-regenerators, for I have carried out several experiments with this type of circuit during the last year.

Many valves were tried, including such types as EF50, EF54, 6K7, 6J7, EC52, etc., all with good results, and all strapped as triodes. But the best valve found so far, is the B7G-1R5, around which a set was built small enough to go into the coat pocket. The tuning coil is 1in. in diameter, and consists of 16 turns of 30 s.w.g. enamelled copper, spaced by its own diameter. Both trimmer and tuning condensers are 3-30 pF. With an 18in. aerial the receiver gives excellent results on the 20-metre Amateur band. Many Italians coming in during the day, and then perfect reception of local "hams" during the evening —and with what really matters, plenty of volume.

When built, the tuning condenser should be set half mesh, and then with the domestic receiver set to the middle of the 20-metre (14 M/c) band, the 3-30pF trimmer is adjusted until the hiss which will be heard in the loudspeaker is at maximum volume, the small receiver is then ready to be used.

It must be remembered, that any deviation from the aerial length will necessitate re-trimming.—G. J. BAMFORTH (Sheffield).

Amplifiers

SIR,—I was very interested in the single-ended amplifier described in the February issue and this brought to mind an old controversy regarding amplifiers. I remember before the war there used to be big battles in one of the magazines concerning the respective merits of the push-pull (transformer-coupled as well as R.C. coupled) and the parallel or single-ended stage. The question of second and third harmonic distortion was often thrashed out and I wonder why to-day there is such an emphasis on the push-pull stage. I notice that the firms which specialise in amplifiers for so-called quality reproduction all use the R.C. arrangement with tetrodes connected as triodes in the output stage. Why not go the whole hog and use a really fat triode (I well remember the DO.26s and PX.25As) and still feel that a good triode in a single-ended output stage takes a lot of beating.—G. BETTERTON (Worthing).

Reminiscences

SIR,—As one of the readers of PRACTICAL WIRELESS since 1932 please allow me to send my congratulations to everyone connected with the issue of the journal. Well do I remember those early days of "bright emitters," microphone amplifiers, square-drawn connecting wire, etc.

Married life, from 1933, curtailed my activities in radio, as also did the war years. In fact, I did not become really "active" again until about three years ago.

My first task was to start on test gear (with the meter in PRACTICAL WIRELESS Service Manual) and I have taken a great interest in articles by Dresser, Kendall, Paterson, G2FMY, etc. Not that I've built them all yet, but I'm pushing on, learning all the time. When the new series for beginners is published I'll brush up some theory and get practical knowledge at the same time.

I've never yet constructed a PRACTICAL WIRELESS set, but hope eventually to make some form of a "family" set with pre-set and "free" tuning, also a radiogram. The modern quality amplifier in the current issue is of interest as an amplifier.

Other quality amplifier designers, including Lewis George and Bonavia Hunt, have stressed the importance of direct coupling. On page 31 of "High Fidelity Radio" the latter says: "Direct coupling is responsible for the really beautiful upper frequency reproduction. One has only to insert a blocking condenser between anode and grid to realise the difference." That's why I look doubtfully upon C.3-6-7 of the Quality Amplifier. However, I may still build it, using a 500 volt transformer. It will be interesting to see what kind of feeder is designed; which I hope will at least be of variable selectivity. I have tried two T.R.F. circuits and find that they are useless locally. Reverting to Bonavia Hunt again, I see that he advocates the output valves in parallel—not p-p. Perhaps this is merely a personal fad.—E. WELLS (York).

Short-wave Results

SIR,—I should like to thank you for the recent hints given on short-wave reception. As a result of the various notes I have read over the past year I have taken up this side of receiving, and find it most interesting. I am now building a special short-wave receiver and welcome all the information you can give for this branch. I know it may sound selfish, but I should like to see the short-wave section increased to four pages a month. I am sure others will not object to that as they are adequately catered for in the rest of the pages. I think it would be a good plan to publish complete receiver designs for this particular phase of reception.—G. ROBERTS (Exeter).

A PERSONAL TWO

(*Continued from page 273*)

same time, a situation which could not be obtained with the normal potentiometer in the grid circuit of the output valve.

Heater Circuit

Since the cabinet is very crowded, and both valves generate a fair amount of heat, a filament-transformer is used in preference to a dropping-resistor. A model giving 6.3 v. at 1.5 a., with a centre-tapped secondary costs only about 2s. 6d. more than a .3 a. mains-dropper, and is far more efficient. The H.T. is provided by a 280 v. 60 mA. metal rectifier, mounted on top of the chassis, at one end, as shown in the illustration. Smoothing is obtained by a 4.7 K Ω, 1 watt resistor, and an ex-Government 32-32 μF, 350 v.w. electrolytic condenser. A 25 μF, 25 v.w. condenser is used for the cathode resistor by-pass of the EL32 but could be increased to 50 μF if one is to hand. The mains on/off switch is incorporated in the mains lead, about 9in. from the grommet in the back of the set.

Apart from R1 and R2, the values of the resistors are not very critical. All others except the low values, 56 Ω and 20 Ω, can be obtained from the unit, joining several in series if necessary to reach the given value; R3 is given by a block of 100, 100, 50, 50 K Ω. All powers are $\frac{1}{4}$ or $\frac{1}{2}$ watt except R1 and R2, which are 1 watt.

An aluminium container as used for a gross of Oxo Cubes provides the chassis. This is quite strong enough to bear the weight of the components, even with several holes cut in the top to allow for ventilation, and has the advantage of being soft enough to cut with a pair of snips or old scissors. The lid is cut up for condenser clips, etc. Bolt holes may be made with a bradawl or small screwdriver.

The minimum inside dimensions of the cabinet are 5¾in. by 6¾in. x 8in., the chassis being supported on two runners the tops of which are 1in. from the bottom of the cabinet. The back of the cabinet is made from Hardboard, and is bolted directly to the chassis, the whole being retained in the cabinet by two screws through the back into the ends of the runners. A further piece of Hardboard is screwed to the underside of the runners, thus enclosing the cabinet completely.

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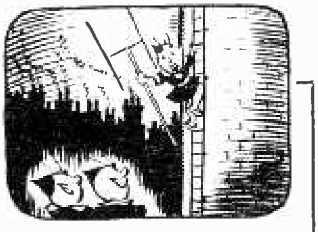

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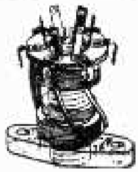

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News from the Trade

A New Collaro Pickup

COLLARO, LTD., have introduced their new "Studio" pickup which is the complete answer to the present-day pickup problems relative to the reproduction of long-playing gramophone records.

The pickups, which are of the high-fidelity crystal type, are impregnated by a special process and a complete guarantee is given for use under tropical conditions. This, as far as we can trace, is the first time that such a guarantee has been given for a crystal pickup.

The new Collaro Pick-up.

Two types are available:

Type "O" for normal receivers and amplifiers.

Type "P" for amplifiers with pre-amp stages and filters.

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Both cartridges are equipped with special stylii which require no special knowledge for needle change. Stylii changes can be effected in a few seconds. The stylii in each pickup have very low inertia values, in consequence of which records can be played at the very low needle point pressure already quoted.

The type "O" cartridge is inner compensated, in other words, no special filters are required, and it has an output sufficient for all standard amplifiers.

Type "P," however, is a constant velocity type and pre-amplification will be necessary.

The Type "O," has a range of from 25 to 10,000 c.p.s. with an output of .6 volts at 1,000 c.p.s. on 78 r.p.m. records, and Type "P" has a range of 25 to 12,000 c.p.s. with an output of .15 volts at 1,000 c.p.s. on 78 r.p.m. records.

Extensive tests have proved that these pickups will track any long-playing record yet manufactured, including all those records in which tracking difficulties have been experienced with other types of pickups, and it is felt that the introduction of this particular pickup is of inestimable value to the correct reproduction of long-playing records.

Selling prices have been kept to a minimum and the retail price of either type (including tax) is £4 0s. 8d. including pickup arm with twin ball-bearing base. Both pickups are attractively boxed for display purposes.

The cartridges, including mounting hardware, are also available as replacements for all cartridges with standard hole fixings at a price (including tax) of £2 6s. 0d.—Collaro, Ltd., Ripple Works, By-Pass Road, Barking, Essex.

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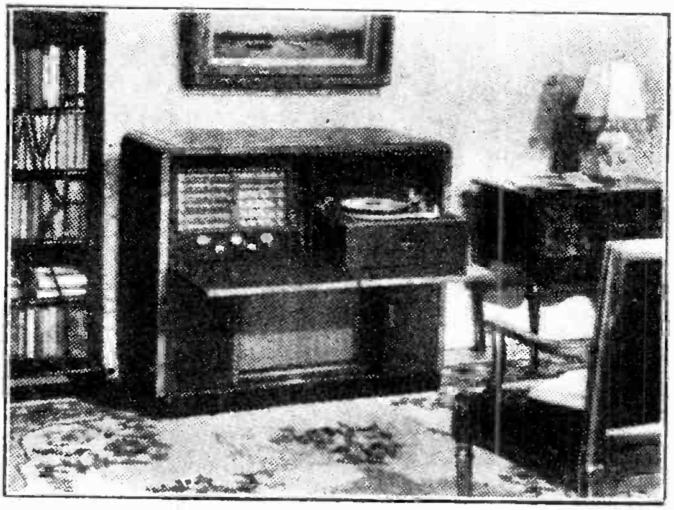

H.M.V. Model 1617A in a domestic setting.

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PRACTICAL WIRELESS, May, 1953.

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