A UNIVERSAL PUSH-BUTTON 4

1/-

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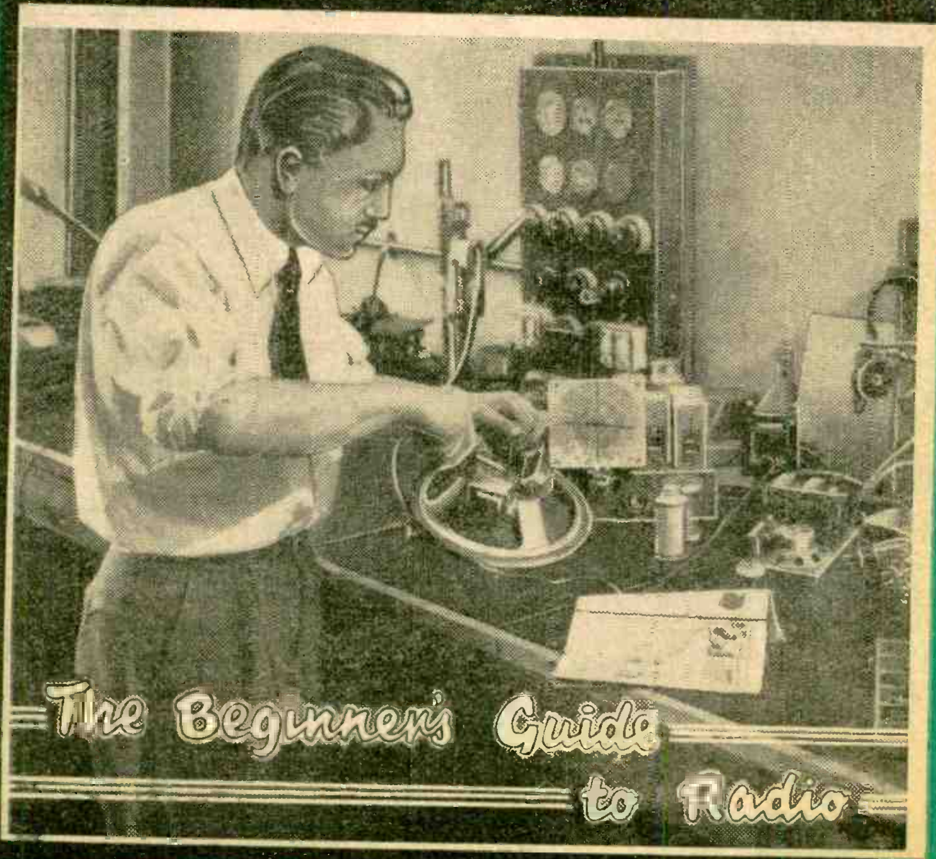
SEPTEMBER 1954

EDITOR:
F. J. CAMM

PRACTICAL WIRELESS



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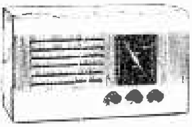

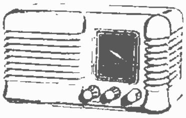

We can supply all the parts (including valves, 5in. moving coil speaker, cabinet, chassis, and everything down to the last nut and bolt) to enable YOU to build a professional-looking radio. The chassis is punched and drilled ready to mount the components. There is a choice of any of three attractive cabinets 12in. long, 5in. wide by 6in. high, as follows : either ivory or brown bakelite, or wooden, finished in walnut. Complete and easy-to-follow point-to-point and circuit wiring diagrams supplied.

MODEL 1. T.R.F. RECEIVER

This is a 3 valve plus metal rectifier TRF receiver with a valve line-up as follows : 6K7 (HF), 6J7 (Det) and 6V6 (Output). The dial is illuminated and when assembled the receiver presents a very attractive appearance. Coverage is for the Medium and Long Wave bands. Operates on 200/250 volts A.C. Mains.

Plus 2/6 Packing, Carriage, Insur. **£5.10.0**

MODEL 2. SUPERHET RECEIVER

This is a powerful midget 4 valve plus metal rectifier Superhet Receiver with a valve line-up as follows : 6K8, 6K7, 6Q7, 6V6. The dial is illuminated and coverage is for the Short Wave bands between 16-50 metres, the Medium Wave bands between 180-550 metres, and the Long Wave bands between 800-2,000 metres. Operates on 200/250 volts A.C. mains.

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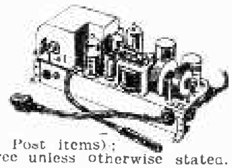
T.R.F. RECEIVER We can supply this Receiver ready built at £6.15s. 6d. plus 3/6 p.c.

ALL COMPONENTS SUPPLIED ARE GUARANTEED FOR ONE YEAR

NOTE : We would respectfully suggest to those interested in building this receiver that they send for OUR Instruction Booklet. Intending constructors can then judge for THEMSELVES how comprehensive this Booklet is.

Instruction Booklet and priced Parts List for either of the above available separately at 1/-. This money will be refunded if circuit diagram is returned as NEW within 7 days. *When ordering please state Model No.*

HIGH QUALITY A.C./D.C. AMPLIFIERS—*NEW*



For 200-250 A.C./D.C. Push-pull output (approx. 3 w.). Valve line-up : 4 latest type miniature Mullard valves —1 UCH42, 1 UAF41, 2 UL41 in push-pull. Special feature —separate smoothed H.T. supply is incorporated to enable an R.F. tuner unit to be powered by the amplifier. Dimensions, 9in. x 4in. x 4in. Supplied complete with circuit diagram. **69/6**

Packing, carriage, insurance on each model, 3/6.

TERMS OF BUSINESS : Cash with order (or C.O.D. Post items) ; all orders for small items totalling over £2 post free unless otherwise stated.

4 watt AMPLIFIER KIT

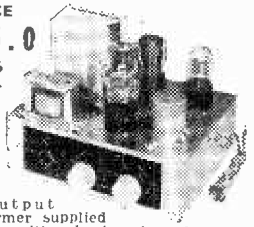
This is a 3 valve 3 stage Amplifier for use with Gramophone, Microphone or Radio. *Valve line-up is as follows :* 6SL7 : 6V6 : 5Z4. Negative feed-back. Tone control. Voltage adjustment panel incorporated. 4 watts output. For operation on A.C. Mains 200/250 volts.

The complete Kit includes every item down to the last nut and bolt, drilled and punched chassis, engraved front plate, and comprehensive point-to-point wiring circuit diagram. Chassis dimensions : 8in. x 6in. x 2½in.

ALL COMPONENTS SUPPLIED ARE GUARANTEED FOR ONE YEAR

PRICE **£4.5.0**

Plus 2/6 Pkg.Carr. & Ins.



The Output Transformer supplied is for use with a loudspeaker of 3 ohms impedance and we would suggest that the output of the completed amplifier justifies the use of one of the latest W.B. H.F. Speakers which can be supplied as follows : 8in., 60/6 ; 9in., 67/- ; 10in., 73/6. All plus 2/6 pkg., carr. ins.

Circuit Diagram only, available separately at 1/-. To those who require this Amplifier ready-built we can supply it at £5.1.0. plus 3/6 pkg., carr., ins.

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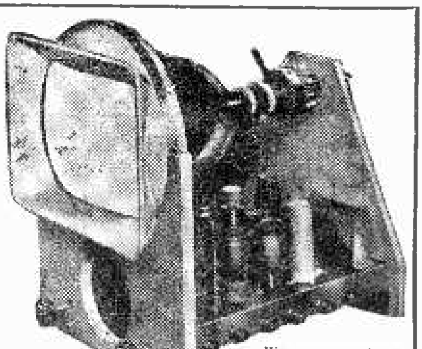

This is the 12" **TELE-VIEWER** and can be completely built for only **£28-16-4** (Plus cost of C.R.T.)

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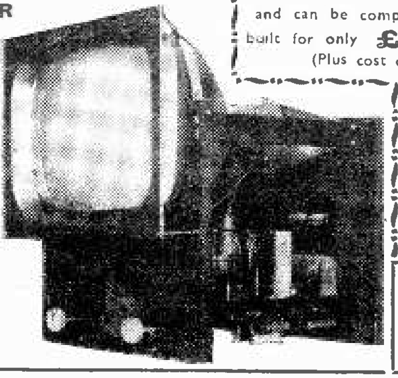

★ This is the most efficient large screen TV yet offered to constructors.

★ Excellent Time Base efficiency producing 15 to 16 Kv with ample scanning power for C.R.T.'s up to 17 inch.

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The complete set of ASSEMBLY INSTRUCTIONS for these T/Vs are available for 5/- each. They include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENT PRICE LIST. ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE. AN ATTRACTIVE TABLE MODEL CABINET FOR THE 12in. Model IS AVAILABLE FOR £6.19.6.

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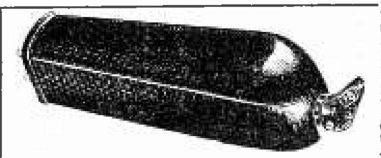
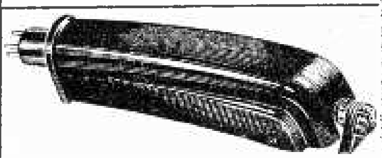
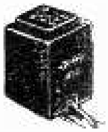
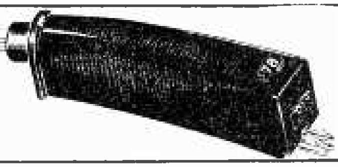
Bring your equipment up to date with ACOS REPLACEMENT PICK-UP HEADS

If you already own a fine radiogram or record-player you now have the opportunity of rejuvenating it – of bringing it right up to date for a quite modest sum. Acos Hi-g crystal pick-ups are now available in a range of specially designed "plug-in" models to suit most famous makes of record reproducing equipment.

These Acos "Hi-g" pick-ups, you will find, represent a truly phenomenal advance in pick-up design with regard to both reproduction and tracking characteristics (so important with many of the new microgroove recordings). Ask your Dealer!

MODEL		
HGP 33-1 & HGP 37-1 Collaro		**HGP 33-1 Collaro.** A Hi-g pick-up head incorporating the HGP 33-1 turnover cartridge for both standard and microgroove records. Will fit Collaro units RC 532; AC 534; AC3/534; 3/RC 532; and the Studio pick-up. **HGP 37-1 Collaro.** A Hi-g pick-up head incorporating the HGP 37-1 turnover cartridge with cantilever sapphire styli. Designed for both standard and microgroove records. Will fit the above mentioned Collaro units. Both models available in cream or walnut. *Ask for Data Sheets No. 4700 and 4800.*
HGP 33-1 & HGP 37-1 Garrard		**HGP 33-1 Garrard.** A Hi-g pick-up head incorporating the HGP 33-1 turnover cartridge for both standard and microgroove records. Will fit Garrard units RC 75M; RC 80M; RC 90; RC 111; Model TA. **HGP 37-1 Garrard.** A Hi-g pick-up head incorporating the HGP 37-1 turnover cartridge with cantilever sapphire styli. Designed for both standard and microgroove records. Will fit the above mentioned Garrard units. *Ask for Data Sheets No. 4700 and 4800.*
HGP 39-1		Hi-g pick-up heads incorporating cantilever sapphire styli. Separate heads for standard and microgrove records. Will fit the Acos GP 20 pick-up arm and the Garrard C type adaptor. Used on the following units: RC 72A; RC 75A; RC 80; and the Model M unit. Can be used on any units which at present use the GP 19 heads. *Ask for Data Sheet No. 4400.*
HGP 35-1		Separate plug-in type Hi-g heads for standard and microgroove records; fitted with cantilever sapphire styli. The crystal unit is identical to that of the HGP 39-1 above. Can be used on Garrard units RC 75M; RC 80M; RC 90; RC 111; and the TA player. *Ask for Data Sheet No. 4000*
HGP 41-1		Separate Hi-g plug-in type heads for standard and microgroove records incorporating the crystal unit as used in the HGP 39 pick-up head. Will fit Collaro units RC 532; AC 534; AC3/534; 3RC 532. Available in cream or walnut. *Ask for Data Sheet No. 4500.*
HGP 45		Separate Hi-g pick-up heads for either standard or microgroove records. The crystal unit is identical to that used in the HGP 39-1 head. Will fit Garrard units RC 80; RC 72A; RC 75A; and the Model M player. Can be used on any unit which at present uses the Garrard C adaptor with GP 19 heads. *Ask for Data Sheet No. 4600*

PRICE 32/6 (plus 10/5 P.T.) for all types except HGP 39 models which are **32/-** (plus 10/3 P.T.)

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RADIO SHOW
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Practical Wireless

EVERY MONTH
VOL. XXX, No. 575, SEPTEMBER, 1954

Editor: F. J. CAMM

22nd YEAR OF ISSUE

COMMENTS OF THE MONTH *By THE EDITOR*

Licence for Model Control Equipment

READERS who are operating model control equipment without licence should take particular note that a licence became necessary as from June 1st this year. Anyone operating such equipment must make application for a licence to the Radio Department, H.Q. Building, G.P.O., St. Martin's le Grand, London, E.C.1. They will receive an application form together with the conditions applying to the use of such equipment. The fee is £1, which covers a period of five years.

It is pointed out that it is highly desirable that the regulations applying to maximum radiated power and frequency stability be observed in order that operation outside the band, or any other misuse, may not result in future difficulties for radio-control enthusiasts in general.

No doubt the new regulations have been made in view of the possibility of interference with TV reception over a wide area, due to harmonics from a transmitter not within the permitted lower band.

THE NEW "FURY FOUR"

WE shall shortly commence publication of constructional details of the 1954 version of the famous "Fury Four," which has been under tests now for some months. Manufacturers now report that they are able to supply the tuning units and other components around which it has been designed. This is in accord with our usual policy of not publishing constructional details until readers are able to obtain all of the parts. It is, of course, a design which totally differs from that of the original, and we are certain that its performance will satisfy the most meticulous.

THE BBC MONOPOLY

DURING a discussion in the House of Lords on the TV Bill, the question of the BBC's monopoly of sound radio was raised, and Lord Woolton in reply said it was his opinion that broadcasting from other countries had done much to break the BBC's exclusive right in this country. He added, however, that it is not part of the Government's policy at the present time to interfere with the sound broadcast monopoly of the BBC. Lord Waverley opined that available money should be spent on promoting technical progress instead of on duplicating existing services. Lord Selkirk, replying for the Government, said that we are standing on the verge of vast technical development and we must have money to develop it. It would be foolish, he said, not to take advantage of this new source.

Doubts were expressed on the question of programme quality, but we were reminded that the BBC operated at many levels, including the fatuous, the frivolous and the vulgar, and, we may add, the inane.

It is our view that any monopoly in this field of endeavour is bad. It can delay progress and become subject to the political whims of whatever party happens to be in power. If the BBC finds one particular programme is popular it "flogs" it in a number of other programmes of similar character. One party game a week should be enough, and the cast should be varied each week.

COMPONENT FAILURE

MR. DENIS TAYLOR, of the Atomic Energy Research Establishment, speaking at the Industrial Electronics Convention, said that careful examination of all electronic components which had failed had shown that the failure rate per instrument had increased from 0.55 per cent. in 1949 to 1.36 per cent. in 1953—a high figure. The chief offenders are the more orthodox components such as thermionic valves, resistors and capacitors. A recent review at one factory where several thousands of instruments were in continuous use had shown that more than 70 per cent. of the total failures were due to thermionic valves. It is also true that in ordinary radio receivers component failure is all too frequent. In this case, however, the chief cause of failure in mains sets is in connection with electrolytic condensers and resistances. An analysis of queries received in this office shows a high percentage of failure due to these two components. Valve failure is at the bottom of the list. Where valve failure does occur, more often than not it is due to the failure of one of the two components named. Dial light failure is frequent, and in spite of denials by ELMA, it seems undeniable that flashlamp bulbs, dial lights and even household lamps do not give the same hours of service as they did before the war.—F. J. C.

Round the World of Wireless

By "QUESTOR"

Mr. J. Clarricoats

MR. JOHN CLARRICOATS, general secretary of the Radio Society of Great Britain and a member of the Southgate Borough Council since 1945, has now been elected an Alderman of the Borough of Southgate.

Mr. Clarricoats has been secretary of the Society for the past 24 years.

Transmitters for Scandinavia

TWO high-power, long-wave broadcast transmitters came "on the air" officially recently. One is at Klöfta, in Norway, a 200 kW transmitter, operating on a frequency of 218 kc/s, which commenced regular programme transmissions on Saturday, June 19th. The other, at Kalundborg, Denmark, had its official opening ceremony on Monday, June 21st. This is also a 200 kW transmitter, and can be heard on a frequency of 245 kc/s.

Both these transmitters have been designed and built by Marconi's Wireless Telegraph Co., Ltd.

Pye, Ltd., Opens U.S. Office

MR. C. O. STANLEY, chairman of the board of directors of Pye, Ltd., has announced the appointment of William M. Cagney as regional supervisor for the activities of the Pye group of companies in the United States of America. The office will be located in the Fifth Avenue Building, at 200, Fifth Avenue, New York.

Mr. Cagney, formerly sales manager and manager of the sales engineering department of the Link Radio Corporation, has specialised in the design and sale of many large mobile and point-to-point radio systems.

Author's Dictation Machine

MR. ALAN HOLMES, the author, is totally blind and disabled. In the past the only way he could write a book was by typing with one hand, which naturally restricted his speed. He found himself in a position where his thoughts were outstripping the speed at which he could get them down on paper, and this made writing an arduous task for him.

He therefore had an "Emidicta" dictation machine installed which also has typewriting attachments, and is now able to record his thoughts at any rate he wishes. Before transcribing them into type, he can effect any corrections on the recording.

Does this picture really need a caption? Fans of "Big-hearted Arthur" can hear him regularly each week in "Hallo, Playmates" on both the Home Service and the Light Programme.

Mr. Holmes has now increased the speed in which he can complete a novel for the publishers.

Broadcast Receiving Licences

THE following statement shows the approximate number of sound receiving licences issued during the year ended May 1954. The grand total of sound and television licences was 13,479,308.

Region	Number
London Postal ...	1,613,414
Home Counties ...	1,437,083
Midland	1,239,134
North-eastern	1,612,609
North-western ...	1,254,575
South-western ...	1,007,097
Wales and Border Counties	624,934
Total England and Wales	8,788,846
Scotland	1,087,499
Northern Ireland ...	223,597
Grand Total	10,099,942

Third Programme Coverage

AS part of a plan to improve the coverage of the Third Programme the BBC proposes to build a low-power transmitting station at Swansea, Glamorgan.

The new station, which will be automatic in operation, will have a power of 1 kW and will use the wavelength of 194 metres (1546 kc/s). It will improve the reception of the Third Programme in Swansea and its immediate surroundings, an area which does not receive a satisfactory service from the main Third Programme transmitter at Daventry on 434 metres.

P.A. Equipment for Liner

THE new Belfast-built 20,000-ton Shaw Savill passenger liner, *Southern Cross*, to be launched by Her Majesty the Queen in August, is to have a most comprehensive MIMCO sound-reproducing and order system installed by the Marconi International Marine Communication Co., Ltd. This installation, specially designed for marine use, will rank among the largest fitted on board ship and will feed a network of 200 loudspeakers situated in passenger and crew spaces, providing news, entertainment items and facilities for announcements and orders.

The heart of the system will be in a special sound-reproducing equipment room adjacent to the radio office.

Brentford Evening Institute

THE following radio courses are to commence at Brentford Evening Institute on September 20th, enrolment taking place on the evenings of September 13th-17th inclusive at a registration fee of 15s.: *Radio Servicing I*, Mondays from 7-9 p.m. The course assumes no previous knowledge of radio and some practical work will be included. *Radio and Television Servicing II*, Tuesdays from 7-9 p.m. *Radio Amateurs' Course*, Wednesdays 7-9 p.m. Also for the beginner, preparing for the C. & G. examination held in May, 1955.

Radar Finds Crippled Ship

AN outstanding example of the use of radar and radio in the service of safety of life at sea was afforded recently when the Marconi Marine "Radiolocator IV" radar on board the British Transport Commission's *Slieve Bawn* was used to locate the steam lighter *Celt*, in difficulties in exceptionally heavy weather off St. Bees Head, on the Cumberland coast.

The lifeboat escorted the *Celt* safely into Barrow, while the *Slieve Bawn* continued her interrupted voyage to Heysham. The *Celt* is considerably smaller than the size of vessel required by regulations to carry radio-telephone equipment. But for her voluntarily-fitted "Seamew" transmitter/receiver, the situation might have developed much more seriously.

Pye Supplies Radio-telephone

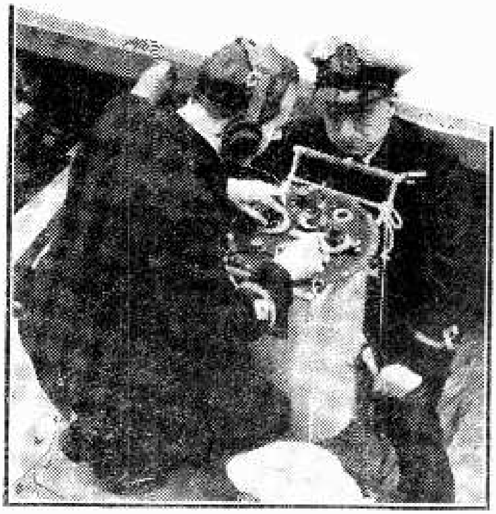
IN competition with other manufacturers, Pye (Canada) have received from the Highways Branch of the New Brunswick Department of Public Works an order for a large quantity of radio-telephone equipment.

This is a province-wide scheme on 152-174 Mc/s to provide communication to snow-ploughs and other road-maintenance vehicles, plus a separate point-to-point network on 72-76 Mc/s. They have received an order for fixed stations only, covering one half of the province as a start.

British Microwave Radio Link for Canada

THE General Electric Company Ltd. of England is to supply microwave radio relay equipment to carry television programmes in Canada between London and Windsor, Ontario. The order has been obtained by the Canadian General Electric Co. Ltd., the main contractor for the scheme, jointly from Canadian National Telegraphs and Canadian Pacific Telegraphs.

The link, which will employ similar equipment to that used on the Swiss Eurovision link supplied by the G.E.C., will incorporate four relay stations. It will carry 525-line pictures in black and white, or in colour. The installation is to be carried out in three stages: a one-way link, a second link in parallel which is reversible, and the conversion of the first link into a reversible system.



The "Salvita" portable radio transmitter and receiver, for use in ships' lifeboats, is inspected and tested before being installed aboard in preparation for any emergency.

The Electro-magnetic Transducer System

A PUBLICATION describing the operation of the S.E.I. electro-magnetic transducer system has recently been issued by Salford Electrical Instruments Ltd. The system, which enables a reading to be taken at a distance of up to 1,000 yards from the point at which the actual measurement is made, is highly versatile. It is used in the aircraft industry, in asbestos sheet manufacture, in plastics production, in rolling mills and in coal bunkers, as well as for many other applications. The new publication includes a general description, describes the standard heads and indicating instruments used with this system, and shows six typical applications in diagrammatic form: a full technical specification is also included.

Automatic Alarm Receiver

A NEW type of automatic alarm receiver, complying fully with the revised Post Office specification for the reception of the international radio alarm signal, has been designed by Marconi Ltd., and is now in production.

The "Seaguard," as the new equipment has been named, is switched on when the radio officer goes off watch. It then maintains a reception watch on the distress frequency and, if the international alarm signal of twelve four-second dashes at one-second intervals is transmitted by a ship in distress within range, the "Seaguard" responds before the end of the fourth dash by actuating an alarm bell system which calls the attention of the receiving ship's officers to the fact that distress traffic is in progress. The radio officer, alerted by the alarm bell in his cabin, then returns to the wireless room and listens for details of the distress on headphones plugged into the receiver unit of the "Seaguard."

The "Seaguard" consists of two main units, the receiver and selector, both housed in one cabinet.

Radio Ball Tickets All Sold

MR. F. H. ROBINSON, social secretary of the Radio Industries Club, states that all tickets for the Radio Industries Ball at Grosvenor House on August 27th have now been sold, and that no further applications can be considered.

Free Batteries for Blind

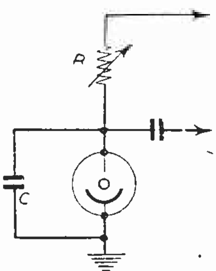
THE Cardiganshire Association for the Blind are to supply to blind people free radio batteries for their receivers.

Designing OSCILLOSCOPES

A SHORT SERIES FOR THE SERVICEMAN AND EXPERIMENTER.
PART 3 DEALS WITH THE TIMEBASE

(*Continued from page 494, August issue.*)

THE third part of the 'scope is the timebase, and this can be one of several types. The commonest is the linear timebase in which the spot is moved across the screen at a constant speed, and then quickly returned to the other side, and the procedure repeated. The exponental timebase is very rarely used as in it the spot does not move at a constant speed but starts rapidly and gradually slows down. The use for this is mainly found in Radar, and it will not be dealt with further here. The other much used timebase is the sine wave. This latter is



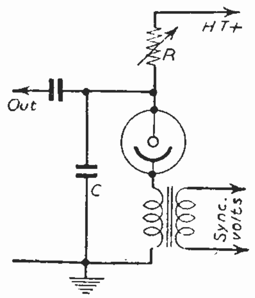


Fig. 8 (left).—A simple saw tooth generator using a voltage stabiliser. Fig. 9 (right).—A saw tooth generator with facilities for synchronising.

readily available at all frequencies from very low to many Mc/s.

The circuits for the linear timebase can best be obtained from the valve designers. Such firms as Mullard Ltd. are only too pleased to give the circuits and all the data for various valves. Many very good circuits have appeared in the past editions of PRACTICAL WIRELESS. If, however, the reader insists on designing his own timebase it is best to use soft valves such as the EN31. Again, the simplest timebases can be made with the aid of Neon tubes of one form or another. The Osglim lamp or voltage stabilisers can be used but the actual output voltage is rather low. This latter can, of course, be amplified with a suitable amplifier such as one described in the last article.

A Suitable Circuit

A typical circuit is given in Fig. 8. Here the condenser C is charged through the resistance R until a voltage is reached at which the tube will conduct, the tube suddenly takes a pulse of current, and then the voltage in the condenser falls; this then rises on the cessation of the current through the tube. This charge of the condenser through the resistance R and the discharge through the tube continues and the output is a saw tooth wave. There are, however, several points to be watched. The resistance R should consist of two resistors in series, one fixed and the other variable. If too much current is allowed through the tube it will be very quickly ruined. The tube will also be ruined if the pulse current is too high, and it is advisable to place a resistance of a few hundred ohms in series with a voltage stabiliser tube if that is being used. This is not needed in the case of the Osglim lamp as it incorporates a resistance in the base of the lamp. The writer has had experience with very low frequency timebases of this type where the tube has actually been blown to pieces due to the surge of current where no limiting resistance has been used. The variation in frequency is obtained by the variation of the resistance and the capacity of the condenser. The first can be variable, whilst the latter can be of suitable switched values. The H.T. voltage also makes a difference.

Whilst the circuit in Fig. 8 is quite reasonable and interesting, it lacks the facility to lock to an incoming signal. If, however, a transformer is placed in series with the tube and a voltage applied to the primary, a voltage in the secondary will add to the voltage in the condenser and allow the tube to fire. The circuit is shown in Fig. 9, and the transformer has to be fed from a valve amplifier.

The soft or gas triodes such as the EN31 make a better timebase, as the circuit does not require an extra valve for triggering. The sync voltage is fed to the grid, and the amplitude of the sync controlled by a potentiometer. The higher the H.T. voltage applied to the circuit, the straighter will be the saw-tooth wave. As the circuit requires a standing voltage for the grid, this is developed by the resistance and the condenser in the cathode circuit—the higher the value of the condenser here the better, as it will help to keep the operation linear.

Heater Supply

One of the most interesting types of timebase, and one of the simplest circuits, is the 50 cycle timebase

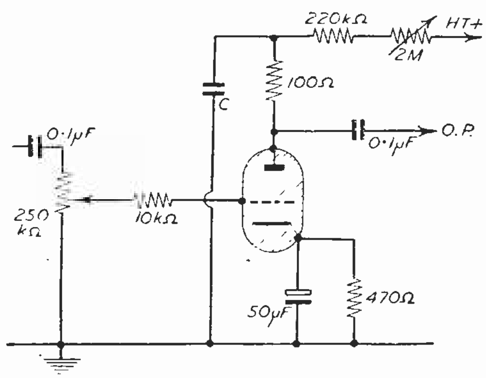


Fig. 10.—A simple thyratron timebase.

using a sine wave from the heater supply. Here an amplifier only is required, and there is no delay in the scanning voltage being fed to the tube. Consequently there is little risk of there being a burn on the screen during the warming up time—only on being switched off. The timebase can be used for the checking of a very wide variety of faults—connected mainly with hum in one of its many forms. 100 cycle hum will appear as a figure of eight on the screen, and the 50 cycle anything from a bent line to a circuit. Hum modulation can also be checked with the same circuit.

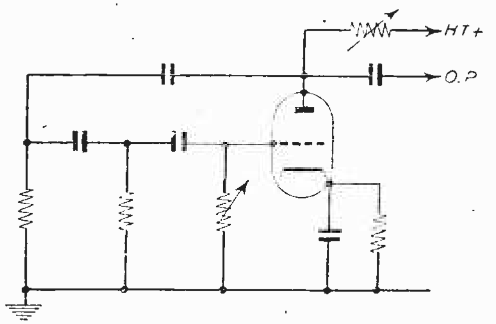


Fig. 11.—A phased shift sine-wave oscillator.

The other type of timebase is the sine wave—the best supply here is a variable frequency oscillator of the sine-wave variety. This type of circuit can be used for checking the distortion of amplifiers. The phase shift amplifier using a high gain triode or pentode can be used to obtain the required frequency, and a typical circuit is shown in Fig. 11. The values of the various resistors in the circuit are not shown and these can be calculated. At the required frequency the impedances of the condensers should be the same as that of the resistors. If the final resistor at the grid of the valve is made large and variable, the output of the oscillator will be tunable. The setting of the variable resistor in the anode circuit of the valve should be such that the circuit is only just oscillating—do not try to increase the output with this resistance as the harmonic contents of the wave will increase sharply.

It is hoped that the foregoing series of articles will have been of assistance in designing 'scopes—but space has not allowed the full range of circuits to be discussed, but many of these can be found in the back numbers of this paper.

Filter Circuits

HOW THEY ARE APPLIED TO POWER SUPPLY SMOOTHING

By D. Howe

EVERY radio constructor is anxious to find some means of cheap yet effective smoothing, for the power supply is the criteria of most electronic equipment used for sound reproduction. The accepted smoothing circuit, consisting of condensers and choke is effective, yet represents a loss of H.T. volts across the choke, and usually a trace of mains hum remains.

The more particular home constructor uses full-wave rectification to remove this hum, but it means more equipment and more expense, and he pays more to remove that A.C. component in the smoothing circuit.

The practice, these days, for economy reasons, is to use half-wave rectification straight from the mains, relying on the normal supply voltage to be sufficient to provide a reasonable anode voltage. This means hum and just sufficient H.T. volts (with the usual smoothing circuit), but this is accepted as long as the cost is low.

With a little investigation into filter circuits, it is possible to devise a smoothing circuit which removes all trace of hum, using half-wave rectification, and provides a higher H.T voltage for the valve anodes and screens.

Consider the circuit shown in Fig. 1.

VS is the supply voltage and VR and VC are the voltages across the resistance R and condenser C, respectively.

If a vector diagram be drawn of VR and VC, the vectors will be at right angles to each other, and the hypotenuse of the triangle so formed will be VS as shown in Fig. 2.

If the supply voltage be at a fixed frequency, then the voltage across the condenser will be determined by its capacity C, since

$$XC = \frac{10^6}{2\pi . f . c}$$

so varying the value of C will cause the vectors to slide along the semi-circle.

If the value of C be such that its reactance XC is the same as the resistance of R, then VR = VC.

Fig. 3 is Fig. 1 with the addition of another condenser and resistor, each of the same value as those in Fig. 1 but connected the other way round.

In this case, VS is the output from a half-wave rectifier, and consists of D.C. with a 50 c/s A.C. component superimposed on it. The D.C. is allowed to flow through one resistance to the load and back through the other resistance. There is no trace of A.C. present through the load since, to the A.C.

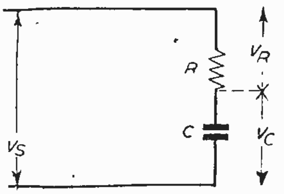


Fig. 1 (above).—A simple smoothing circuit.

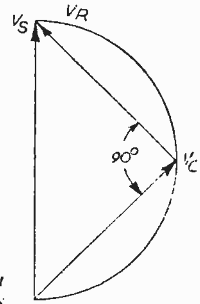


Fig. 2 (right).—Showing a vector diagram of the voltages across the resistance R and condenser C.

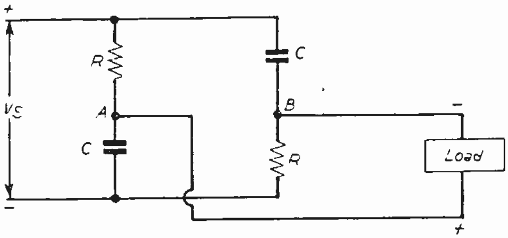


Fig. 3.—A similar type of smoothing circuit to that shown in Fig. 1, but with the addition of another condenser and resistor.

component, the points A and B are equipotential (i.e. VR = VC).

This is not a very convenient smoothing circuit since it is a four-wire circuit.

Bridge Circuit

If we look at the left-hand side of Fig. 4, it is seen that it is Fig. 3 redrawn as a bridge circuit (the load would go across T and T').

The right-hand side is a replica of the left, and if instead of a load we imagine a rectified D.C. supply equal to VS to be applied to it, then both sides of T

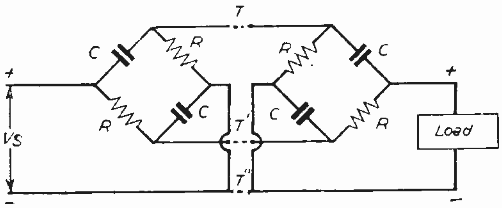


Fig. 4.—The circuit shown in Fig. 3 redrawn as a bridge circuit.

will be at equal potential so that they can be joined together. Similarly with T' and T'' (shown dotted).

The two resistances in the top half of the circuits are in parallel and thus can be replaced by one of value $\frac{R}{2}$.

Similarly, the two condensers in the bottom half of the circuit can be replaced by one of value 2C, and the circuit can be redrawn as shown in Fig. 5.

Double Filter

Thus we now have a double filter circuit which by-passes all 50 c/s hum, and has a common negative.

If R be 100 ohms, then the total resistance in the smoothing circuit to the D.C. supply is 200 ohms, assuming a current of 60 milliamps for the average radio set, the volt drop across the smoothing circuit

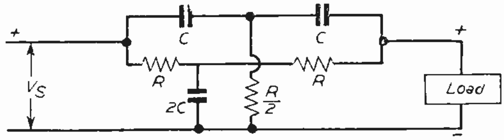


Fig. 5.—A double filter circuit.

is 12 volts—much better than that of the conventional choke.

For a resistance of 100 ohms, then C will have to have a value given by

$$100 = \frac{10^6}{2\pi \,.\, 50 \,.\, c}$$

which will be 32 microfarads.

If full-wave rectification is used, then the hum frequency is 100 c/s and with R as 100 ohms, then C will be 16 microfarads.

Using components advertised in these pages, a half-wave smoothing circuit as described above was built that provided better H.T. volts without any trace of mains hum; proving this smoothing arrangement to be better and more efficient than the conventional circuit.

V.H.F. Radio for Mines Rescue

VEHICLES attached to the mines rescue service for the North-Western Division of the National Coal Board have been fitted out with V.H.F. radio communication equipment. The installation, which has just been completed by The General Electric Co., Ltd., is believed to be the first of its kind for this application. Covering all the collieries in the North-Western Division, together with the licensed mines situated in Lancashire, Cheshire and North Wales (a total of 111 collieries), it greatly facilitates rescue operations since, with V.H.F., the rescue workers at the pithead are at all times in uninterrupted communication with their headquarters. This can save vital minutes in reaching the scene of an emergency, or in bringing up reinforcements of men or materials.

The rescue vehicles equipped with V.H.F. apparatus act as mobile stations and are in direct communication with a fixed station located in the Rescue Superintendent's office at headquarters. Wherever the vans go in the five widely-spread groups of collieries in the North-Western Division, which stretches from Wrexham in Wales to Burnley in Lancashire, they are always under immediate headquarters' control.

A communication system of this kind is necessary because the rescue workers may have to operate from a disused shaft or in some similar out-of-the-way site where no ordinary communications exist. Furthermore, the V.H.F. network keeps the vehicles informed of the latest developments at the pit-head and at headquarters even when they are on the road. It is expected that before long most of the coalfields in Great Britain will be using V.H.F. surface radio for this work.

The headquarters of the mines rescue service for the North-Western Division of the N.C.B. is at Boothstown, near Manchester, and is manned by 17 full-time operators under the control of the Rescue Superintendent, Mr. A. Cunliffe. Boothstown is also able to call on 182 fully-trained rescue workers who are employed as miners in the local collieries.

The five vans which are attached to the Boothstown headquarters are always on call at a moment's notice, and are equipped with special breathing apparatus, fire-fighting appliances and similar rescue gear.

Surplus Output Pentodes

PUSH-PULL AND Q.P.P. VALVES

By E. G. Bulley

THIS article is written to cover both the output pentodes and those tetrodes that have the pentode characteristics. Both of these types are available upon the surplus market and should prove extremely useful to the constructor.

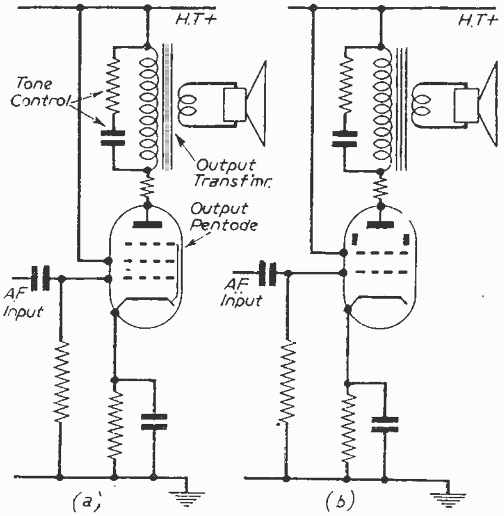


Fig. 1.—A typical circuit showing a single pentode and tetrode output stage.

The pentode has, however, three grids, plus the anode and cathode, making five electrodes in all, whereas the beam tetrode has only two grids, beam forming plates, together with the anode and cathode.

The output pentodes are in principle similar to R.F. pentodes, with the exception that they are designed to handle much larger anode currents and screen voltages. Furthermore, no provision is made for screening in the output pentode as in the case of the R.F. pentode.

A typical circuit showing a single pentode and tetrode output stage is shown in Fig. 1, and it is as well to mention here that such stages are to be preferred to that of the triode output, because the sensitivity and the power output for similar size valves are much greater.

However, when two of such valves are connected in push-pull, one can expect twice the output as from that of a single valve of the same type. In push-pull systems, however, the amplification is the result of the application of equal alternating voltages of opposite sign to the grid circuits of the two valves, and the circuit arrangement is such that their anode voltage add, thus giving twice the power output of one valve. One must, however, bear in mind that valves used in such an arrangement must be correctly matched, otherwise the amplitude of the even harmonics will be the difference between the amplitude of harmonics in each valve. Nevertheless, if the valves are correctly matched the even harmonics are cancelled out. A typical push-pull arrangement is shown in Fig. 2 and such a system is preferred to that known as a parallel arrangement. The sensitivity of push-pull circuits is lower than that of valves connected in the parallel arrangement.

Balanced Circuit

By studying the basic circuit of the push-pull system one will note that the two circuits are balanced and that the cathodes of both valves are taken to the centre tap of the input transformer T1. The output transformer T2, namely, the one feeding the speaker, has a centre-tapped primary. The reader will therefore appreciate such a circuit when he realises that at any one time the opposite ends of the transformer T2 are at opposite potentials to that of the cathode. This also means that the control grid G1 of the first valve is negative, whereas the other control grid will be positive. To clarify this still further it can be said that both the voltages and currents of one of the valves in question are out of step with those of the other; that is to say, the anode current of V1 rises whilst that of V2 will fall. This characteristic does, therefore, prevent distortion so long as both circuits are balanced.

The parallel arrangement mentioned earlier in this article is rarely used in ordinary radio practice, but is included for the interest of the reader who likes to experiment with all kinds of circuitry. Such a circuit is shown in Fig. 3, where it can be seen that all similar electrodes are strapped together. The valves, of course, should be of the same type, and an advantage of the arrangement as shown is that it doubles the sensitivity of one valve with a given input voltage. The reader will appreciate the operation of the parallel operation when he realises

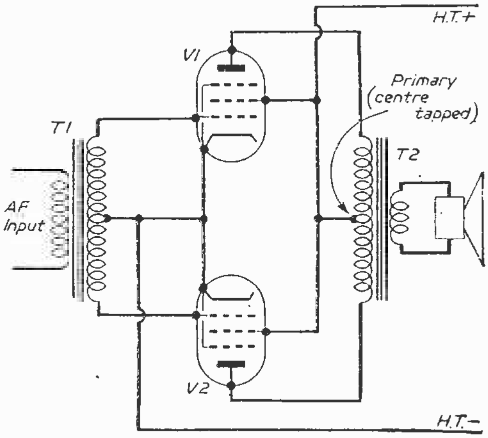


Fig. 2.—Showing a push-pull arrangement.

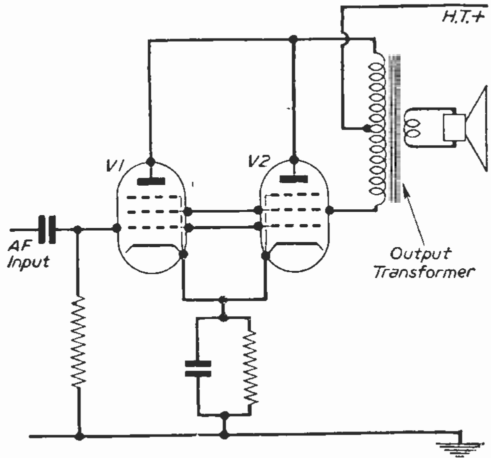


Fig. 3.—The parallel arrangement whereby all similar electrodes are strapped together.

to the valve by a centre-tapped transformer as in the more conventional push-pull arrangement, using two separate valves.

It is, however, usual practice to incorporate a tone filter across the primary of the output transformer, the filter consisting of a suitable resistor and condenser. The value of these components depends upon the speaker used and the degree of tone correction one requires. As a point of interest, the output transformer ratio is equal to the square root of the anode-to-anode load divided by the minimum speaker impedance.

A further point of interest in Q.P.P. is the fact that it does differ slightly from the conventional push-pull, because Q.P.P. valves are biased to a fairly high value, so that the anode currents under normal conditions are very low. In the conventional arrangement the valves are usually biased at the mid-point of their characteristics.

In conclusion, the experimenter will find that by experimenting with such circuits with valves that are available at very reasonable prices, he will benefit himself both in knowledge and practical experience.

TABLE ONE
POWER OUTPUT PENTODES AND TETRODES

		Ef	Amps If	Max. Anode Volts	Max. Scr'n Volts	Max.	Max. Scr'n Diss	Slope	1	2	3	4	5	6	7	8	T C	Base	
CV65	DH	2.0	.15	150	150	.75	—	4.5	F—	—	A	G2	G1	—	—	F+	—	MO	
NR43	DH	4.0	.25	300	200	—	—	1.6	A	G1	FG3	F	G2	—	—	—	—	B5	
NR53	IH	4.0	1.2	250	250	9.0	—	2.0	—	G1	G2	H	H	K+G3	A	—	—	B7	
NR85	IH	6.3	0.7	250	250	8.5	—	2.5	—	H	A	G2	G1	—	H	K	—	I.O	*
ARP17	IH	6.3	0.7	250	250	8.5	—	2.5	—	H	A	G2	G1	—	H	K	—	I.O.	*
NR72	IH	4	2	250	250	—	—	10.5	—	—	G2	H	H	K	A	—	G1	B7	*
NR77	IH	6.3	1.35	250	250	18.0	2.5	5.5	—	H	A	G2	G1	—	H	K+G3	—	I.O.	
NR95	IH	26	.3	135	135	10	1.35	10.0	—	H	A	G2	G1	—	H	K	—	I.O.	*
ARP9	IH	13	.4	250	250	8	—	7.5	—	G1	G2	H	H	K	A	—	—	B7	*
ARP9A	IH	13	.65	250	250	—	—	8.0	—	G1	G2	H	H	K	A	—	—	B7	*
ARP10	IH	4	2	250	250	9	—	9.1	—	—	G2	H	H	K+G3	A	—	G1	B7	
ARP18	DH	1.9	.2	150	150	—	—	3.2	A	G1	F	F	G2	—	—	—	—	B5	*
ARP37	DH	2.0	.2	120	120	—	—	3.0	F—	—	A1	G2A B	G1A	G1B	A2	F+	—	MO	*1
VR502	IH	26	.3	135	135	10	1.35	10.0	—	H	A	G2	G1	—	H	K	—	I.O.	*
VR503	IH	26	.3	250	200	13	2.8	10.0	H(CT)	H	A	G2	G1	—	H	K	—	I.O	*
VT75A	IH	4.0	2	400	300	10	3	6.25	—	G1	B.F.P.	H	H	K	G2	—	A	B7	*
VT75B	IH	4.0	2	400	300	25	3	6.25	—	G1	B.F.P.	H	H	K	G2	—	A	B7	*

* Tetrodes with pentode characteristics. *1 Quiescent push-pull pentode. B.F.P. Beam Forming Plates.

that by having all like electrodes strapped the internal resistances of the valves are halved, whereby with such a reduction of resistance the output is twice that of a single valve.

Q.P.P.

Table One is a list of surplus valves and included in this list is a double-pentode valve. Such a valve is known as a Q.P.P. valve or to expand the abbreviation, aquiescent push-pull. These valves comprise a pair of matched pentodes in one envelope and for convenience to the reader both sections are marked A and B (see Table One).

A typical circuit incorporating such a valve is shown in Fig. 4, the speaker being coupled

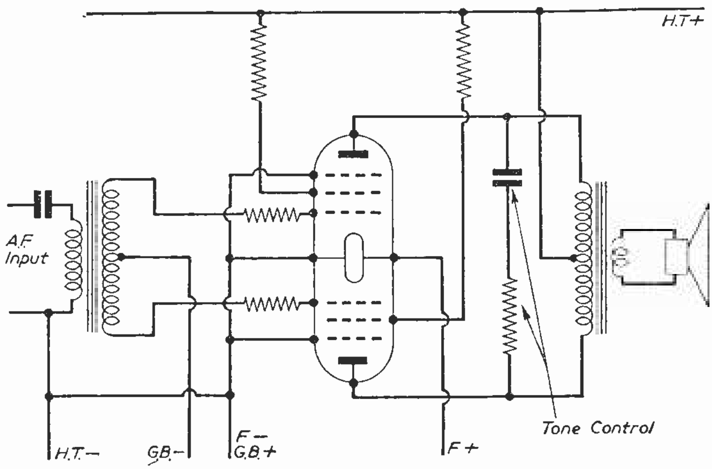
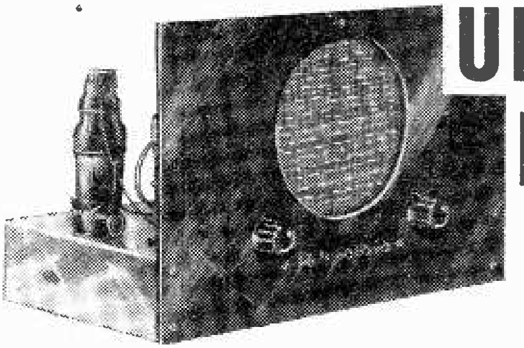


Fig. 4.—A typical circuit incorporating a Q.P.P. valve.



UNIVERSAL PUSH-BUTTON 4

AN A.C./D.C. RECEIVER WITH PUSH-BUTTON STATION SELECTION

(*Concluded from page* 481, *August issue*)

If an A.C. meter is not available, the clip should be adjusted until the set reaches full operating volume, from cold, in approximately 30 seconds.

The intermediate clip of the dropper should then be adjusted until the anode and screen grid voltages of the 43 valve do not exceed 160 and 135 respectively. If a meter is not available, the intermediate clip should be set about ¾in. from the upper clip. The actual setting depends upon the mains voltage, and will require to be lower with 250-volt mains, than can be used with 200-volt mains. The receiver will operate well with lower voltages, but with high voltages care should be taken to see that the maximum ratings of the output valve are not exceeded. The voltages should be measured, if possible, when the set has settled down to ordinary operation, and the high H.T. voltage found a few seconds after switching on should be ignored.

It is desirable that the neutral, or " earthed " mains lead be the one going to chassis, so that the danger of shocks, if the chassis is touched, are minimised. A 3-pin mains plug may be used. Reversible connectors may be marked.

The pre-sets should be selected with the stations desired in view, or in a few cases it may be impossible to tune in the wanted station. Pre-sets with a maximum capacity of .0005 μF have a fairly high minimum capacity, and are not suitable for stations of low wavelength. For the long-wave Light Programme, and any medium-wave station above about 350 metres, .0005 μF pre-sets will be suitable. For 250 to 350 metres or so, .0002 μF pre-sets can be used. If a very low wavelength medium-wave station is desired, .0001 μF, or 50 pF, pre-sets should be used here.

The local station should be tuned in with no difficulty, by depressing a suitable button and adjusting the trimmers with an insulated screwdriver for maximum volume. More accurate settings can be obtained if volume is kept down by turning back the volume control.

Other stations, of weaker signal strength, can be found by turning up the volume control and carefully adjusting the correct pair of pre-sets a little at a time until the station is heard. Each pre-set can then be adjusted for maximum volume. The long-wave trimmers should be adjusted first, since they introduce some stray capacity through being permanently wired to the grid circuits.

If necessary, such trimmers can easily be reduced in capacity by removing a plate or so. But this will not normally be necessary, if it is remembered that stations

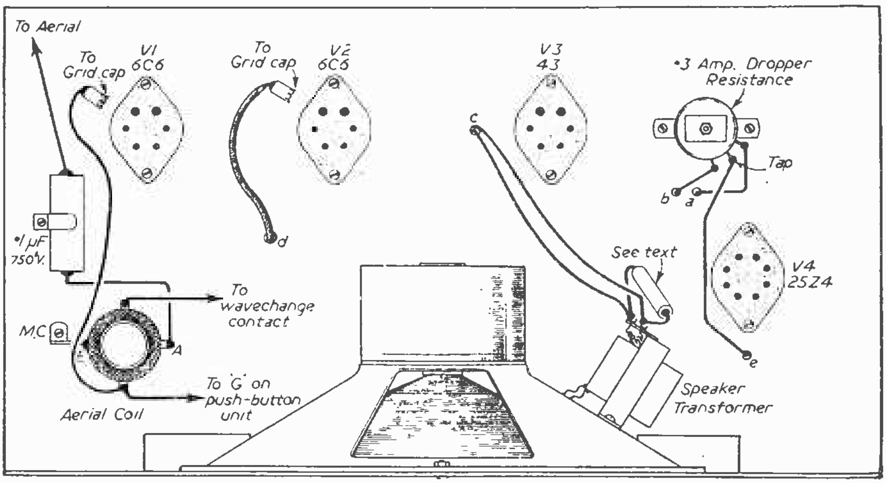


Fig. 2.—Showing the top of the chassis layout. The chassis is approximately 7in. x 13in. and was bent up from sheet aluminium.

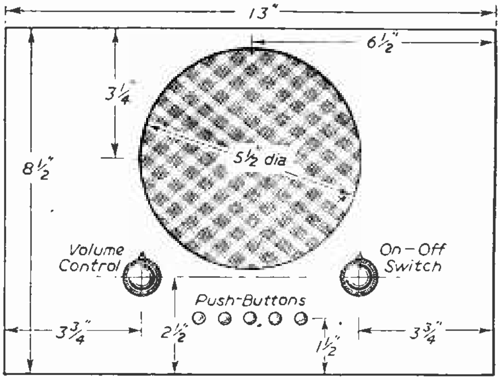


Fig. 4.—Showing the panel layout.

of low wavelength cannot be tuned in with trimmers of high capacity.

It is best to connect the trimmers in such a manner that the top plate, near the adjusting screw, is that which is "earthed." The presence of the screwdriver will not then upset tuning.

Alternative Valves

A number of valves equally suitable to those given are available and can be used if to hand. In R.F. and detector stages, 6J7 valves can be used, and connections are shown in Fig. 5. These valves have the same characteristics as the 6C6 types. In the R.F. stage, a 6K7 can be employed.

A 25A6 is suitable for output purposes, being the same as the 43, except that it has an octal base.

For rectifier, 25Y5, 25RE and 25Z5 valves can be

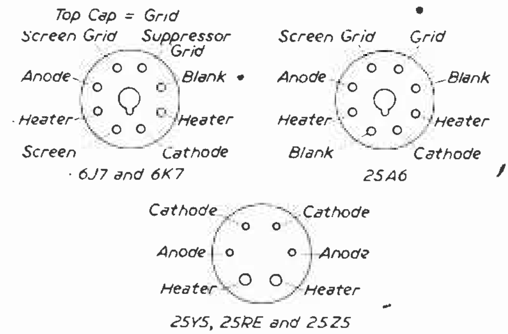


Fig. 5.—Valve base connections.

used, with a UX6 pin holder. These valves have pairs of anodes and cathodes, and can be used for half-wave rectification by wiring both anodes together (to connect to the 100 ohm resistor), and both cathodes together (this point going to the smoothing choke).

The most suitable load for the output valves mentioned is about 5,000 ohms. The transformer primary should be able to carry 35 to 40mA, and the transformer should have a ratio of about 45.1, if used with the usual 2 to 3 ohm speaker.

If the R.F. and detector valves are of the unshielded type, then they should be enclosed in screening cans.

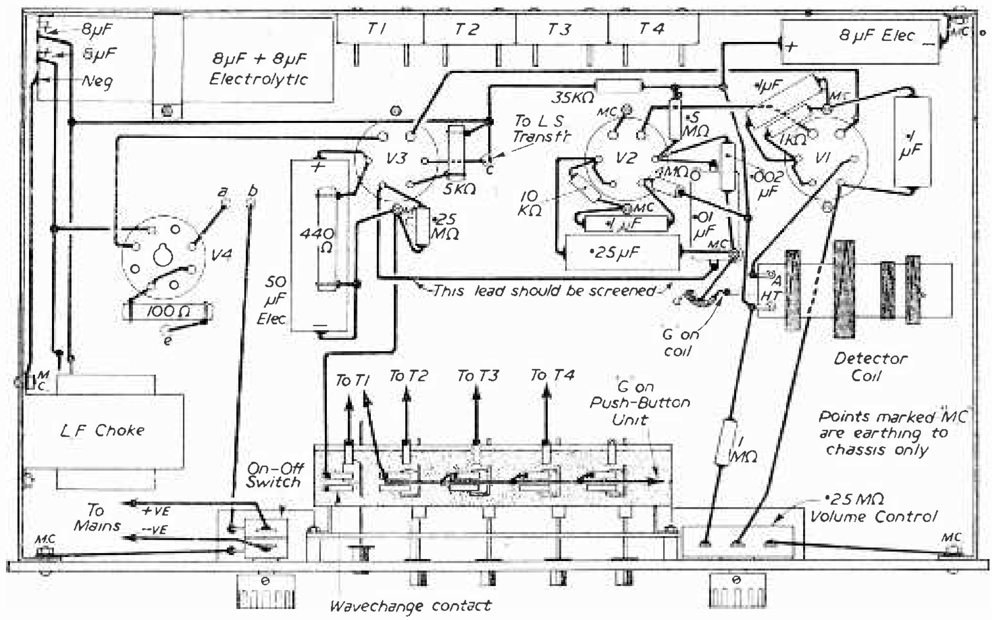


Fig. 3.—Wiring and components under the chassis.

The Beginner's Guide to Radio

The Seventeenth Article of a Series Explaining the Fundamentals of Radio Transmission and Reception. This Month We Give Further Notes on Reading a Circuit and Information on Testing Instruments

By F. J. CAMM

FIG. 72 given last month shows the circuit and the practical wiring diagrams relating to it. The circuit includes a radio frequency stage, a detector with reaction, and the output valve is, of course, transformer coupled. I have not the space to reproduce all of the theoretical signs used in connection with radio. They are given in my "Practical Wireless Encyclopædia." A list of radio symbols,

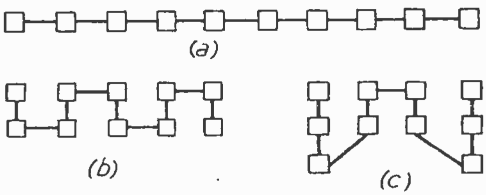


Fig. 73.—(a) A wireless circuit is really a chain of components joined together. (b) The same chain folded up to conserve space. (c) The best arrangement of components, allowing space for tuning condensers or speaker.

however, does not tell the beginner sufficient. It tells him that a particular sign stands for a particular component, but the beginner needs to know when he sees a particular circuit what it means in terms of a particular set until he reaches the stage when he can dispense with diagrams. He should learn not to depend on a wiring diagram always being available. In fact, a circuit diagram is very much more graphic than a wiring diagram. Manufacturers, for example, do not issue wiring diagrams, only theoretical circuits.

A circuit is really a number of different components linked together, and Fig. 73 indicates this in diagrammatic form. If all the components were strung together in a straight line the set itself would be unnecessarily long and shallow, as shown in the first diagram. The components are therefore arranged in a compact form as is indicated by the other two diagrams. The third arrangement is best in that it leaves a central space for the mounting of the tuning condensers or speaker. In reading a circuit diagram it is important to remember that an arrow through a component means that it is variable. Variable resistances and variable condensers are other examples of conventional signs where the arrow is used. It is also important to remember that electrolytic condensers have positive and negative poles, unlike the usual type of fixed condenser.

Testing Instruments

It is seldom that a receiver is built which works satisfactorily straightaway. It may not work at all, it may give distorted signals, it may lack selectivity or the station may not be received at the correct point on the tuning scale. Adjustments have to be made and quite often it is necessary to take current and voltage measurement throughout the circuit to make quite sure that the correct voltage is being applied at the plates of the valves and that the correct current is flowing in the various parts of the circuit. For this purpose we must use test meters, such as voltmeters, ammeters, milliammeters, and so on. It is possible to purchase a meter which will enable one to make all of those measurements instead of having a number of separate instruments. In an earlier lesson I explained how some tests could be made without instruments at all. Of course, it is only the advanced experimenter who needs elaborate test gear and the beginner may find a simple instrument for measuring current and voltage sufficient for his immediate needs.

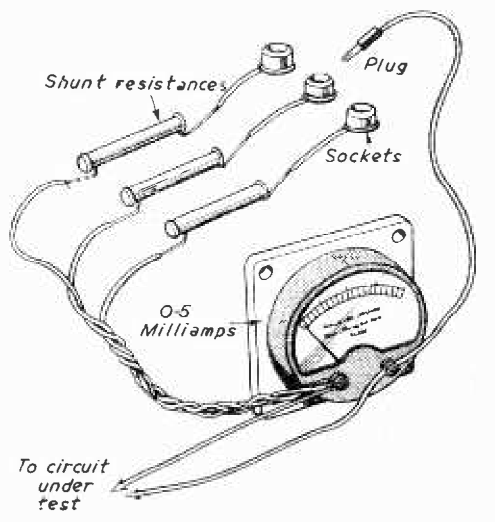


Fig. 74.—Using a milliammeter and shunt resistances to take readings beyond the range of the meter.

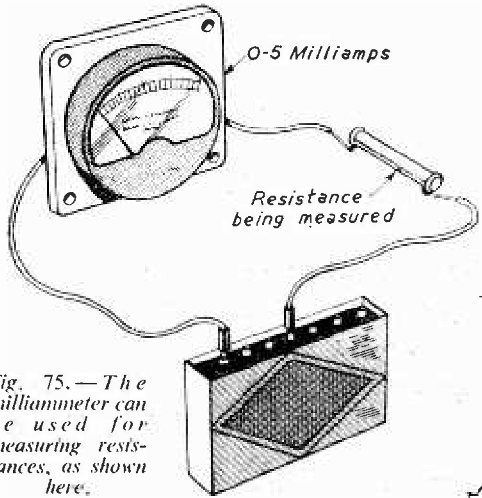


Fig. 75.—The milliammeter can be used for measuring resistances, as shown here.

As a matter of fact, it is quite possible to take all of the usual measurements by means of a first-class milliammeter used in conjunction with suitable resistances or "shunts." The ammeter must be of the moving coil type and it should have a full-scale deflection of about 5 milliamps, so that it may be used to take measurements of current down to about .5 milliamp. Its range can be increased up to 10, 20, 50 and 100 milliamps, as well as to 1, 2 and 5 amps, merely by connecting "shunt" resistances between its terminus.

Now, before the correct value of these resistances can be determined the resistance of the meter itself must be known and then the values can be found by simple proportion. For example, if the resistance of the meter is 100 ohms, and it is intended to take readings up to 50 milliamps with a meter whose full-scale deflection is 5 milliamps, the meter must only pass 5 milliamps, and therefore the parallel resistances will have to carry the remaining 45 milliamps. Expressed in another way, the meter will take one tenth and the resistance nine tenths of the total current. It follows that the resistance will have a value of one ninth of the resistance of the meter, or 11.11 ohms. By this method the value of any other shunt can be found by dividing the multiplying factor less 1 into the resistance of the meter. In the example given above the multiplying factor was 10 (50 divided by 5). I give below a short table showing the values of resistances for other ranges.

Milliammeter Giving Maximum Deflection of 5 Milliamps

Max. Deflection Required	Multiplication Factor	Resistance of Shunt
10 milliamps ...	2	100 ohms
20 ,, ...	4	33.33 ohms
50 ,, ...	10	11.11 ohms
100 ,, ...	20	5.26 ohms
1 amp	200	.503 ohms
2 amps	400	.251 ohms
5 ,, ...	1,000	.1 ohm

Resistances to the values can be made by winding suitable lengths of resistance wire on to small ebonite rods. The wire must be chosen so that it will safely carry the necessary current and the proper gauge can be obtained from wire gauge tables, such as those given in our Vest Pocket Book, entitled "Wire and Wire Gauges" (3s. 9d. by post). Fig. 74 shows the method of connecting them. One end of each is connected to one terminal of the meter, the other ends all being taken to sockets into which a plug from the second meter terminal can be inserted according to the range required.

Voltage Measurements

The same meter can be used for measuring voltages by connecting resistances in series, as already explained. Here again, it is necessary to take the resistance of the meter into consideration when determining the size of the resistances required.

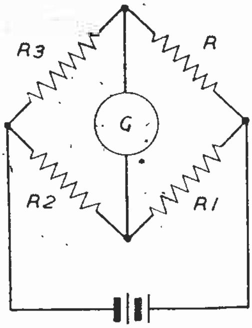


Fig. 76.—A resistance bridge.

The method of calculation, however, is different and it is necessary to employ Ohm's Law. We know that the resistance of a circuit in ohms is equal to the voltage across the circuit, divided by the current in amperes flowing in it. Therefore, if the meter is to read 5 volts whilst passing 5 milliamps, the resistance should be 5 divided by 1/200, which equals 5×200, which is 1,000 ohms. We must remember, however, that the resistance of the meter, 100 ohms, as well as the series resistance is in circuit and the value of the latter must, therefore, be only 900 ohms. It follows that if the meter were required to read up to 50 volts a series resistance of 9,900 ohms (10,000 − 100) would be required.

(To be continued.)

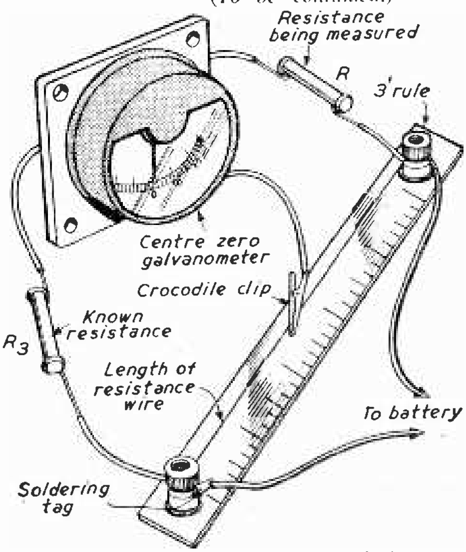


Fig. 77.—A practical arrangement of the simple bridge shown by Fig. 76.

9 Octave

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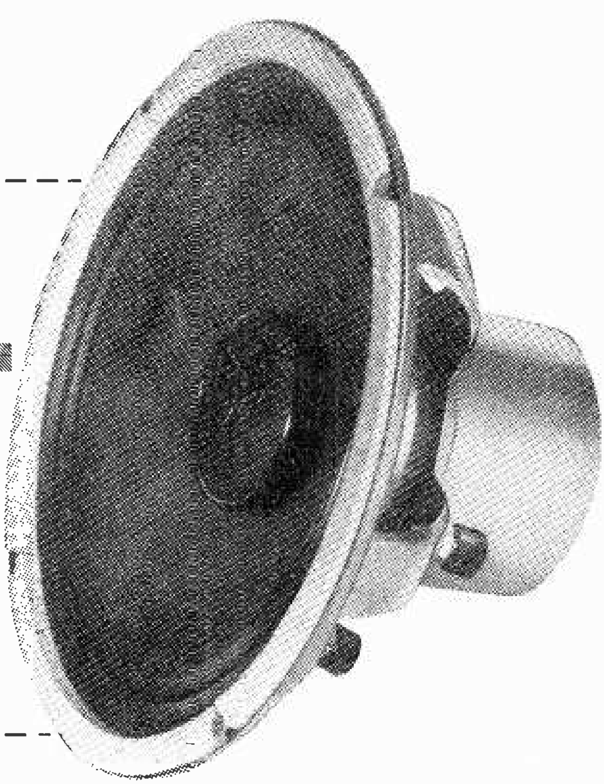
from a single unit



The G.E.C. metal cone loudspeaker gives lifelike reproduction of any type of sound over a range of 9 octaves. This includes the entire musical fundamental range together with overtones which give tonal quality and character to the performance of each musical instrument. The sound engineer will appreciate the simplification and improvement in performance which has been achieved by combining the following attributes in a single unit.

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On Your Wavelength

BY THERMION

A 25th Anniversary

I WAS pleased to be present at the showrooms of Messrs. Mullard Ltd. a few weeks ago at the invitation of my old friend Colin H. Gardner, who was celebrating the completion of 25 years' service with that pioneer company. Gardner, like his firm, is also a radio pioneer, and you have, no doubt, enjoyed his reminiscences which have recently appeared in this journal. He is one of the few who have remained in the industry since its inception in those formative early twenties. I was associated at that time with the production of the first issue of *Amateur Wireless*, which did not survive the competition of P.W. and later was absorbed by it. The passage of a quarter of a century since those days will mean that many others will be celebrating 25 years' service, although this journal has another three years to go before it reaches the quarter-century mark.

There were plenty of his friends present to wish him well as he enters the second 25 years and he received many tokens of regard, both verbal and actual. It is due to men like Colin Gardner that industries, and the firms which compose them, are able to progress and themselves celebrate 25 years of successful trading.

Another Anniversary

ANOTHER pioneer, L. O. Sparks, who was a regular contributor to this journal some years ago and who has since become a regular advertiser in it, is also celebrating an anniversary—although for the shorter period of 10 years, during which he has been successfully pioneering his well-known data sheets. Sparks is skilled on both sides—transmitting and receiving—and he brings to bear on the production of his helpful data sheets over 30 years' experience of experiment and providing designs for amateur constructors. My congratulations to him, with the wish that I shall be invited to *his* 25th celebration !

Pubs and Entertainment

A MEMBER of Parliament recently asked the President of the Board of Trade to take steps to amend the Copyright Act so as to prevent authors or composers, or the Performing Rights Society acting on their behalf, from obtaining fees from innkeepers or hotelkeepers to listen to television or radio programmes. This society is most active in collecting fees from the bonifaces of this country under the Act, not only in connection with television and radio, but also if they have a piano installed in one of the bars which is used to entertain the public. Most publicans have to pay a few guineas a year to cover the playing of copyright music. I have always felt this to be wrong. If a teacher buys a book on mathematics he is not prevented from using it as a basis for his lectures and does not have to pay fees when he takes examples from it for the purposes of teaching. The playing of songs on the piano, in my view, should not be protected by copyright.

Car Radio

I WONDER why it is that so few amateurs turn their attention to car radio receiver design? Information on this subject is very scarce and the only reference that I have been able to trace is a section in "The Practical Motorist's Encyclopædia" published by the publishers of P.W. Few contributors submit anything but scanty information on the subject and that is usually concerned with the installation of the aerial or the rectification of faults. I am glad to know that experiments are being conducted in the P.W. laboratory and, I understand, with promising results. If only it were possible to step up D.C. ! Away would go such troublesome devices as vibrating reed rectifiers and the problem would be simple. My car is fitted with a Radiomobile receiver made by H.M.V. I have used it for over six years and have had very little trouble. Such troubles that have occurred have been concerned with the rectifying unit and they have been quickly remedied. Any reader who has had experience of building a car radio receiver, and by that I mean one which is built into the car as a permanent fixture as distinct from a portable, might care to drop me a line.

Another 21st Birthday

CONGRATULATIONS to our stable companion *Practical Mechanics*, which with its October issue follows P.W. (which celebrated last year) in achieving 21 years of continuous and successful publication, under the editorship of Mr. F. J. Camm. He has already received a large number of tributes from readers, schoolmasters, and members of industry. His new production, *Practical Motorist and Motor Cyclist*, has, in the short space of six months, broken circulation records. He must certainly hold all records for output !

The New "Fury Four"

I HAVE been testing for some time the new version of the famous "Fury Four," the design for which originally appeared in our issue dated January 28th, 1933. Publication of details will shortly commence herein. They have been delayed because, I understand, certain manufacturers are not yet ready to go into production with some of the components. That difficulty has now been overcome. Although I am not permitted to make more than a passing comment, I can say that its performance is remarkable and I have no doubt that it will be built in the same large numbers as the original, many hundreds of which are still in operation and giving faithful service. But times have changed since the original design was first produced. Conditions in the ether are much more critical and the public demands a greater degree of selectivity than was possible at that time. Incidentally, I should like to hear from all those readers still operating the "Fury Four," either in its battery or its mains version.

AMPLIFIER DESIGN

6.—UNTUNED AMPLIFIERS—CONTINUED

By R. Hindle

(*Continued from page 490 August issue*)

A Series of Articles Dealing with the Theoretical Considerations of Amplifier Design, and Containing at a Later Stage Constructional Details of Various Types of Amplifier.

A TWO-STAGE amplifier is indicated and conveniently a double triode will be chosen so that effectively a compact single valve unit will result.

There is nothing very controversial about the circuit which appears in Fig. 26. R1 and C1 are decoupling units about which nothing will be said until later in this part. R2 and R4 are the two coupling resistors (RL1 and RL2 to use the notation previously adopted in these articles). C4 and C5 are the coupling capacitors (Cc1 and Cc2 in the now familiar notation). R3 and R5, with C2 and C3, are the cathode bias components which will also be left for discussion until after the designing spadework is completed. Dynamic curves are provided in the Brimar valve data on this valve for three different values of load, i.e., 47 KΩ, 100 KΩ and 250 KΩ, and these are reproduced in part, so far as they are required for the present purpose, in Fig. 25. The first step is to examine the dynamic curves of anode current against grid voltage for a substantially straight portion. A glance at the grid current curve shows that Ig begins at about .6 volt negative, and this region must be avoided at all costs because if grid current is allowed to flow whilst the valve is operating as an amplifier a voltage will be developed across the resistance between grid and earth which will result in distortion. Sometimes, where only a small signal is to be applied, a tiny grid current is deliberately permitted and the resultant voltage in the grid resistor is used as the valve bias, the cathode in this case being connected directly to earth. Such a scheme will not suit the present purpose of a utility amplifier because of the distortion and also because of the effect that it might have on the source of the signal ; so the grid current region will be avoided and, for safety, the grid will not be allowed to go less than 1 volt negative. A straight-edge placed along the curve indicates that the curve is substantially straight from −1 volt to −7 volts, with a middle grid voltage of −4 volts. Thus if a permanent bias of −4 volts is applied the signal can be allowed to swing 3 volts on either side with reasonably little distortion (there is some little curvature, of course, even if it is not noticeable with the application of the straight-edge). This permits, therefore, a 6-volt signal input peak-to-peak.

These operating conditions seem quite suitable for the present purpose so that various data available from the curves for 100 KΩ load and −4 volts bias are read as follows :

Anode current, Ia = 1.7 mA.
gm = 1.45 mA/V.
μ = 16
ra = 15 KΩ

The formula for actual gain was used in earlier parts of this series and is (formula 3) :

$$\text{Gain} = \frac{RL}{ra + RL} \times \mu$$

$$= \frac{100\ K\Omega}{15\ K\Omega + 100\ K\Omega} \times 16$$

(by substituting the above figures)

= 14 times.

Each stage is identical so the overall gain of the two stages will be 14 × 14 = 196, which will satisfy the stipulated requirements.

The permitted input signal to the second stage, i.e., 6 volts peak-to-peak as decided above, is also the maximum *output* from the first stage, and so the maximum input to the first stage (and so to the amplifier) will be $\frac{6}{14}$ V, or about half a volt peak-to-peak (or .25 volt peak).

The bias is produced by the anode current of the two halves flowing through R3 and R5 respectively. Thus the current, as above, of 1.7 mA has to produce 4 volts bias and so by Ohm's Law,

$$R3 = R5 = \frac{4 \times 1000}{1.7}$$

$$= 2300 \text{ ohms.}$$

The nearest standard size will be satisfactory ; the resistance size for cathode bias is far from critical and anything from 2,000 ohms to 2,500 ohms will suffice. Actually the standard size of 2,200 ohms with the usual 20 per cent. tolerance will be chosen.

The load resistances R2 and R4 have now to be

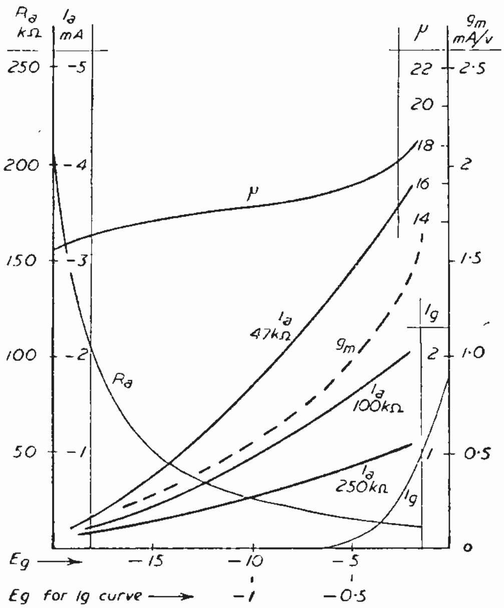


Fig. 25.—Dynamic characteristic of the 12AU7.

determined. The dynamic curve from which the straight portion has been selected assumes a load of 100 KΩ, but, as was seen previously, this is the value of the anode resistor in parallel with the resistance of the following circuit. In the case of the first half of the valve the load is therefore R2 in parallel with R6. According to the Brimar data the 12AU7 can have up to 1 MΩ grid circuit resistance if auto-bias is used and, of course, auto-bias is the name for the method of biasing the cathode by virtue

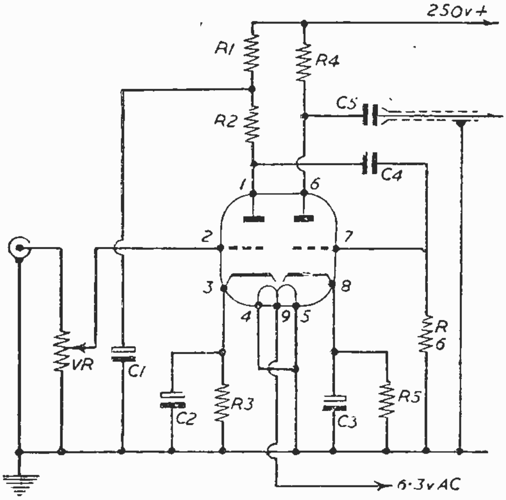


Fig. 26.—Completed amplifier design.

LIST OF PARTS		
R1 22 KΩ		C1 8 μF 350 v. Dubilier Type BR
R2 100 KΩ	Dubilier	C2 100 μF 12 v. Dubilier Type BR
R3 2,200Ω	Type BT	C3 100 μF 12 v. Dubilier Type BR
R4 100 KΩ		C4 .03 μF 250 v. Dubilier Type 410
R5 2,200Ω	½ Watt	C5 .1μF 250 v. Dubilier Type 410
R6 1 MΩ		
V 12AU7 Brimar VR 1MΩ Volume Control Dubilier Type YN		

of the valve's own current flowing through a resistor in its cathode circuit, such as is being used in the present design. As a matter of interest, if the valve obtains its bias from any other source the grid resistance has to be kept down to 250 KΩ. This is because of the tendency in the case of auto-bias for deviations from the anticipated working conditions to be automatically compensated for. For instance, if grid current flows a bias is built up across the grid resistance. Auto-bias will have the effect of then reducing the cathode bias so that the overall bias is not much changed. If fixed bias from another source is used, of course, this compensation could not take place. R6 will therefore be made 1 MΩ, as it is intended to keep well clear of the grid current region so far as the curves show it. There is some slight grid current, of course, at even more negative grid bias, too small to be recorded on the curve, but yet sufficient to prevent the use of a very much larger grid resistance than the 1 MΩ specified.

R2 now becomes the resistance which, in parallel with 1 MΩ, makes 100 KΩ, but as the grid resistor is 10 times the wanted load it will have little effect in determining the load, and R2 can safely be made 100 KΩ. If the reader doubts, let him work it out. The formula is

$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2}$$

$$\frac{1}{100K} = \frac{1}{R1} + \frac{1}{1M\Omega}$$

$$R1 = \frac{1M\Omega}{9}$$

$$= 111\ K\Omega$$

which is within the normal tolerance of resistors (20 per cent.) for one nominally 100 KΩ.

R4 cannot be calculated, of course, without knowing to what kind of a circuit the amplifier output is to be connected, but it will be made 100 KΩ also. Some gain will be lost if the output is connected to a resistance much less than 1 MΩ. There is a possibility that a power output valve may have a resistive input circuit of as low as 100 KΩ, in which case the gain of the last stage in the amplifier will be reduced, making the overall gain 168 times, but the more usual resistive input circuit of 220 KΩ will reduce the second stage gain to give an amplifier gain of 180 times.

Lower Frequency Response

The gain, calculated on the basis of the selected working conditions, refers to the mid-frequency range of the band being handled and, as has been seen, the capacitances in the circuit determine the upper and lower frequencies at which gain begins to fall off. The coupling capacitances C4 and C5 determine the lower cut-off and their effects are cumulative. For instance, reference to page 344 of the June issue will indicate the method of determining the sizes of these capacitors. Supposing that a 20 per cent. drop in gain at 25 c/s can be tolerated for the present purpose. The first stage must be arranged to drop only 10 per cent. The second stage will then cause a drop (if similarly designed) of 10 per cent. of the remaining 90 per cent, leaving 81 per cent. of the original gain or an overall attenuation of 19 per cent., slightly better than was stipulated.

Working on these lines, then, amplification at 25 c/s has to be .9 of that at middle frequencies and so 25 c/s = 2fo in the notation in the previous article referred to above, fo being the frequency at which the reactance of the coupling capacitor equals the following grid resistance. So

2fo = 25 c/s.

fo = 12.5 c/s.

Reactance of C4 at 12.5 c/s = R6 = 1 MΩ.

C4 = .02μF to nearest stock size (from Table 3 or by calculation).

Similarly, the reactance of C5 at 12.5 c/s must at least equal the resistance of the following circuit, but as this is a utility amplifier the following resistance cannot be determined, but it is reasonable to expect that it will rarely be below 200 KΩ. So, taking this figure, C5 is seen to be .1μF, i.e., the resistance is a fifth of the previous case, so the capacitance is five times as big. For a given degree of fidelity (so far as the coupling only is considered) at the lower end of the band required the product of C and R is constant and one could quote the coupling required for the present specification as .02 MΩ/μF from which any combination suitable can be derived.

TABLE 3

	100 c/s	50 c/s	25 c/s	12.5 c/s	10 c/s
.001 μF	1.6MΩ	3.2Mμ	6.4 MΩ	12.8 MΩ	15.9 MΩ
.005	318 K	637 K	1.3 M	2.6 M	3.2 M
.01	159 K	318 K	637 K	1.3 M	1.6 M
.02	80 K	159 K	318 K	637 K	795 K
.05	32 K	64 K	127 K	254 K	318 K
.1	16 K	32 K	64 K	127 K	159 K
.25	6.4 K	12.8 K	25.6 K	51 K	64 K
.5	3.2 K	6.4 K	12.7 K	25.5 K	32 K
1	1.6 K	3.2 K	6.4 K	12.8 K	16 K
2	795	1.6 K	3.2 K	6.4 K	8 K
4	397	795	1.6 K	3.2 K	4 K
8	199	397	795	1.6 K	2 K
16	100	199	397	795	1K
32	50	100	199	397	500
100	16	32	64	128	159

Table giving reactance of capacitances at lower frequency limit.

Upper Frequency Response

It still remains to check the upper frequency range of the amplifier and it will be assumed that no more than a 20 per cent. drop in response at 20 Kc/s is permissible. As before, the effect of the two stages is cumulative, so that each stage must have a gain down by only 10 per cent. at 20 Kc/s.

Consider first the coupling between the two sections of the valve. The effective load is R2 (100 KΩ) in parallel with R6 (1 MΩ), but as R6 is 10 times R2 it will have little effect on the result and we can quite happily take 100 KΩ as the effective load. The reciprocal formula would give the exact effective load if it should be thought worth calculating, i.e.,

$$\frac{1}{R}=\frac{1}{R1}+\frac{1}{R2}$$

$$=\frac{1}{100K}+\frac{1}{1000K}$$

$$R=\frac{1000K}{11}$$

$=91$ KΩ which is within the normal tolerance of resistors nominally 100 KΩ.

According to the valve data reproduced in Table 1 the following are the stray capacitances of the 12AU7:

Cgk = 1.6 pF
Cak = .5 pF (second half .35 pF)
Cga = 1.5 pF

The gain we have already found to be 14 times and so the Miller fed back capacitance is 15 times Cga = 22 pF and the total valve strays across the load amount to Cgk + Cak + Miller Effect, i.e., 1.6 + .5 + 22 = 24.1 pF. In addition are the wiring and component strays which we previously assessed at 15 pF giving a total shunt capacitance near enough to 40 pF. The Miller Effect is here calculated for the actual gain; hence the slight difference compared with Table 1, where a standard gain was assumed.

Now to give the upper frequency desired the reactance of stray capacitances must equal or be greater than the effective load (100 KΩ) at fp but, as above:

$\frac{1}{2}$fp = 20 Kc/s
fp = 40 Kc/s

Reactance of 40 pF at 40 Kc/s = 100 KΩ, which equals the effective anode load and is, therefore, suitable for the purpose.

It will not often occur that the reactance works out exactly equal to the resistive load. It was, in fact, unpremeditated in the present instance. Supposing, however, that the design had proceeded in the earlier stages on the basis of a 220 KΩ load. Now it would have been discovered that such a load was unsuitable, and the earlier stages of the design would have to be reworked on the basis of a 100 KΩ load. The writer chose the 100 KΩ curve because experience dictated this as a probably suitable load. On the other hand, supposing a load of 50 KΩ had been chosen. Now it would be clear that the frequency characteristic would be better than the original stipulation, and this in the majority of cases could be accepted. If for any special reason it was desired not to make the frequency range any more extensive than the original stipulation two courses would then be open. Either the earlier parts of the design could be reworked on the basis of a 100 KΩ load or, what is more likely (as, presumably, satisfactory gain and output voltages were offered by the design as it stood), the value of the strays could be increased to the value that would have a reactance of 50 KΩ by adding a 40 pF capacitor from anode to earth or from anode to H.T.

Now, with regard to the amplifier output circuit, detailed calculations are again impossible without knowledge of the circuit to which the amplifier is to be connected. In particular one would have to bear in mind the stray capacitance that might be introduced by the connecting lead. Assuming, however, that care will be taken with units to be worked with the amplifier, one can be reasonably certain that the characteristic will be something very like that specified with the component values now determined and Fig. 26 gives the circuit as it now stands.

Cathode By-pass Capacitance

Any resistance or reactance in the cathode circuit causes negative feedback which is generally undesirable because it reduces the gain. Bias considerations require that 2,200 ohms should be inserted at this point and the by-pass capacitors have the purpose of shunting these resistors with a low reactance so that the effective impedance is as near zero as possible. Clearly, therefore, there is no optimum size for the by-pass capacitor—it should be as large as possible so that its reactance will be as small as possible. 1 μF would have a reactance of 8Ω at 20 Kc/s and this is small enough compared with the resistance of 2,200Ω that it is to by-pass and would be quite satisfactory. At 25 c/s, however, the reactance would be over 6,000Ω—not a very satisfactory by-pass for 2,200Ω! It is necessary, therefore, to consider by-pass capacitors from the point of view of the lowest frequency to be handled. 50μF will have a reactance of over 120 ohms and this will appreciably reduce the cathode circuit impedance, but in our design we shall do better. A capacitance of 100μF will be specified and this will have a reactance of only 64Ω at 25 c/s. Both C2 and C3 will have this value.

Supposing the capacitance is inadequate. A value of 1μF, for instance, was found adequate at 20 Kc/s, but as the frequency decreases the reactance increases and consequently the effectiveness of the capacitance decreases.

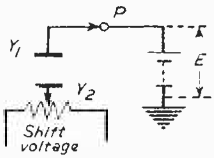
(To be continued)

Measuring Voltages with a "Scope"

SIMPLE METHODS OF HIGH RESISTANCE VOLTAGE MEASUREMENT EXPLAINED

By S. C. Murison

IT is surprising, yet true, that many experimenters have oscilloscopes but do not have high resistance voltmeters. This may be because it is more pleasant (and sometimes less costly) to build an oscilloscope than it is to make a reliable high resistance A.C.-D.C. multi-range voltmeter. However, most experimenters have a voltmeter of some sort. Often it is of such low resistance that its connection to a circuit upsets the action so badly that the true conditions cannot be established. A



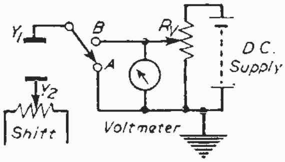


Fig. 1 (Left).—The Y-plates of a cathode-ray tube.
Fig. 2 (Right).—Checking the deflection sensitivity.

typical example of this difficulty is in trying to use a low-resistance meter for measurements on a multivibrator. In such an example it is of no avail to deduce how much current the meter is drawing and then make a correction to the voltage indicated. The potential distribution is probably so badly upset that the circuit is operating in an entirely different way from that which it does in the absence of the meter.

Few amateurs seem to use their oscilloscopes to resolve this difficulty—probably because they think that it would only confound confusion still further. In practice the oscilloscope is capable of excellent results. The amount of complication introduced depends entirely on how accurately voltages have to be measured. A further advantage is that whether the voltage is A.C. or D.C. does not affect matters much. The principle involved is the fundamental one of electrostatic deflection.

In Fig. 1 only the Y-plates of a cathode-ray tube are shown ; it is to be understood that the other electrodes are connected in the usual way. If the wire from Y1 is first connected to earth and then to P, the spot will move from one position to another above the first. The vertical movement depends on three things : (1) the design of the cathode-ray tube : (2) the E.H.T. voltage used ; and (3) the value of the voltage E. Because the first of these is fixed once and for all before the user gets the tube it will not vary and so affect the accuracy of measurements. The E.H.T. voltage may vary but will not do so in a rapid or random way. The effective deflection sensitivity (by which is meant the voltage necessary to move the spot a given distance) varies inversely with the E.H.T. voltage. This means that if the E.H.T. voltage *decreases* by 5 per cent., the deflection sensitivity will *increase* by 5 per cent. and all the voltages measured will appear to be 5 per cent. high.

For the amateur this is probably no real difficulty as the value of E.H.T. will not vary by anything like 5 per cent.—always assuming that the mains voltage stays nearly right. If the method outlined above and shown in Fig. 1 is used, it is good practice to check the sensitivity every few weeks or when a power cut seems likely to have reduced the mains input voltage.

Checking the deflection sensitivity is easy. The arrangement shown in Fig. 2 is used. The D.C. supply shown can be any power pack which is well smoothed. The oscilloscope H.T. supply will be satisfactory, providing that the timebase is well decoupled or switched off. If the voltmeter to be used is of low resistance, the potentiometer RV is best wire-wound : a value of 25 kΩ rated at 3 W should meet most needs. The method is to set the switch to A, and adjust the shift control to make the spot (or line) coincide with an ink-mark near the lower edge of the screen. When this has been done set the switch to B and using a non-metal scale, adjust RV to move the spot (or line) up a fixed number of inches or centimetres. The meter now reads the voltage corresponding to this amount of movement. The sensitivity is arrived at by dividing the meter reading by the number of inches (or centimetres) of movement. Representative value are 33 volts per centimetre at an E.H.T. of 1.8 kV for a VCR97 ; 50 volts per centimetre at an E.H.T. of 2 kV for a VCR138 ; and 45 volts per centimetre at an E.H.T. of 800 V for a VCR139A.

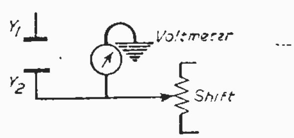


Fig. 3 (Above). — A voltmeter built into the oscilloscope.

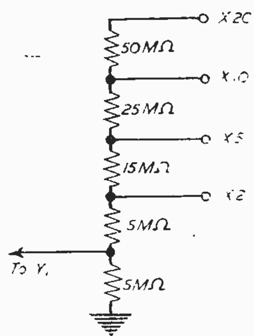


Fig. 4 (Right).—A practical divider using resistors.

When measuring deflection sensitivity, the largest possible movement should be used because this improves the accuracy of the measurement. Stray magnetic fields can hamper this work by making the spot move through an arc rather than along a straight line. For this reason, the cathode-ray tube should be well shielded.

Improved Method

A more elegant method is to build a voltmeter *into the oscilloscope.* Then the E.H.T. voltage can vary without affecting the accuracy of the measurement. The arrangement is shown in Fig. 3. The meter should preferably be a centre zero type, but a normal one can be used with a reversing switch. The full-scale deflection necessary depends on how many volts are provided across the shift control. Usually a 250-0-250 volt type should be satisfactory. The resistance of the meter is not important provided that the shift potentiometer can carry the current drawn by the meter.

Using this arrangement the procedure is: With Y1 connected to earth, adjust the shift potentiometer to bring the spot (or line) to some chosen position. Read the meter. Then connect Y1 to the voltage to be measured. Using the shift control, return the spot (or line) to the original chosen position. The difference between what the meter now reads and what it previously read is the value of the voltage being measured.

The methods so far described are useful for voltages up to about 500 volts. The lower limit depends upon how small is the spot, and in practice the lower limit is about 15 to 20 volts. To measure lower voltages than this calls for more complication than most amateurs would care for. It should be noted that the methods shown in Figs. 1 and 3 give the *peak* value of alternating voltages. Consequently, for sine waves the result given by the oscilloscope must be divided by 1.4, if the R.M.S. value is needed as is usually the case.

High Voltages

By making a potential divider, the upper limit of voltage can be extended. How far it can be extended depends on the amount of care devoted to insulation. Theoretically, one could use a capacitive potential divider, but the odd values of components needed make the method impracticable. A practical divider using resistors is shown in Fig. 4. Its success depends on three things: (1) using the closest tolerance resistors obtainable; (2) mounting the resistors on high-grade insulating material with the greatest possible tracking length; and (3) ensuring that the voltage across the ends of any one resistor is within the maker's rating. Few carbon resistors are supposed to be run with more than 750 volts between ends, regardless of wattage considerations. The effect of this is that unless one can afford resistors specially designed for high-voltage use, the higher values in Fig. 4 have to be made from several resistors in series. Although this takes up a good deal of room it is worth doing, for the result is the equivalent of a high resistance E.H.T. meter. Because of its inevitable stray capacitances, this form of potential divider is not suitable for use much above 50 c/s.

An experimenter modifying his oscilloscope in the way suggested will find his time and effort well rewarded by the resulting ease of high resistance voltage measurements.

News from the Clubs

ROMFORD AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: N. Miller, 18, Mascalls Gardens, Brentwood, Essex.

ALTHOUGH the winter lecture programme has now ended the club will continue to hold meetings every Tuesday at 8.15 p.m. at the R.A.F.A. House, 18, Carlton Road, Romford. A junk sale will be held on the first Tuesday of every month.

New members will be warmly welcomed and it is hoped to commence Radio Theory classes in addition to the Morse classes already running. The club station, G4KF, will be on the air, usually on top band, on meeting nights.

CHESTER AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: E. Yates (G3ITY), 210, Stamford Road, Blacon, Chester.

CLUB activities have been mainly outdoors of late, with Field days. We are pleased to announce that we shall be at Hope Mountain again, South of Mold, on August 15th. The station call will be GW3ATZ/P.

We shall be operating the club station from Merioneth, North Wales, on Sunday, August 29th. The station call will then be GW3GIZ/P, which will be running for the second time this year.

The club is open each Tuesday at 7.30 p.m. at the Tarron Hut, Y.M.C.A., Chester. A welcome awaits all visitors.

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

IN spite of very heavy and prolonged rain, the D.F. event scheduled for Sunday, June 13th, took place as arranged. The venue was Green St. Green, Kent and four teams set off at mid-day to locate the transmitting site where the club portable transmitter was operating under the call sign G3GHN/P. The winner was the present holder of the D.F. shield, D. Bennett, and his team comprised C. Bullivant (G3DIC) and J. Green.

On June 19th a party of members visited the BBC receiving station at Tatsfield and a pleasant afternoon was spent seeing the type of work carried out at this establishment. Much interest was taken in the equipment in use and the many varied aerial arrays. Another interesting event during June was the visit to the clubrooms on June 18th by Mr. R. Coles of Standard Telephones & Cables, Ltd., who gave a talk entitled "Selenium Rectifiers and their Applications."

Programme for August: 6th and 20th—Constructional Evenings. 13th—Junk Sale. 27th—Quiz.

The Clifton Amateur Radio Society, catering for all ages and tastes, meet every Friday evening at 7.30 p.m. at the clubrooms, 225, New Cross Road, London, S.E.14. Visitors and anyone wishing to become a member are invited to call any Friday.

SOUTH SHIELDS AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: W. Dennell, 12, So. Frederick Street, South Shields.

THE club meets every Friday at 8 p.m. in the Trinity House Social Centre, 134, Laygate Lane, South Shields. The club has its own "shack" from which G3DDI operates on 80 metre telegraphy and telephony. Members interested in sound amplifiers and music take turns of duty each weeknight in the operating chair controlling the amplifier system of the community centre. The amplifiers were constructed by the members of the club during the last three months. The immediate project in hand will be the South Shields Annual Flower Show event during the period of August 26th to 29th, and members will be contributing an "interest" exhibition including the operation of two amateur stations operating on the 20, 40 and 80 metre bands with the distinctive call sign in use GB3SFS. Reports of reception of any transmissions received from the exhibition stations will be acknowledged by QSL card. Reports to be addressed GB3SFS, Pier Pavilion, South Shields, Co. Durham.

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

A MEETING was held on Saturday, June 19th, at the Y.M.C.A. Torquay, under the chairmanship of G2GK, and a very interesting talk on "Mobile V.H.F. Operation," was given by Mr. Thommasson, of Exeter, which was much appreciated by all.

G3AVF has made a transistor-transmitter, using an input power of 50 milliwatts, on 1.8 Mc/s, with which he has made several cross-town contacts. He is now trying to modulate this. At the meeting on July 17th an "inquest" was held on the recent N.F.D. of the R.S.G.B., in which several members took part. At the meeting, on August 21st, a talk on "Aspects of Crystal-Grinding" will be given by W. A. Launder, B.Sc. (G3FHI).

Meetings are held on the third Saturday of each month, at 7.30 p.m., at the Y.M.C.A., Torquay. Intending visitors to Torbay are always welcome.

(*Continued on page* 550)

NEWS FLASH

1 The world-famous range of RADIO MAIL Test Gear Kits are now on sale at most reputable component dealers throughout the United Kingdom.

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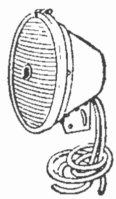

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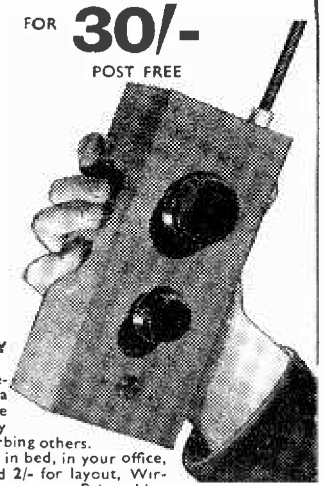

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REASONS FOR THE USE OF HIGH FREQUENCIES

By F. E. Apps

V.H.F. is now being very extensively used and a reasonable idea of this rather intricate subject is very necessary to the man who wishes to progress with radio.

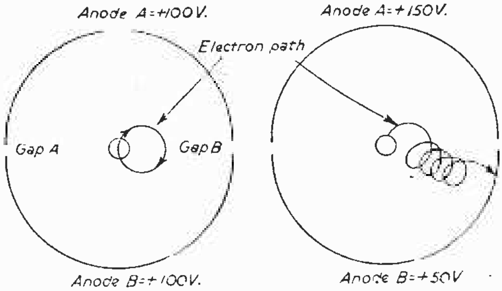


Fig. 1.—(Left) Showing the electron path when the two anodes are at equal potential. Fig. 2.—(Right) Showing how the electrons travel in complicated paths when anode B is at a lower potential than anode A.

Some may naturally ask why use such high frequencies? Are they really necessitous? The answer is "Yes," very much so, as communications grow more comprehensive. Here are a few reasons for using V.H.F. First, effectiveness of radiation of electro-magnetic energy increases with the frequency. Secondly, equipment and aerials are much smaller for these frequencies and render them very useful for portable or automatic fixed stations.

Thirdly, the very high frequencies used make them very suitable for a host of transmissions even with wide bandwidth, without overlapping.

Now, when one approaches the subject of V.H.F. it is necessary to reason in quite a different sphere than one does in ordinary broadcast frequencies. In ordinary radio works, one deals with the inductance, capacity and resistance of circuits and the voltages applied and the currents flowing in these circuits. In V.H.F. one deals more with electric and magnetic fields and the medium in which these fields are, and its dielectric constant, its conductivity and its permeability. Again in V.H.F. one deals more with displacement current than with current in a conductor. Thus, as a varying electric field will produce a magnetic field, just as a varying current in a conductor will produce one, the rate of change of electric flux through any medium is called the displacement current because the magnetic field produced is directly proportional to it. Though current and displacement current are practically the same, as regards magnetic effects, one must know that displacement current is not subject to the IR^2 loss that occurs in current flowing through a conductor. Do not confuse leakage current with displacement current, the latter being the current "through" the dielectric of a perfect capacitor and is equal to $C\,dv/dt$.

Generation of V.H.F. Oscillators

To generate V.H.F. oscillations has been one of the major problems of V.H.F. technique, owing to the fact that the ordinary valve as used for the lower frequencies cannot oscillate at frequencies above 500 Mc/s and it is desired to go much higher than this, up to 30,000 or more megacycles per second. The factors that limit the ordinary valve from oscillating at these V.H.F.s are as follows:

(a) Electron transit time.

(b) Power loss, due to large capacitance charging current, skin effect, dielectric loss in valve base, electromagnetic radiation and the impossibility of keeping the size of the oscillator circuit components within the limits necessary, owing to the build of the tube.

All these were referred to in the February number and will not be entered into again.

Types of Valves Used as V.H.F. Oscillators

The very low inter-electrode capacitances needed for V.H.F. and for low charging current loss means that small electrodes must be used. It cannot be achieved by increasing the distance between electrodes as this will mean increasing electron transit time. Now a V.H.F oscillator with a given inter-electrode capacitance fixed transit time and given linear dimensions with fixed voltage will have an optimum condition of operation at a certain frequency only, and to increase that frequency the dimensions of the valve must be reduced. Some of the first valves used for V.H.F. oscillators were the "acorn" and "doorknob" valves. These valves had low transit time,

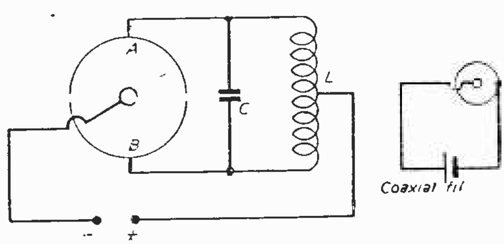


Fig. 3.—Oscillation occurs when the two anodes are connected to a resonant circuit as shown.

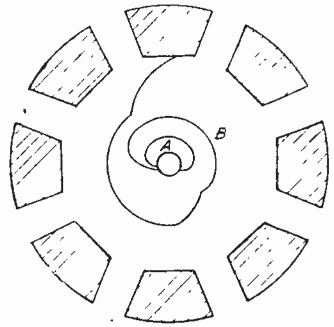


Fig. 4.—Electron orbit of resonance oscillator. A = Electrons gaining energy from field. B — Electrons losing energy to field.

small lead capacitance and inductance and small inter-electrode capacitance. These valves will oscillate down to a wavelength of about 30 cms. The grid is sometimes in the form of parallel straight wires equidistant from the filament, and in other types consists of tungsten wire loops that project into a slot in a block of graphite that acts as the anode. As the grids in these valves are very close to the filament there is a limit to the power dissipation, owing to the fact that if the grid gets hot it may start emitting electrons.

The "door-knob" type valves were of double-ended construction and so could be used at the centre of a half-wave Lecher system. Higher frequency output could be obtained from these valves by using the second harmonic. This was attained by mounting the valve within a metallic tube whose dimensions allowed it to be a waveguide for propagation of the second harmonic but not large enough for the fundamental (B). Both these types of valves were used as negative-grid oscillators.

Positive Grid Oscillators

This type of oscillator is much used in V.H.F. work and is dependent upon electron transit time. A positive voltage is applied to the grid and zero, or a small negative voltage to the anode. The oscillator circuit generally consists of the grid and anode leads forming a Lecher wire system, but may also be placed between grid and cathode or anode and cathode. The explanation of a positive grid oscillator is as follows. Assuming the grid and anode potentials are constant and that electrons are leaving the cathode being accelerated by the potential on the grid, they will mostly pass through the grid and then come under the retarding effect of the anode. They will come to rest and most of them again will pass through the grid. This continual passing backwards and forwards through the grid will set up H.F. oscillations and power can be obtained for an external circuit between grid and anode or anode and cathode.

Only low power can be obtained from this type of oscillator owing to difficulty in cooling the grid.

The frequency of the external resonant circuit must be very near to the transit frequency. If the difference in frequency is increased, oscillations will cease. At wavelengths of 20 cms. and below the power output drops considerably, as the shot transit time and inter-electrode capacitance necessitates small electrodes, closer spacing of electrodes and higher grid volts. This causes more electrons to be captured by the grid and the ratio of H.F. grid current to direct grid current is small, resulting in lower output.

Magnetron

This is the most efficient V.H.F. generator of oscillations known at present. In its simplest form, it consists of a cylindrical anode with a coaxial filament and a magnetic field, parallel or nearly parallel to the filament. The single cylindrical type is not now used and split anode types are the usual types met with now. V.H.F. oscillations may be set up by a magnetron in three different ways.

1. Negative resistance or dynatron oscillations.
2. Resonance oscillations.
3. Transit time oscillations.

Negative Resistance or Dynatron Oscillations

See Figs. 1 and 2. When the potentials on the two anodes are equal the electron path is as in Fig. 1. If anode B is at a lower potential than anode A, then electrons travel in complicated paths and strike anode having lower potential. Thus, anode current flows to anode B and Ia—Ib is negative when Ea—Eb is positive. If the two anodes are connected to a resonant circuit (Fig. 3) oscillation occurs. With this type of magnetron oscillator, the frequency can be in the neighbourhood of 600 megacycles/sec., depending upon the dimensions of the magnetron.

Resonance Oscillation Magnetrons

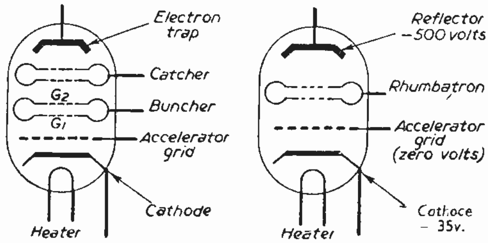
These are multigap magnetrons and we now have a succession of effects on the electrons at each gap and also take into consideration transit time effects. Consider the electrons leaving the cathode; some will after one loop return to cathode, but others will take a longer orbit and in passing gaps gain or lose energy from the field. If the voltage and magnetic field are adjusted correctly, many electrons will lose energy to the H.F. field and oscillations will be maintained. See Fig. 4.

Transit Time Oscillations

In this case, oscillations can be maintained in split anode magnetrons at frequencies that are in relationship to the frequency of the electron loops in the magnetic field. Although an external circuit is used to obtain power, the frequency of the oscillations is not affected by it. It has been noted that when the magnetic field and the cathode are inclined slightly the output is increased. Very high frequencies can be obtained with this type up to 300,000 megacycles/sec.

Klystron

This was dealt with in PRACTICAL WIRELESS of May, 1954, and the diagrams are repeated below.



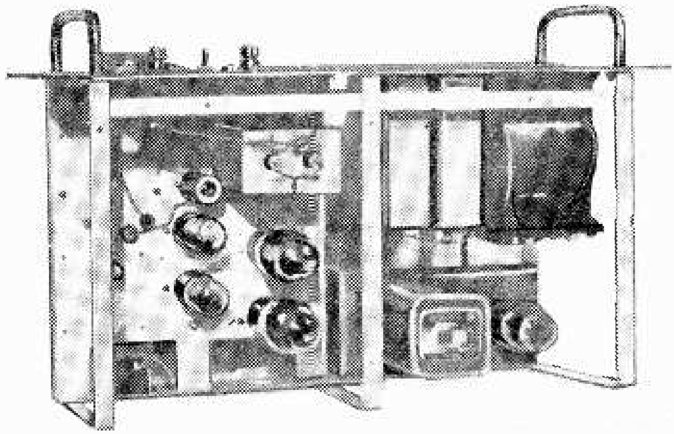
Figs. 5 and 6.—Diagrams of two common forms of Klystron.

Stabilised Power Supplies

SOME THEORETICAL NOTES AND CONSTRUCTIONAL DETAILS

By E. N. J. Marguerit

(*Continued from page 463 August issue.*)



IT has been mentioned earlier that a power supply of this type is almost ripple free. The reason for this is that the D.C. amplifier is of a degenerative nature and therefore any ripple that would appear at the junction of R1 and R2 is fed back into the system, leaving a very small amount in the output. The higher the gain of the D.C. amplifier, the more ripple free will be the output. The expression for the amount of ripple appearing at the output is denoted by α and is given by

$$\alpha = \frac{dE\ out}{dE\ IN}$$

Where dE out is the change in output potential for a change dE IN in input potential.

Practical Considerations

1.—*Reference Potential.* If the power unit is to supply a perfectly stable output it is essential that the reference voltage itself possesses the same degree of stability. For this reason, when designing a power unit, the choice of a reference voltage falls on the output given by a high stability glow discharge tube such as the Mullard 85A2. It would be unwise to take the reference potential from a voltage regulator tube such as a VR75, VR105 or VR150, because its stability is very poor.

When using a high stability glow discharge tube it is important to maintain the current through it as near as possible to the quiescent current recommended by the manufacturers. This is achieved, first, by feeding the tube from the stabilised side of the power unit and, secondly, by using a wire-wound resistor to drop the voltage to the required value.

It is also necessary that the reference source be ripple free; this is effected by means of a resistor-capacitor filter connected to the output of the glow tube.

2.—*D.C. Amplifier.* As stated before this should have as high a gain as possible. This is achieved by using two stages of D.C. amplification consisting of two double-triodes which operate at low anode current, hence the anode loads have relatively high values. Type 6SL7-GT is used, but 12AX7 could be substituted without any circuit change. Here again it is necessary to use resistors that are not likely to change their values with age or with temperature. High-stability carbon resistors are satisfactory, but wire-wound resistors are to be preferred. The operation of the D.C. amplifier is precisely the same as that explained for the simpler types discussed earlier.

Two points, however, are worth noting:

A. The last anode of the second double-triode is fed from the unstabilised side of the supply as this provides a higher potential, and hence a higher value of anode load is needed, thereby increasing further the gain of the system.

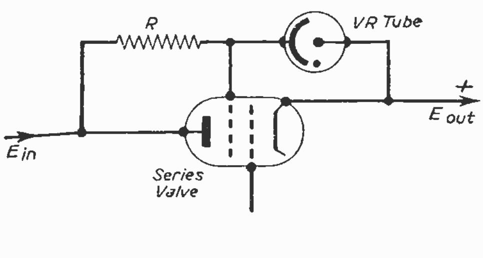


Fig. 11.—The screen grid is maintained at a constant potential with respect to the cathode by means of a voltage regulator tube.

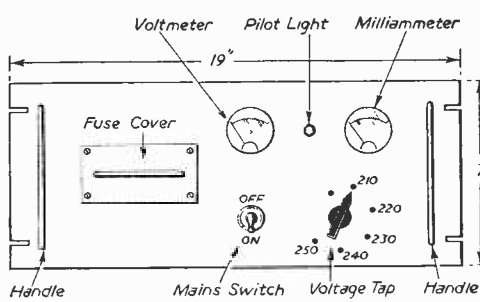
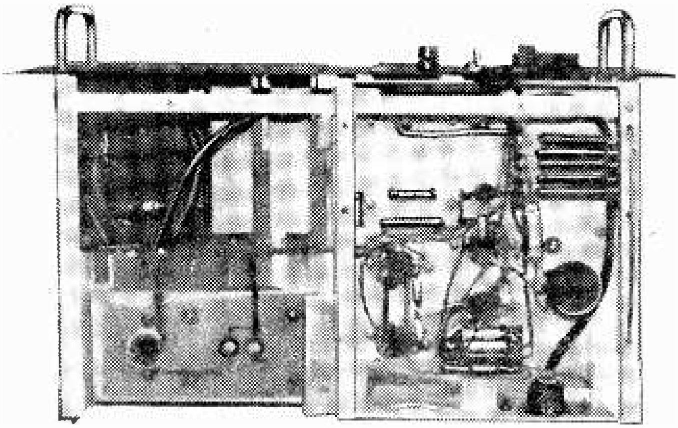


Fig. 12.—The front panel of the power supply.



Another view of the power unit.

B. The capacitor connected between the positive output terminal and the grid of the first triode prevents a phase lag at the grid and compensates to some extent for additional phase shift in the amplifier.

3.—*Tendency for Oscillation.* Any feedback system is liable to oscillate at some high frequency, and this one is no exception. To remedy this a large-value capacitor is placed across the output. Furthermore, all high-impedance points should be fitted with stoppers. This includes all grids in the D.C. amplifiers and the control grid of the series valve. These resistors should be connected directly to the valveholder pins with the minimum possible length of lead.

4.—*Dissipation of Series Valve.* An important factor to watch is the anode dissipation of the series valve. The valve used for this purpose in the power unit described is a 6Y6, which is available on the surplus market. This valve has an anode dissipation of 12 watts. It is, therefore, possible to pass 75 milliamperes through it when the voltage drop across it is 150v. If more current is required from the power unit a second or more valves can be connected in parallel.

5.—*Heater Supplies.* There must be three heater windings on the mains transformers, one for the rectifier valve, one for the series valves and one for the D.C. amplifier valves and output. The winding feeding the series valves heaters should preferably be centre tapped and the centre tap connected to the cathodes. If a centre tap winding is not available one side of the heaters must always be connected to the cathode.

It is sometimes found that if the three windings mentioned above are on the same transformer violent high-frequency oscillations occur. This can be remedied by using a separate transformer for the heaters of the series valves.

The heaters of the D.C. amplifier valves must not be connected to their cathodes as the latter should be as ripple free as possible.

6.—*High Voltage Capacitors.* The reservoir and smoothing capacitors must be rated at 750v. D.C. As it is a bad practice to connect two electrolytic capacitors in series it is recommended that paper capacitors be used in these positions.

7.—*Wiring Precautions.* It is usual when building a wireless to use the chassis as a ground connection for the negative leads, but in pure electronics it is better not to do this, but instead to wire the whole circuit so that it is "floating" with respect to the chassis. The reason for this is that if several points on the chassis are used for "grounds" it is quite possible that unwanted ripple will appear in the circuit.

Another advantage in having a "floating" system is the possibility of connecting, at one point on the chassis, leads of either polarity.

8.—*Obtaining Better Regulation.* It was mentioned in the theoretical considerations that the series valve should have a high amplification factor. One way to do this is to connect the series valve as a pentode. This is readily achieved by maintaining the screen grid at a constant potential with respect to the cathode by means of a voltage regulator tube, as shown in Fig. 11. A VR105 can be used in this position as the absolute stability of the screen potential is not essential. Care must be taken when calculating the value of R that the maximum permissible current through the tube is not exceeded. This current will be maximum when no load is taken from the power unit. It will be minimum when full load is taken out, and there it must not be too low as to cause the extinction of the tube. R1, of course, should be of the wire-wound type and capable of dissipating the required power.

All these points have been considered in the design of the power unit shown in Fig. 15.

Specifications

Input : 230v., 50 c/s.
Outputs : 1. 6.3v. at 2a. A.C.
2. 300v. stabilised from 0 to 150 m/A.
Internal Resistance (from no load to full load) : 0.5 ohm.
Regulation (for mains variation of ±20v.) : 0.06v.
Ripple Content : 3 millivolts.

Constructional Details

An Air Ministry Power Unit Type 3, Ref. No. 10K/11517, available on the surplus market was used to build the unit described.

This consisted of a standard 19in. rack fitting steel case with chromium-plated handles and containing an unstabilised power supply delivering 50 milliamperes at 250v. It also contained a 0-300v. voltmeter and one 0-150 m/A milliammeter. Both these instruments were used in the final unit. All the rest of the components were discarded except the pilot lampholder and its bulb and the mains on/off switch.

The appearance of the front panel of the power supply as available from surplus sources is shown in Fig. 12. The unit was stripped completely in order to drill the additional holes more easily and also to spray the panel. Behind the front panel was a steel framework holding two chassis where the components were secured. The larger of the two chassis is used to accommodate the D.C. amplifier and the

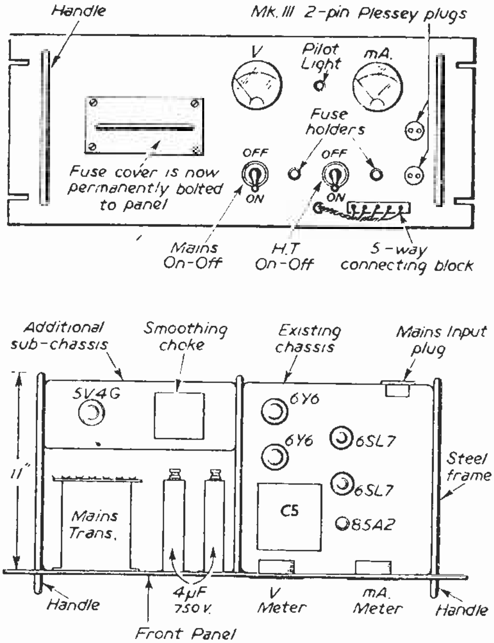


Fig. 13.—The front panel and the interior of the unit after alteration.

series valves, while another small sub-chassis is made to support the rectifier valve and the smoothing choke. The front panel and the interior of the unit after alteration are shown in Fig. 13.

The mains transformer, reservoir and smoothing capacitors are bolted directly by means of countersunk bolts on to the front panel. Additional items on the panel are :

1. One on/off switch for H.T. output.

2. Two cartridge type fuse holders, one for mains input, the other for H.T. output.

3. Two two-pin Mk. III Plessey plugs. This permits bringing the L.T. and H.T. outputs through screened cables when minimum hum pick-up is required. These plugs and their associated sockets are available on the surplus market and require a ⅞in. hole clearance.

4. A G.E.C. or similar 5-way connecting block. This affords a rapid and simple way of connecting the outputs to any external equipment.

After assembling all the components as shown on the photographs, wiring is done with 23 s.w.g. P.V.C. covered tinned copper wire of different colours. All heater leads should be twisted and kept as near to the chassis as possible. In the interest of tidiness the wiring should be laced with strong twine whenever possible.

If constructors wish to build the unit on a chassis that is at hand the layout of the D.C. amplifiers should be followed very closely as any large departure from it might result in violent oscillations and disappointment.

When the wiring is finished, it should be checked to ensure freedom from mistakes. Then the unit, fitted with fuses, can be switched on. After a warming-up period of 30 secs. the voltmeter should read about 300v. Bring the instrument to read 300v by adjusting the preset potentiometer VR1. The voltmeter should be checked against a standard meter.

If everything is satisfactory at this stage some voltages and currents should be checked. The following table shows the readings obtained with a 20,000 Ω/V instrument or with a valve voltmeter.

VOLTAGE CHART

	Vk	Va	Bias. Cath. grid.
V4a	200	290	1.2
V4b.	200	300	1.1
V5a	86	200	1.2
V5b	86	200	1.2
V6	—	85	—

Next connect a 2KΩ wire-wound resistor capable of dissipating 50 W. across the output. Switch the H.T. switch to the ON position, the milliammeter should read 150 mA. and the pointer of the voltmeter should remain on 300v.

If the stability has to be measured use can be made of the circuit shown in Fig. 14.

V is a PX25 power triode, Army No. V.R.40 used here as a variable load for the power unit. A chain of three equal resistors, R1, R2 and R3, is also connected across the output. A backing-off supply consisting of a 120v. H.T. battery is connected at the junction of R2 and R3 and the negative line. A 0-100 µA. microammeter M, shunted with VR2 1v. f.s.d. and having a 1 KΩ resistor in series, serves as a voltmeter. The filament of the PX25 is heated from a separate 4v. 2 A. transformer. With VR1 in such a position that there is a large bias on V the H.T. from the power unit is applied to the circuit. As V is cut off no current will flow through it. Making sure that M is short-circuited by VR2, adjust VR1 until the milliammeter on the power unit reads

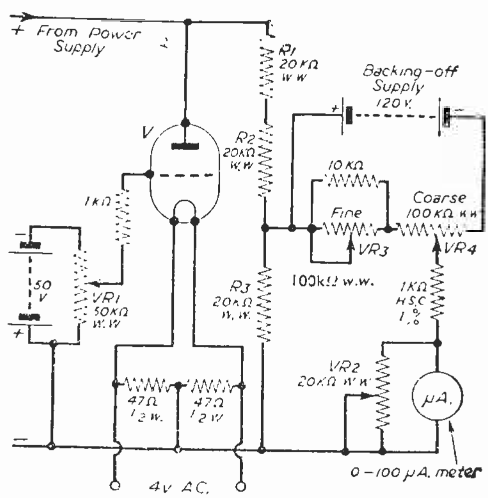


Fig. 14.—Circuit for measuring stability.

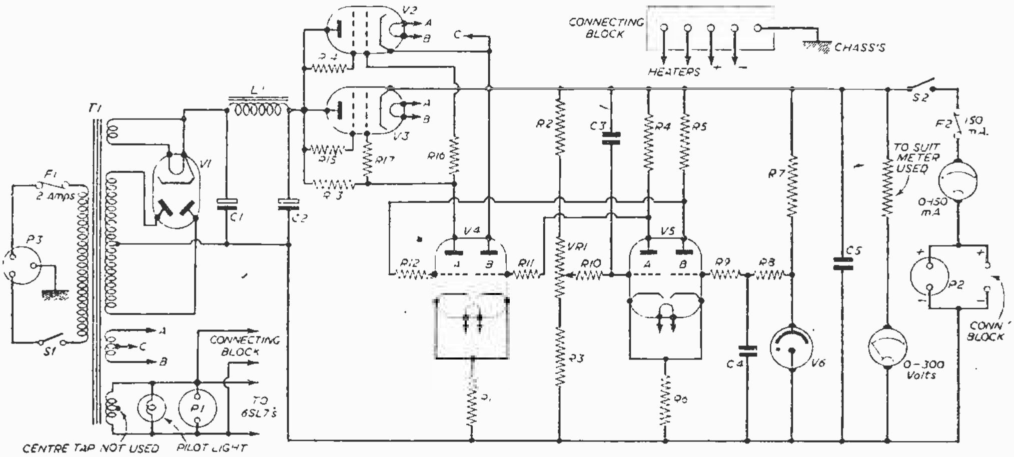


Fig. 15.—Diagram of the power unit.

exactly 100 mA. M will then show some reading. Bring the pointer of M back to zero by adjusting VR4. When the pointer coincides with the zero division bring VR2 to the opposite end of its travel, hence making M most sensitive while maintaining the pointer on the zero division by adjusting the fine backing-off control VR3. Having done this rotate VR1 until the current through V is zero; M will now read some fraction of a volt. Call this amount e volts, then the internal resistance of the power supply is given by

$$\frac{3e}{I} \text{ ohms}$$

where e is expressed in volts and I is the current in amperes producing the change e. (In this case 100 mA.)

To check the stability of the power supply for variations in mains voltage the circuit of Fig. 14 is again used. Here the power supply is connected to a variable mains supply, such as a Variac transformer, and VR1 adjusted so that the unit delivers, say, 100 mA to the PX25 with a mains input of 230v. The Variac setting is then altered so that the input is 210v. and the reading on M is noted. The Variac is adjusted again until the input is now 250v., and the new reading on M is noted. Hence the variation in the output voltage of the power supply for mains variations of $\pm$20v. is found. When doing this the readings of M must be multiplied by a factor of 3 to allow for the resistor chain R1, R2 and R3.

NOTE:—A 5V4G was chosen as the rectifier valve because its maximum output current is 175 mA. A 5U4G could be substituted, but it seems rather wasteful to do so, as its maximum output current is 225 mA.

LIST OF PARTS

VALVES:

- V1—5V4G Brimar.
- V2, V3—6Y6 surplus or 6V6 or 6L6 Brimar.
- V4A-V4B / V5A-V5B ½ 6SL7-GT, or ½ 12AX7 Brimar, or ECC83 Mullard.
- V6—85A2 Mullard.

VALVE HOLDERS:

- 5 International Octal-McMurdo.
- 1 B7G Clix-Ediswan.

TRANSFORMER AND CHOKE:

- T1—Mains transformer. Gardner's Type R133. 400-0-400v. at 180 mA. 5v. 3.5 A. 6.3v. 3 A. C.T. 6.3v. 3 A. C.T.
- L1—10 H 150 mA. choke 130 ohms. Elstone.

CAPACITORS:

- C1, C2—4 μF. 750 v. oil filled (surplus).
- C3, C4—0.1 μF. 350 v. T.C.C. "Metalpack."
- C5—6 μF. 500v. oil filled (surplus).

RESISTORS:

- R1, R2—200 K Ω HSC 1% ½ w. Welwyn.
- R3—68 K Ω HSC 1% ½ w. Welwyn. +10 K Ω Di Ho in series.
- R4, R5—240 K Ω HSC 1% ½ w. Welwyn.
- R6—100 k Ω HSC 1% ½ w. Welwyn.
- R7—39 KΩ wire-wound 5% 3 w. Welwyn.
- R8—100 K Ω 20% carbon ½ w. Erie.
- R9, R10, R11, R12, R16, R17—1 K. 20% carbon ½ w. Erie.
- R13—470 K Ω 20% carbon ½ w. Erie.
- R14-R15—100Ω 20% carbon ½ w., Erie.
- VR1—25 KΩ wire-wound potentiometer. Colvern.

PLUGS:

- P1, P2—Mk. III 2-pin plugs. Plessey or surplus.
- P3—Mains plug, 3-pin. Bulgin P73.

SWITCHES:

- S1, S2—Single pole on/off. Bulgin S263.

THE NATIONAL RADIO SHOW

August 24th to September 4th

List of Principal Exhibitors in Alphabetical Order, with Stand Numbers

Name	*Address*	*Stand No.*
Aerialite, Ltd. ...	Castle Wks., Stalybridge, Cheshire	64
Antiference, Ltd.	Southern Rd., Bicester Rd., Aylesbury, Bucks.	34
Argosy Radio-vision, Ltd.	Argosy Wks., Hertford Rd., Barking, Essex	8
Associated Technical Mfg., Ltd.	Vincent Wks., New Islington, Manchester, 4	25
Automatic Coil Winder & Elec. Equip. Co., Ltd.	Winder House, Douglas St., S.W.1	61
Balcombe, Ltd., A. J.	52, Tabernacle St., London, E.C.2	35
Belling & Lee, Ltd.	Cambridge Arterial Rd., Enfield, Middx.	67
Bowmaker, Ltd....	Bowmaker Hse., Lansdowne, Bournemouth	47
British Broadcasting Corporation	Broadcasting Hse., London, W.1	200
Brown Bros., Ltd.	Browns Bldgs., Gt. Eastern St., E.C.2	91
Bulgin & Co., Ltd., A. F.	Bye Pass Rd., Barking, Essex	99
Bush Radio, Ltd.	Power Rd., Chiswick, W.4	86 & 89
Chald Products, Ltd.	184, Low Rd., Leeds, 10	26
Champion Elec. Corp.	Champion Wks., Drove Rd., Newhaven, Sussex	33
Cole, Ltd., E. K.	Ekco Wks., Southend-on-Sea, Essex	22 & 92
Collaro, Ltd. ...	Ripple Wks., Bye Pass Rd., Barking, Essex	11
Co-operative Wholesale Society, Ltd.	Exhibition Section, 99, Leman St., E.1	106
Cosmocord, Ltd.	700, Gt. Cambridge Rd., Enfield, Middx.	44
Cossor, Ltd., A. C.	Cossor Hse., Highbury Grove, N.5	57
Decca Record Co., Ltd.	1-3, Brixton Rd., London, S.W.9	39
Dubilier Condenser Co. (1925), Ltd.	Ducon Wks., Victoria Rd., North Acton, W.3	83
Dynatron Radio, Ltd.	The Firs, Castle Hill, Maidenhead, Berks.	103
E.M.I. Sales & Service, Ltd.	Head Office, Hayes, Middx.	9 & 73
Econasign, Ltd. ...	92, Victoria St., London, S.W.1	23
Edison Swan Elec. Co., Ltd.	155, Charing Cross Rd., W.C.2	37
Electric Audio Reproducers, Ltd.	17, Little St. Leonards, Mortlake, S.W.14	49
English Elec. Co., Ltd.	Marconi Hse., Strand, W.C.2	85
Ever Ready (G.B.), Ltd.	Hercules Place, Holloway, N.7	66
Ferguson Radio Corp., Ltd.	105, Judd St., London W.C.1	14
Ferranti, Ltd. ...	Hollinwood, Lancs.	58 & 76
Fitton, Ltd., R. N. (Ambassador Radio)	Princess Wks., Brighouse, Yorks.	41
Garrard Eng. & Mfg. Co., Ltd.	Newcastle St., Swindon, Wilts.	71
General Elec. Co., Ltd.	Magnet Hse., Kingsway, W.C.2	68
Gibbs, Ltd., Herbert E.	First Ave., Montague Rd., Edmonton, N.18	20
Goodmans Industries, Ltd.	Axiom Wks., Wembley, Middx.	63
Gramophone Co., Ltd.	Head Office, Hayes, Middx.	10
Hartley Baird, Ltd.	Lancelot Rd., Wembley, Middx.	88
Hobday Bros., Ltd.	21, Great Eastern St., E.C.2	78
Hunt (Capacitors), Ltd., A. H.	Bendon Valley, Garratt Lane, S.W.18	90
Iliffe & Sons, Ltd.	Dorset Hse., Stamford Street, S.E.1	45
Invicta Radio, Ltd.	Radio Wks., 79, Parkhurst Rd., Holloway, N.7	94
J.B. Mfg. Co. (Cabinets), Ltd.	86, Palmerston Rd., London, E.17	18
J. Beam Aerials, Ltd.	Cleveland Wks., Weedon Rd., Northampton	31
Keith Prowse & Co., Ltd.	159, New Bond St., London, W.1	1
Kolster - Brandes, Ltd.	Footscray, Sidcup, Kent	70
McMichael Radio, Ltd.	190, Strand, London, W.C.2	72
Marconiphone Co., Ltd.	Head Office, Hayes, Middx.	13
Masteradio, Ltd.	10/20, Fitzroy Place, N.W.1	62
Mullard, Ltd. ...	Century Hse., Shaftesbury Ave., W.C.2	56
Multicore Solders, Ltd.	Multicore Wks., Maylands Ave., Hemel Hempstead, Herts.	100
Murphy Radio Ltd.	Welwyn Garden City, Herts.	40

Name	Address	Stand No.
Nera of England. Ltd.	Jefferies Passage. High St., Guildford	208
NEWNES, LTD., GEORGE	Tower House, Southampton St., W.C.2	51
Pam Radio & T/V, Ltd.	295, Regent St., London, W.1	84
Peto Scott Elec. Insts., Ltd.	Addlestone Rd., Weybridge, Surrey	60
Philco (Overseas), Ltd.	Romford Rd., Chigwell, Essex	36
Philips Elec., Ltd.	Century Hse., Shaftesbury Avenue, W.C.2	96 & 97
Pilot Radio, Ltd.	31/37, Park Royal Rd., N.W.10	59
Plessey Co., Ltd.	Vicarage Lane. Ilford, Essex	28
"PRACTICAL WIRELESS" & "PRACTICAL TELEVISION"		51
Pye, Ltd. ...	Radio Wks., Cambridge	4 & 95
Radio Gramophone Dev. Co., Ltd.	Eastern Avenue West, Mawneys, Romford, Essex	93
Regentone Radio & T/V, Ltd.	Eastern Avenue West, Mawneys, Romford, Essex	38
Roberts' Radio, Ltd.	35/37, Creek Rd., East Molesey, Surrey	102
Rola / Celestion, Ltd.	Ferry Wks., Summer Rd., Thames Ditton, Surrey	3
Rudman, Darlington (Electronics), Ltd.	Wednesfield, Staffs ...	207
Simon Equipment, Ltd.	48/50, George St., Portman Square, W.1	104
Sky-Masts ...	Beadon Garage, Beadon Road, W.6	30
Sobell Industries, Ltd.	Langley Park, nr. Slough, Bucks.	12
Standard Tel. & Cables, Ltd.. (BRIMAR)	Footscray, Sidcup, Kent	6
Standard Tel. & Cables, Ltd. (SenTerCel)	10, Essex St., London. W.C.2	82
Stella Radio & T/V Co., Ltd.	Oxford Hse., 9/15, Oxford St., W.1	55
Taylor Elec. Insts., Ltd.	419, Montrose Ave., Slough, Bucks.	54
Telegraph Condenser Co., Ltd.	Wales Farm Rd.. North Acton, W.3	101
Telemechanics, Ltd.	3, Newman Yard, Newman St., W.1	81
Telequipment, Ltd.	1319A. High Rd., Whetstone, N.20	80
Telerection. Ltd....	Antenna Wks., St. Pauls, Cheltenham	5
Trix Electrical. Ltd.	1/5, Maple Place, Tottenham Court Rd., W.1	65
Ultra Electric, Ltd.	Ultra Works, Western Ave., Acton, W.3	69
Valradio, Ltd. ...	New Chapel St., Feltham, Middx.	29
Vidor, Ltd. ...	West St., Erith, Kent	87
Waveforms, Ltd.	Radar Wks., Truro Rd., N.22	75
Westinghouse Brake & Signal Co., Ltd.	82, York Way, King's Cross, N.1	2
White - Ibbotson, Ltd.	52A, Goldhawk Rd., Shepherd's Bush, W.12	98
Whiteley Elec. Radio Co., Ltd.	109, Kingsway, London, W.C.2	105
Wolsey Television, Ltd.	43/5, Knight's Hill, West Norwood, S.E.27	16
Wright & Weaire, Ltd.	131, Sloane St., London, S.W.1	74

NEWS FROM THE CLUBS

(*Continued from page 538.*)

SOUTH MANCHESTER RADIO CLUB

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

OUR future programme of lectures is as follows: August 13th, Simple Oscilloscopes. F. Cooknell, G3IPN: August 27th, The Construction of Amateur Radio Equipment. G. A. Fisher: September 10th, Design of Mains Transformers and Chokes. N. Ashton, G3DQU.

BRADFORD AMATEUR RADIO SOCIETY

Hon. Sec.: F. J. Davies, 39, Pullan Avenue, Bradford, 2.

ALTHOUGH the holiday season has arrived, we are still continuing our meetings, the next two being on August 17th and September 14th. After these dates meetings will be held fortnightly.

One or two readers have written asking if we cater for beginners. We should like to assure the less-experienced enthusiasts in the district that we shall welcome them at Cambridge House, Bradford, and will do all we can to help them.

READING RADIO SOCIETY

Hon. Sec.: L. A. Hensford (G2BHS), 30, Boston Avenue, Reading, Berks.

AT the meeting on June 26th, a general discussion developed into a practical demonstration of fault-finding in a valve voltage regulated A.C. mains power pack. On June 29th, a party was conducted over the B.E.A.'s generating station at Earley. Meetings for August have been cancelled but the September programme includes, on September 11th, a talk by Mr. F. A. Ruddle, entitled "Alignment of Radio Receivers," and on September 25th, a lecture entitled, "Old and New Radio—From Crystal to Valve and Back Again."

WARRINGTON AND DISTRICT RADIO SOCIETY G3CKR

Hon. Sec.: G. H. Flood, 32, Capesthorne Road, Orford, Warrington.

MEMBERS and their families joined in the Annual Social Outing at Trentham Gardens.

Lecturettes for Beginners provided a popular evening, when old timers found a host of questions awaiting them.

A S.W.L. in the Club obtained first place in the Association of North Western Radio Societies' Receiving Contest, and was presented with a certificate at the Societies' last meeting.

The P.O.P.S. Club will shortly hold a meeting in the district and our members are hoping to attend.

Future events: Aug. 3, "Mystery Evening"; Aug. 15, "Shack Visit"—G2FCV, G.S. Leigh; Aug. 17, Business and Any Questions; Aug. 29, Region 1 Field Day. Site: "Davyhulme Cottage," Dark Lane, Higher Whitley, Cheshire; Sept. 7, "Radio Control for Model Aircraft." Meetings are held at 7.30 p.m. at the "King's Head Hotel," Winwick Street.

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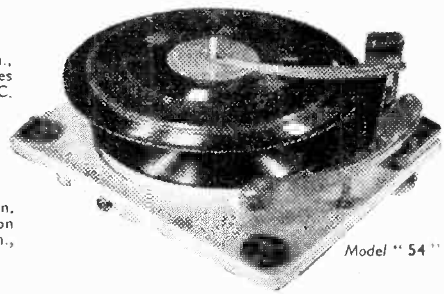
COLLARO'S latest complete mixing unit for 7in., 10in. and 12in. records. Suitable for A.C. voltages 100/125 and 200/250 and available for A.C./D.C. supplies.



Model "54"

RC531 NON-MIXING CHANGER

for single speed operation at 78 r.p.m. with 10in. and 12in. records. **Also 3RC531.** 3-speed version for operation at 33⅓, 45 and 78 r.p.m. with 7in., 10in. and 12in. records.

RC532 MIXING-VERSION of Model RC531 for single-speed operation at 78 r.p.m. with 10in. and 12in. records intermixed in any order. **Also 3RC532.** 3-speed version, for operation at 33⅓, 45 or 78 r.p.m. with 7in. records, or 10in. and 12in. records intermixed in any order.

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Absolutely uniform speed; reproduction free from rumble and frequency modulation.
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★★★5-VALVE 3-BAND A.C SUPERHET. RECEIVER
★★★5-VALVE 3-BAND A.C. D.C SUPERHET. RECEIVER
★★★6-VALVE 3-BAND A.C. SUPERHET. RECEIVER
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★★★SIGNAL TRACER A.C
★★★5-WATT QUALITY AMPLIFIER A.C. WITH NFB
★★★10 - WATT PUSH - PULL QUALITY AMP., A.C. WITH NFB
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A factory made Power Pack, Output Stage and Speaker, contained in a black crackled cabinet to match the receiver, can be supplied at ONLY **£5/10/0.** Operates receiver immediately.

DEDUCT 10/- IF PURCHASING RECEIVER & POWER PACK TOGETHER. Please add carriage costs of 10/6 for Receiver and 5/- for Power Pack.

100 MICROAMPS METERS. 2½in. Circular Flush Mounting. Widely calibrated scale of 15 divisions marked "Yards," which can be re-written to suit requirements. These movements are almost unobtainable to-day and being BRAND NEW IN MAKERS CARTONS are a snip. ONLY **42/6.**

TRANSFORMERS.—Manufactured to our specifications and fully guaranteed Normal Primaries. 425-0-425 v. 250 m.a., 4.3 v. 4 a., 6.3 v. 4 a., 5 v. 3 a. **ONLY 50/-**; 350 v.-0-350 v. 160 m.a. 6.3 v. 6 a., 6.3 v. 3 a., 5 v. 3 a. **ONLY 42/6**; 250 v. 0-250 v. 100 m.a. 6.3 v. 6 a., 5 v. 3 a. **ONLY 32/6.** 350 v.-0-350 v. 150 m.a., 6.3 v. 5 a., 0-4-5 v. 3 a. **ONLY 32/6.** The above are fully shrouded upright mounting. 5.5 kV. E.H.T. with 2 windings of 2 v. 1 a., **ONLY 72/6**; 7 kV E.H.T., with 4 v. 1 a., **ONLY 82/6.** PLEASE ADD 2/- POSTAGE FOR EACH TRANSFORMER.

500 KC/S CRYSTALS.—Standard 2 pin mounting. Ex-new equipment and perfect. ONLY **15/-** (postage etc., 1/-)

6 VOLT VIBRATOR PACKS.—Made by H.R.O. of America. Output 165 v. 80 ma., 6.3 v. 3 a. Contains 6X5 rectifier and full smoothing. Self contained in black crackled cabinet size 7in. x 7½in. x 6in. ONLY **29/6** (postage, etc., 2/-).

AMERICAN ROTARY TRANSFORMERS.—12 v. D.C. input, output 255 v. 65 m.a. Useful for car radio, or running electric shaver from car battery, etc. ONLY **22/6.**

VACUUM PUMPS.—These are ex-R.A.F. rotary vane type, and are ideal for handymen and model makers, etc. New and Unused. ONLY **22/6** (postage, etc., 2/-).

INDICATOR UNITS, TYPE 6.—Contain VCR97 Tube with mu-metal screen, 4 valves: EF50 and 2 of EB34. NEW CONDITION. ONLY **59/6** (carriage, etc., 7/6).

METERS

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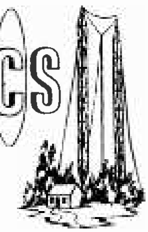

DESIGNING P.A. GRID AND ANODE TUNED CIRCUITS

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

THE design of a P.A. anode circuit offers some interesting problems. It is desired to transfer as much R.F. energy as possible to the load circuit. By load circuit may be meant an actual physical resistance load, or the fictitious "radiation resistance" of an aerial system that is radiating, or, of course, the effective load impedance presented by a feeder line leading to an aerial. However, if we load the P.A. tuned circuit too heavily, the Q is reduced to such an extent that tuning becomes very flat. In fact it is readily noted that the "dip" position of an unloaded P.A. stage is very sharp and critical compared with the flat tuning noticed when the P.A. is fully loaded. In fact the flatter the tuning—that is, the lower the loaded "Q" of the tank circuit—the more of the generated R.F. is transferred to the load. It should be noted that the "low Q" refers only to the loaded condition. In the unloaded condition, the tank circuit Q must be as high as possible. A poor efficiency tank circuit in the absence of a resistance load means that the circuit is "loaded with its own losses." Such a condition means that generated R.F. is merely wasted in heating up the tank circuit.

For high output efficiency, therefore, the tank circuit must be built with low loss components, so that the unloaded Q is as high as possible. The greatest output of R.F. into the load is obtained when the loaded Q is as low as possible. Loading the Q down to zero would in fact result in 100 per cent. energy transfer, but this is not possible for several reasons. There would, of course, be no tuning point on the tank circuit, but worst of all the harmonic frequencies would not be attenuated. To attenuate harmonics a reasonable value of working Q is necessary, and with TVI problems it is essential to have a value of Q sufficient to attenuate harmonics. A value of Q of the order of 12 is recommended as the operating or "loaded" value of the P.A. tuned circuit. However, in commercial practice it is not uncommon to find operating Q values of 5 or so employed.

Incidentally, with an operating Q of around 12, at least 90 per cent. of the R.F. generated in the P.A. valve will be transferred to the load circuit. It should be noted that the missing 10 per cent. of R.F. energy is dissipated in the tank circuit, not at the P.A. anode. Thus a 150 watt P.A. stage generating 100 watts of R.F. will dissipate some 10 watts of R.F. in the anode tank circuit. Thus we have 50 watts dissipated at the valve anode, 90 watts radiated and 10 watts dissipated in warming up the tank circuit. While this 10 watts is not likely to cause any alarm, excessive heat may be a clear sign of undue losses in the tank circuit due to faulty design. A further point is that at V.H.F., where High Q tank circuits are difficult to construct, and where effective loading may be difficult, the tank circuit may dissipate some 30 per cent. of the total R.F. even with a well-designed transmitter. In many cases up to some 50 per cent. of the available R.F. may be wasted in heating the tank circuit. This is graphically illustrated by the writer's experience of 420 Mc/s operation, where the tank circuit may absorb considerable power. It is usually assumed by "experts" that if the power is not available in a coupled lamp load, it is "dissipated at the valve anode." This leads to a state where the P.A. stage may be badly under-run, as the actual power loss is in the tank

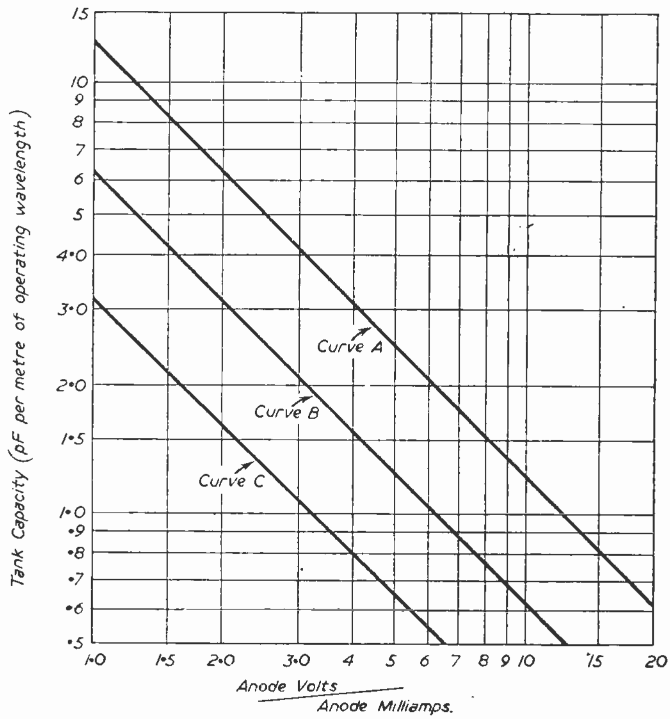

Fig. 1.—Design chart used in conjunction with Figs. 2 and 3, so that the required capacity can be read off.

circuit. On an anode dissipation basis the valve may be capable of dissipating much more power. However, as any 420 Mc/s worker will agree, it is usually not easy to improve tank circuit efficiency so as to obtain more R.F. output! Also at V.H.F. the leads and seals of the valve may prevent more input power rather than the factor of anode dissipation.

Operating "Q"

However, these points all have their relevance to normal short-wave working. Unless the correct operating Q is chosen, harmonics may be accentuated, and anode modulation may not be easy, as well as low R.F. power output. As anode dissipation may also be affected, it is clear that each P.A. circuit for each operating band must be designed to give reasonably correct operating conditions. Fortunately this can be done with very little trouble by using the design chart of Fig. 1. The curve gives the required information in terms of the tank tuning capacity in "picofarads per metre" of the operating wavelength. Thus, for 40-metre operation, the chart figure is multiplied by 40 to give the actual effective value of tank tuning capacity required. The capacity, of course, should include an allowance for the valve and other stray capacities. Thus, using an 807 valve allow at least 15 pF due to the valve and strays. To take an example, a single-ended 807 stage running at 100 mA at 500 volts gives an "anode volts by anode mA" figure of 5. From curve A we see that this requires a tank capacity of 2.5 pF per metre. Thus, 40-metre operation requires a total tank capacity of 100 pF. However, as we assume that 15 pF of strays and valve capacity are already present, then the actual tuning capacitor should be set to a value of 85 pF.

In practice the actual capacity value of the usual semi-circular vaned "straight-line capacity" tank tuning condensers may be estimated from the degree of mesh of the vanes. Thus, half mesh indicates a half capacity and so on. Moreover, if necessary, a little more capacity than indicated may be used. This will slightly reduce power transfer, but will improve harmonic attenuation. Up to twice the given capacities may be used, but one should not use appreciably less capacity than given by the charts. The tank coil used with this calculated value of capacity should be adjusted so that resonance at the required operating frequency is obtained with just about the calculated value of tuning capacitance. It will be seen that, for 80-metre and 40-metre operation particularly, the tank tuning capacity required is rather higher than values found in some amateur installation. However, the values given by the chart will be found to give improved harmonic rejection and, in fact, in some cases have been found to give appreciably better power transfer. This is not surprising, as the design values actually cater for optimum matching, harmonic rejection and anode modulation behaviour. Moreover, it will be found that almost every valve available for V.H.F. work has too high a self capacity to enable optimum 2-metre tank circuits to be built, while almost no valve exists with a low enough self capacity for optimum tank circuit design for 420 Mc/s working. At 2 metres and 420 Mc/s, therefore, the use of a variable tank capacitor is an unnecessary luxury, as adjustable lines for inductance variation with no added tuning capacity will usually give the closest approach to optimum tank circuit conditions.

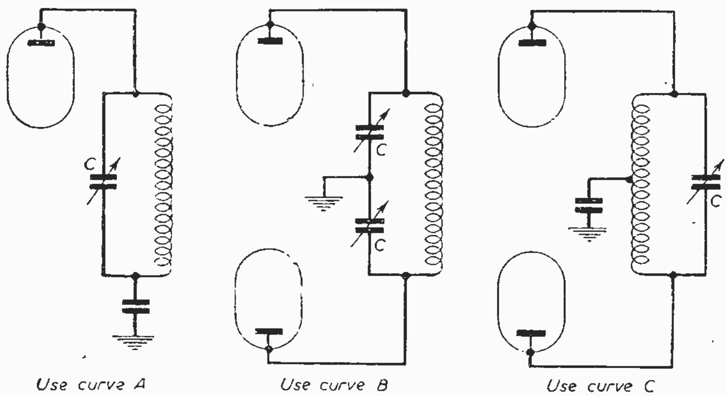

Fig. 2.—The appropriate curve in Fig. 1 to use is shown against the type of anode circuit used.

There are several further points. The three curves A, B and C refer to the types of anode circuit employed. These are shown in Fig. 2. Note, however, that it is the current drawn by the stage as a whole that is considered. It makes no difference in the "double ended" circuit of Fig. 2 whether two valves are used in a push-pull arrangement or whether one valve is used with the tank circuit in a split neutralising arrangement. Provided the same current is drawn at the same voltage the same tank condenser values will be required.

Parallel and Push-pull

Incidentally, in the single-ended stage, if two valves are used in parallel, this again does not make any difference provided the same current is drawn at the same voltage. However, if two valves are used instead of one this usually will double the current as compared with a single valve, so that the tank circuit may need redesigning for the increased current drawn. However, in designing a single-ended stage the only condition is the amount of current drawn at a given anode voltage. It is quite immaterial if this is obtained by using one valve or several in parallel as far as the required value of tank circuit capacity is concerned. In view of the obsession in some quarters with very "low C" tank circuits, even at 80 metres, it will be seen why using a second valve paralleled often makes little difference. The remedy is to redesign the tank circuit using a sizeable amount of capacity as indicated by the chart. Thus, two 807s in parallel drawing a total of 200 mA at 500 volts will require in a single-ended circuit (curve A) a total tuning capacity of 400 pF for 80-metre operation. This is the optimum capacity. However, if used in a push-pull circuit

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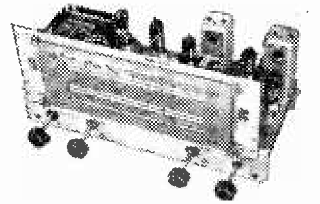

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COPPER ENAMEL WIRE.—½ lb. 14 to 20 s.w.g., 2/- ; 22 to 28 s.w.g., 2/6 ; 30 to 40 s.w.g., 3/6.
SWITCH CLEANER Fluid, squirt spout, 3/9 tin.
5in. RADIO SCREWDRIVERS.—Sheffield made blade, 2½in. x ⅛in. Ins. handle, 5,000 v., 4½d. each.
TWIN GANG TUNING CONDENSERS.—.0005 mfd. midget with trimmers, 8/6 ; 375 pf. midget less trimmers, 6/6 ; .0005 Standard size with trimmers and feet, 9/- ; less trimmers, 8/- ; ditto, soiled, 2/6.
VIBRATOR POWER PACK (Jeff-Travis-U.S.A.).—Compact Steel Case 7in. x 6in. x 4in. 12 v. Input. Output, 90 v. H.T., 6 v. and 1.5 v. L.T. Complete, 25/- ; p. & p., 2/6. Suitable Battery Portable Sets.
LOUDSPEAKERS P.M., 3 OHM.
3in. Plessey, 12/6. Goodmans 4in., 15/6, 5in., 14/6, 6½in., 16/-, 8in. R. & A., 17/6, 10in. R. & A., 25/-, 12in. Truvox, 55/-.

I.F. TRANSFORMERS

465 Kc's Slug tuning Miniature Circular Can, 2¼in. by 1¼in. diam. Fits octal V-holder cut out. High Q and good bandwidth. By Pye Radio. Two mounting feet.

BRAND NEW, 6/9 PAIR

(curves B or C), the actual tuning capacity required in a push-pull pair of 807s will be much lower than for the parallel arrangement. However, generally speaking, the actual working efficiency will be the same provided the parallel and push-pull arrangements are employing the correct tank condenser values for each condition. While push-pull arrangements have certain points of advantage over parallel arrangements, it is not due to capacity effects. Thus, with valves of the same anode capacity one can operate up to the same limiting frequency where valve capacity decides the optimum limit of tuned circuit capacity, as the parallel arrangement demands exactly four times the effective tank capacity as for the same valves in push-pull! Thus, yet another illusion is shattered, as any superiority of the push-pull arrangement is due to its symmetry and not due to "reduction of valve capacity effects." The lesson is, of course, that with correct design either arrangement is about as effective as the other. Point is given to this as the writer has just assisted in the tuning up of an efficient 145 Mc/s stage using an 832 with both sections paralleled!

It is hoped, therefore, that the lesson has been driven home and that those who are tuning 80-metre tanks with a whiff of capacity will take heart and redesign their tank circuits with adequate tuning capacity. In the process they may find TVI ameliorated, anode modulation more pleasant, while harmonics reported S9 plus may disappear. In connection with harmonic reduction, it is perhaps advisable that harmonics are not present at the P.A. grid. Also it is desirable that the grid circuit be designed for optimum drive power transfer to the P.A. grid. In fact, matching the P.A. grid circuit to the grid is very similar to matching the P.A. tank to a load. Also, the design of the grid circuit may materially assist in the reduction of harmonic frequencies in the input to the P.A. grid. In fact, the design of grid tuned circuits . . . although seldom considered . . . is just as important as the design of the anode-tuned circuit.

Fortunately, more latitude is available on the design of the grid circuit—particularly as the use of more than the design value of grid capacity helps in harmonic reduction. The simplest way is to compute the value of "grid bias divided by twice the grid current." The figure obtained is then used instead of the "plate volts by plate mA" figure, to obtain the capacity in "pF per metre" from the chart of Fig. 1. Thus, an 807 taking 3 mA of grid current at 60 volts grid bias gives a figure of "grid bias divided by twice grid current" of 10. From the chart we see this gives for a single-sided grid circuit (curve A) a value of some 1.25 pF per metre, so that the 40-metre grid circuit should be designed to tune with 50 pF of capacity. The value of capacity again depends on whether single-ended or push-pull grid circuits are used and Fig. 3 shows which curve to use.

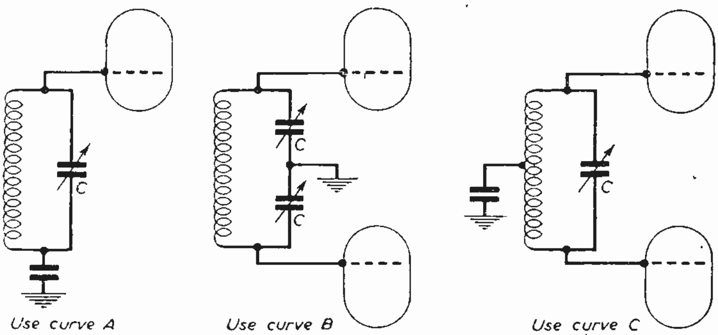


Fig. 3.—By a slight modification, the curves of Fig. 1 may also be used to design P.A grid circuits for optimum operation under grid current conditions.

Radio Tide Gauge for Persian Gulf

A RADIO linked unattended tide gauge that continuously transmits information on the depth of water over the sandbanks at the mouth of the Shatt-al-Arab river in the Persian Gulf has been developed by The Gas Accumulator Co., Ltd., of Brentford, Middlesex, for the Basrah Port Directorate. Mounted on a dolphin structure it will replace the Control Vessel now in service and automatically provide the Port Office at Fao 12 miles away with an exact minute to minute picture of tidal movements.

Power supplies posed the first problem. Specially designed alkaline storage batteries with their associated control gear were eventually ordered from Nife Batteries, of Redditch, Worcs., and probably nowhere else in the world is a completely unattended battery installation called upon to operate under more extreme climatic conditions.

Choosing a parameter into which the rate of tide (R.O.T.) could be translated for radio transmission was the next major problem. Finally, the total tidal range of 14ft. was divided into 140 measurable units and the time taken to transmit each separate message spread out to about 2¾ min. Virtually unaffected by any variable factors, therefore, the parameter adopted is one of pure number—the positive integers from 10-150 for an R.O.T. range of 1ft. to +13ft. Thus, where H is the R.O.T. in feet, the number to be transmitted is given by $N=(H+2)10$.

The transmitter is keyed to send out, on a frequency in the V.H.F. band, ½ second pulses with ½ second intervals. If the R.O.T. is +4.3ft., therefore, 63 pulses are transmitted over a period of 1 min. 3 sec. followed by about 1½ min. silence. Another train of 63 pulses will then be sent unless the R.O.T. has meanwhile changed by at least 1/10ft.

An oscillating balance wheel type flasher generates the pulses—the contacts being closed for about half the swing and open for the remainder. These contacts are connected across the keying terminals of the transmitter via a mercury switch.

SIMPLE CIRCUITS FOR SAFEGUARDING BATTERY VALVES

By David Boswell, B.Sc.

REGARDING the discussion on the principal dangers in supplying battery valves from the mains the following features are listed, according to the author's own opinion, as either preferable or essential.

Essential

1. Series heater arrangement.
2. Initial H.T. voltage rise limited to 90 volts.
3. H.T. voltage limited to 90 volts in the event of filament failure.

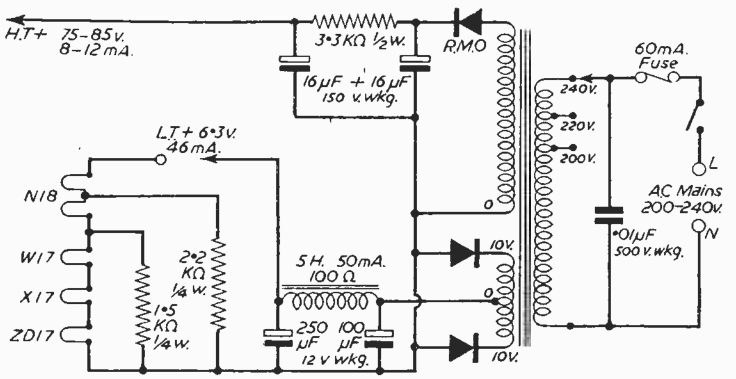


Fig. 4.—Conventional circuit with separate H.T. and L.T. windings.

Preferable

1. H.T. supply withheld until valve heaters are at operating temperature.
2. " Brimistor," to be inserted in heater chain for gradual warm-up period.

The set designer might be tempted to dismiss the requirements given last month as idealistic and likely to add excessively to the cost of components. An examination of the mains supply methods used in commercial receivers confirms this view. It should be stated, however, that the author's prime concern is not the marketing of radio sets, but to improve the life of the battery valve when operated from the mains and to show that this can be done in a simple and inexpensive manner.

Conventional Circuits

Figs. 4 and 5 are considered the best of the conventional circuits from the point of view of voltage regulation and valve protection. Both use a mains transformer and the series method of operating the heaters. In Fig. 4 there are separate H.T. and L.T. windings, and for the filament supply full-wave rectification and smoothing by choke are the good features. The H.T. supply has a 30 per cent. regulation figure, the no-load voltage being limited to about 120 volts, which is rather high. It should be mentioned in passing that if the L.T. smoothing choke has a D.C. resistance of more than 100 ohms it will obviously be necessary to up-rate the working voltage and size of the rectifier and smoothing condensers. In Fig. 6 the transformer has a single secondary winding. Both H.T. and L.T. are derived from this, and it should develop about 110-115 volts R.M.S. on full load. Again, the smoothing choke must be of good quality, having a D.C. resistance of about 500 ohms and an inductance of 10-15 henrys at 60 mA. In the absence of facilities for winding the special transformers required above, a good dodge is to use a standard mains-type radio transformer with a 250-0-250 volt H.T. secondary rated at 50 mA or more. Connect the mains across the outer ends of this winding and the primary, if tapped 240-220-200-0, should then give approximately 0-8-16-110 volts R.M.S. on load. The filaments can be run from the 8- and 16-volt tappings, whilst the 110-volt winding is suitable for H.T. supply. When the primary is untapped, it is only possible to use the method of Fig. 5, though a number of further low-voltage secondaries, if present, might be suitably added to give the 15 or 20 volts necessary for the filaments. This type of transformer is quite satisfactory, but likely to involve undesirable bulk where a fully portable unit is required.

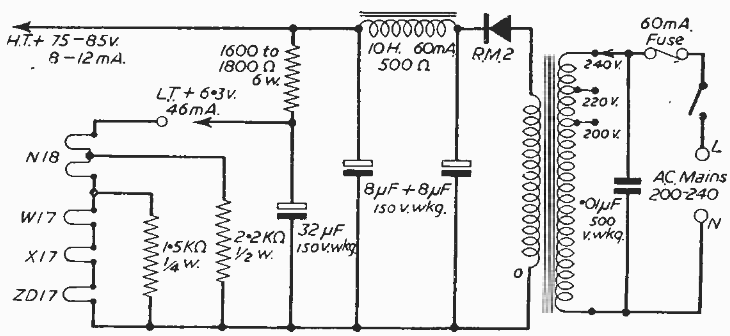
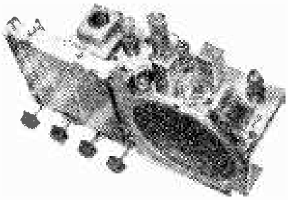


Fig. 5.—Circuit for use when the primary is untapped.

THE SUPERIOR "5"



A.C. mains superhet built by one of our leading manufacturers. Covers long waves 800-2,200 metres, medium waves 200-550 metres, short waves 16-50 metres. Made on a really heavy gauge chassis, size 12in. wide, 7in. deep, and 7½in. high. Double lit dial printed and calibrated in three colours. Dial size approximately 10in. x 4½in.

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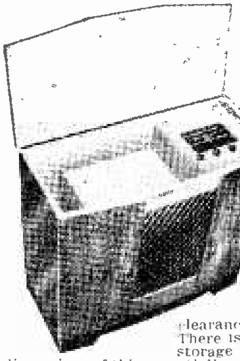
Price complete with 8in. speaker (for separate mounting) is **£11.10.0** or **£3.16.8** deposit. Non-callers please add **10/-** to cover carriage and insurance.

Walnut and veneered cabinet of really first-class manufacture and finish will be available for this chassis. In the meantime, purchasers will receive illustrated details of our "Carton Cabinet." A novel but safe method of operating any radio chassis.

EMPRESS CONSOLE

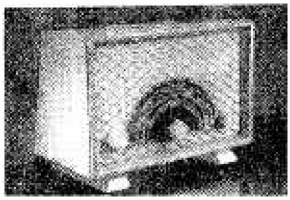


This cabinet is undoubtedly a beautiful piece of furniture. It is elegantly veneered externally in figured walnut, internally in white sycamore. The radio section is raised to convenient level but is not drilled or cut. The lower deck acts as the motor-board, again is uncut. It measures 16 x 14 and has a clearance of 5in. from the lid. There is a compartment for the storage of recordings. Overall dimensions of this essentially modern cabinet are 3ft. wide, 2ft. 8ins. high, and 1ft. 4½ins. deep.

Special price this month **fourteen guineas**—also available by H.P., deposit being **five guineas**.

THIS MONTH'S SNIP

THE "WOLSEY 54"



This month you have an opportunity to purchase a really fine ready built modern Superhet at the remarkable price of

£7.19.6 or £3. deposit,

balance over twelve months.

The Wolsey 54 is an A.C. mains Superhet employing latest circuitry covering long- and medium-wavebands in an ultra-modern case with illuminated dial—overall size approximately 11½ x 7 x 8—complete ready to work. Twelve months' guarantee. THIS OFFER WILL NOT BE REPEATED.

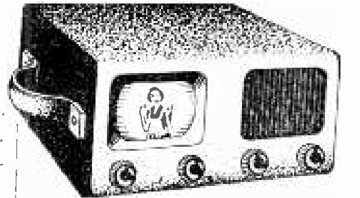
MULTI-METER KIT

The Multi-meter illustrated measures D.C. volts, D.C. m/amps and ohms. It has a sensitivity of 200 ohms per volt and is equally suitable for the keen experimenter, service engineer or student. All the essential parts including 2in. moving coil meter, selected resistors, wire for shunts, 8-point range selector, calibrated scale, stick-on range indicator and full instructions for making are available as a kit, price **15/-**, plus 9d. post and packing.

DANCE AMPLIFIER

Powerful three-valve mains amplifier in portable case—10in. speaker in detachable lid, bass and treble controls. **£7.10.0** complete, ready to work. Microphone, **12/6** extra.

MINIATURE PORTABLE TV.



You can probably think of many other reasons when you may need a midget televisor, but it will certainly be useful when—

(a) Someone is ill, or confined to another room.
(b) Your big TV. fails.
(c) You want to alter or adjust your big TV.
(d) The commercial programmes start.
(e) Servicing an aerial installation.

The Elpreq Miniature Televisor uses standard conventional circuitry, employing a total of 13 valves and 2 crystal diodes. The cathode-ray tube used is a 2½in. Service type VCR139A, which has a standard equivalent and will therefore always be obtainable. The layout is extremely clean, straightforward and professional. The wiring, whilst naturally being a little more intricate due to miniaturisation, is nevertheless completely accessible, and very good results have been obtained. The total cost, if you have to buy every part, would come to **£16-£17**, but you may have many of the components already in stock as only standard conventional components are used. A carrying case, similar to the artist's illustration above, will be available shortly. Its size will be approximately 9½in. x 8in. x 6in. (internally).

Full construction data, layouts, diagrams, templates, etc., running into some 50 sheets, is available, price 5/-, post free.

SIX EXCEPTIONAL BARGAINS!

6½in. Rola Speaker:
This is mains energised 700 ohm field, 2/3 ohm speech coil. Limited quantity only to clear at **8/6d.** each. Postage and packing, 1/-. Quote our ref.: 1M143.

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This contains B7G valveholders, tag strips, etc. Wonderful bargain at **1/6d.** each. Size 9½ x 3¾ x 1½. Postage and packing, 1/-. Quote our ref.: 1E141.

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This is for tuning medium and short waveband. Works with a simple frame aerial, details of which together with connecting diagram, are included at the very low price of **6/6d.** complete. Postage and packing 9d. Quote our ref.: 1H23.

Paxolin Panels:
These are of medium thickness, ideal for dozens of insulation jobs as well as for making up tag strips, control panels, etc. Size 8in. x 5in. at **3/-** per dozen. Postage and packing, 6d. Quote our ref.: 3J2.

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Phone: RUISLIP 5780	Phone: CENtral 2833	Phone: ARChway 1049
Half day, Wednesday.	Half day, Saturday.	Half day, Thursday.

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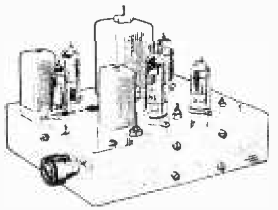

If you live in London, South-east England, or the Home Counties you can build this new Frequency Modulation tuner and enjoy the thrill of the really fantastic high quality programmes on 90 mcs from the BBC's Wrotham station. Has to be heard to be believed, this is the NEW THING in radio. Cost of building approx. £7, complete with valves. Send for full instructions, drawings, circuit and price list, price **1/6**. (Chassis is supplied with *all* holes punched ready for assembly.)

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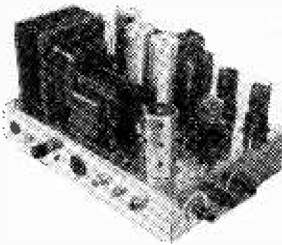

Send today for details of this new Quality Amplifier. Push-pull output with triode connected tetrodes, neg. feedback, independent bass and treble boost controls, separate inputs for radio and gram. All standard parts used and can be supplied separately or in a complete kit. Full instructions, drawings, wiring diagram, and parts list price **2/6**. We are giving demonstrations daily of this amplifier and other Hi-Fi equipment. The new PYE PF91 is here.

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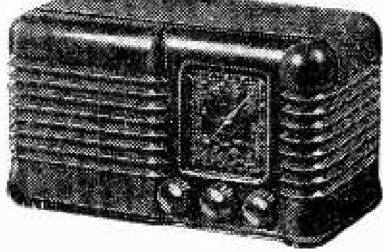

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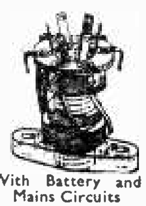

Dual Range Miniature Crystal Set Coil	2/6	with Circuit
Dual Range Coil with Reaction	4/-	with 2 Mains and 2 Battery Circuits
Matched Pair Dual Range T.R.F. Coils with Reaction	8/- pair	With Battery and Mains Circuits

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The circuits in Figs. 4 and 5 offer obvious advantages over those shown in Figs. 1 and 2, yet leave much to be desired. The valves warm up in the face of H.T. voltages 20 or 30 volts in excess of their rated maximum (90 volts), and the life of their emissive filament coating will be increased appreciably if this can be avoided. The fact that they are for A.C. only is not nowadays a serious difficulty, though there are several areas and townships in England still unfortunate enough to have a D.C. mains supply. The A.C./D.C. receiver must be transformerless and is usually less economical because of waste heat and "essential" requirements given in last month's article. It will be seen that the relay, in addition to serving as a smoothing choke, provides automatic power supply selection, delayed H.T. switching, and makes possible the use of a Brimistor to allow the valve heaters a gradual warm-up period. The first two facilities enable the relay to compare favourably, on the score of cost, size and weight, with the normal alternative combination of a transformer and battery/mains selector switch. For those who are luxury minded, a miniature neon indicator bulb may also be used to advantage.

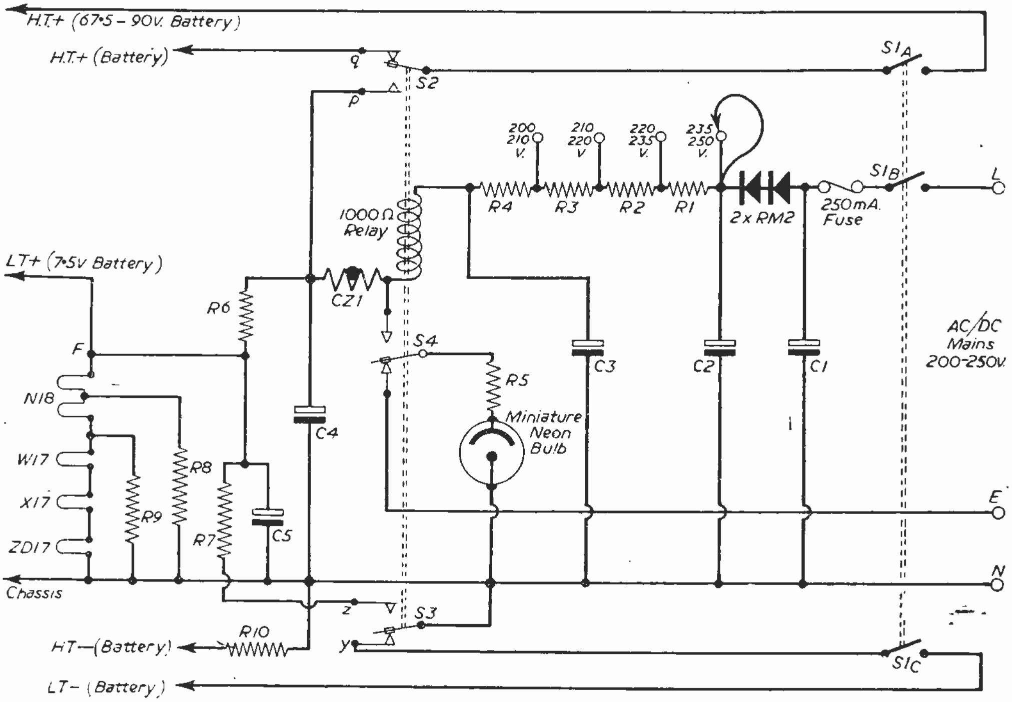


Fig. 6.—An efficient universal supply unit. (*List of components is shown at the foot of page.*)

dissipated in voltage-dropping resistors. With battery valves, however, the heater and H.T. currents are so small that the difference between the cost of running an A.C. only and an A.C./D.C. set is negligible—a matter of three or four pence per annum, perhaps.

An A.C./D.C. Unit

An efficient supply unit of the universal type is offered in Fig. 6. This circuit, employed in the author's own receiver, in fact fulfils all the "desirable"

Operation

The functioning of the circuit is best described by following the sequence in which it operates. Apart from wave change and tuning, the set need only be controlled by a three-pole on-off switch. When this is closed the batteries are brought into play and the set functions as a portable. If the mains are present at A and B, then a circuit is made via the relay coil, Brimistor and valves, though while the resistance of the surge limiter is still high, the relay does not pull

R1—235 Ω (2 × 470Ω ½ w. in parallel).
R2—195Ω (2 × 390Ω ½ w. in parallel).
R3—150 Ω ½ w.
R4—R6—1 kΩ 6 w. wirewound.
R5—15 kΩ ½ w.
R7—680 Ω 6 w. wirewound.
R8—2.2 kΩ ½ w.
R9—1.5 kΩ ½ w
R10—120 Ω ½ w.

C1—.05 μF 500 v. D.C. wkg.
C2, C3, C4—8 μF 350 v. D.C. wkg.
C5—32 μF 150 v. D.C. wkg.

S1—3 pole on-off. (See text.
S2, S4—Break before make.
S3—Make before break.
CZ1—Brimistor (Standard Telephone and Cables).

in completely. The valves will immediately receive normal battery L.T. and H.T. volts, but the application of the latter lasts only for a fraction of a second, if at all, while the relay partially operates to pull S2 away from q (but not over to p) and S3 on to z (but not away from y). This is effected by fitting stiffer springs above the banks of contacts on the relay, which come into play only after the above part-operation is complete. The battery potential at F is now 7.5 volts, but the mains derived voltage rises steadily as the Brimistor warms up, until it reaches 6.3 volts. At this stage, with a current of 53-55 mA flowing through its coil, the relay pulls hard in. It fully operates S2, S3 and S4 to apply mains H.T., light the neon and remove H.T. and L.T. negative battery connections from the chassis. A delay of 10 seconds or more is readily obtained, and in practice the length of this period will give a rough idea of the mains voltage being applied.

It will be noted that under mains-operated conditions the filaments are shunted by a 680 ohm resistor. This normally has a drain of about 9 mA. In the event of a filament breakdown while the set is on, it will permit sufficient current to flow in the circuit to keep the relay energised and limit the voltage appearing on the valve anodes and screens to 90 volts. Should the set be switched on again inadvertently, a current of some 40 mA flows from the mains, but this is not sufficient to pull the relay hard in and no H.T. voltage will be applied to the valves.

Modifying the Relay

The stiffening springs on the relay can be made of .018in. thick by ¼in. wide phosphor bronze strip, or the equivalent in spring steel. They should be set so that the armature will just pull in completely when 53 mA is passing through the coil. It is inadvisable to use an electrical method of adjustment since any shunting resistance across the coil will lower its efficiency as a smoothing choke. In order to obtain a large inductance for good smoothing, the relay coil should have as many turns as possible consistent with its ability to handle continuously the current flowing. A Post Office major relay (Type 3000), by far the most common type available, will dissipate a maximum of 7 watts and this means that with 63 mA D.C. passing (plus a small A.C. ripple component) a coil resistance of about 1,500 ohms can safely be used. In practice a 1,000 ohm coil on this relay has an inductance of 10 henrys at 60 mA (D.C.) and is thus considered suitable.

Other Components

As previously mentioned, the neon indicator is made to serve a dual purpose. When the set is running from the mains it will light up. If, however, upon switching off it remains alight, an indication is given that the chassis is at line potential and the plug connections on the main lead need reversing. The values of the smoothing condensers have been kept as low as possible consistent with good smoothing. Apart from an economy in size and cost, this minimises the surge currents involved in charging and discharging them.

It is not proposed to give any details of a completed receiver in this article, since each constructor will wish to use components on hand, but a brief word on the three-pole on-off switch may be of general use. This can easily be made by combining a double-pole volume control/on-off switch with a three-way tagstrip and a single relay contact arm. (Fig. 7.) The end part of the contact is cut off, bent and soldered on to the tagstrip. This assembly may be fitted either direct to the chassis or clamped beneath the volume control locking unit, enabling a small cam mounted on the spindle to operate the extra switch. The cam, made from an old radio knob, is positioned so that when the double pole switch is off, the relay contact is lifted away from the tagstrip. It is preferable to make this contact operate as S1A, for with a suitable arc of raised portion on the cam, the H.T. can be

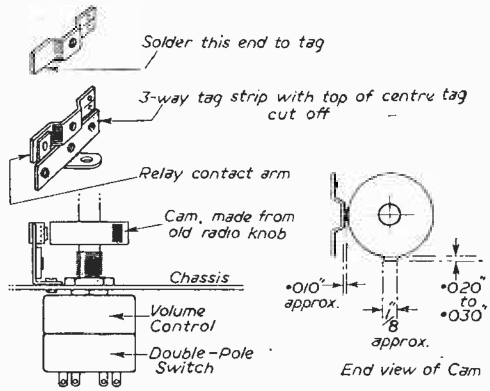


Fig. 7.—A double pole volume control on-off switch, combined with a three-way tagstrip and a single relay contact arm.

switched off just before and on just after the rest of the circuit. A slight manual delay in the H.T. supply is thus obtained; even on battery operation.

Whilst on the subject, it should be emphasised that this power supply does not include a Yaxley-type switch and has, therefore, a distinct advantage over other similar units. This type of switch, especially the miniature variety, is considered quite unsuitable for breaking mains voltages. The path length between contacts along the bakelite wafer is momentarily very short during switching. Also, after a comparatively small number of operations a track of minute silver particles, dust and grease forms a near-conductive layer along the wafer. The combination of these defects renders it liable to breakdown at potentials of 150 volts or more.

Testing Receivers

In conclusion, a word of warning to those who have not used miniature battery valves before:

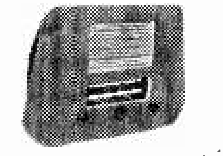
After several costly accidents during testing of receivers, sometimes involving only the merest passing touch of an H.T. wire on to any of the heater leads, or a slight slip with the screwdriver when measuring pin voltages, a useful routine has been evolved for the initial checking of battery sets; this has saved the author many shillings by now:

1. Before inserting the valves, check for insulation from H.T. to earth and from H.T. to all filament tags on the valveholders.

2. Insert valves and check heaters, first for continuity with a 1.5 volt cell and a milliammeter, then for correct current drain with the full L.T. volts.

(*Continued on page* 570.)

THE HARROW BAFFLE CABINET



Build a "second set" to be proud of. Pleasing design cabinet, with drilled chassis, dial, drive and back. Finished in satin mahogany veneer. Outside dimensions: 17½in. wide, 11½in. high, 5in. deep. Receiver design uses 2-6K7, 6V6 and 5Z4. Total cost to build is less than £5/10/-.
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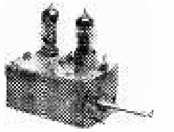
3 a.	9/11	RM.2 ...	4/3
4 a.	12/-	RM.3 ...	5/-
6 a.	19/6	RM.4 ...	18/-

6 Volt		12 Volt	
½ amp.	2/6	½ amp.	3/11
1 amp.	4/6	1 amp.	6/6

CYLDON 5-CHANNEL SWITCHED TELETUNERS



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3V4	7/6	6X5	7/6	VU120A	3/6
6AK5	7/6	6K7	4/6	EL38	15/-
6AM5	6/6	6K8	8/6	EM34	7/6
6AM6	7/6	6F6	6/6	OZ4	6/-
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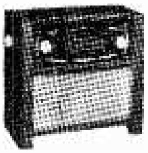

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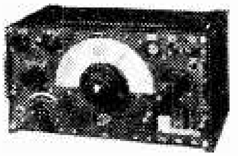

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Comprising chassis 3" x 2" x 1½", switch, LMS iron cored coils, padders, trimmers, nuts and bolts, wire, sleeving, circuit diagram, 456 Kc. Brand new Int. Oct. Valveholders, 2½d., 2/- doz.; All Can Electrolytics, 8 x 500, 1/3, 12/- doz.; 2 x 350 8d., 6/- doz.; 200 x 12 6d., 4/6 doz.; 100 x 6 3d., 2/- doz.; Coils, Coils, "P" Type 2/-, "Q" Type 2/3, TRF 4/- pr.; MSS Superhet 6 coils with circuit, 4/- set; HF Dual-wave 2/9. Crystal Coil L & M 2/-; Tub Cond. .1 x 500 3/- doz. .1 x 350 2/9 doz.; Asst. Grommets 6d. doz.; 2, 4, & 6 BA Nuts 2/- gr.; Brand new BA Nuts & bolts asst. 2 gr. 5/-; Ex-equip. BA nuts, bolts, washers 2/6 lb. (approx. 500 pieces); PK self tap screws 2/6 gr.; 18 SWG Multicore 2/6 doz. yds.; 1 m/m sleeving 1/- doz. yds.; ½ meg. vol. con. with DP sw., 3/-.
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Latest list 3d. Min. P. & P. 1/-.

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5, WHITE LODGE CRESCENT, THORPE-LE-SOKEN, ESSEX

WATERLOO RADIO

VALVES at 2/6 ea., 10 for £1. 2C1'RK34, VR78, D1, VR54 EB34, Germanium Diode at 3 for 20/- your selection. IT4, 3V4, 6B8, 6K7G, 6X4, 6AM6, 3A4, 6BW6, 6CH6, 6AT6, 6AU6, 12BE6, 6BA6, 6BH6, 6BJ6, Z77, 1U5, 50C5, 12A6, 6V6G, 35W4, 6C6, 8D3, 6F6, EF50 VR91, 50L6, 25L6, 7H7, 12SL7, 6AC7, 6L7, 6N7, NR73, ECC31, 6SG7, 6SK7, 6SS7, 6U5G, 6J6.
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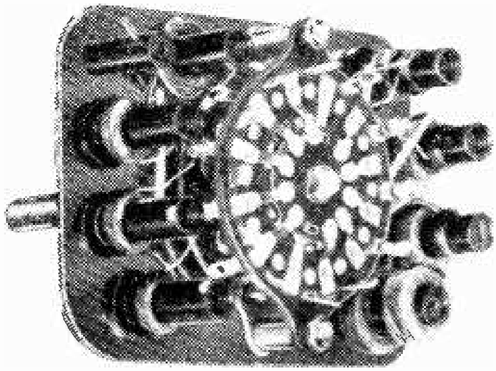
SPECIAL AND TRANSMITTING, 813's 75/-, HK24G 35/-, 723A B 105/-, 725A 210/-, 1B21 55/-, 8012's 8/6, 448A "Lighthouse," 85/-.
CHARGER TRANSFORMERS, 200-250v. A.C. input, 1.5a at 6-12 volt, 12/6, 3 amp. 21/-, 6 amps. 29/6, 10 amps. 50/-. Post 2/-. Charger Rectifiers Bridge for use with above transformers, 2 amp. 11/3, 3 amp. 12/6, 4 amp. 15/-, 6 amp. 23/6, 10 amp. 30/-. Post 1/6.
35, TENISON WAY, SOUTH BANK, LONDON, S.E.1.

News from the Trade

Denco Coil Packs

WE are informed by Denco (Clacton) Ltd., 357/9, Old Road, Clacton-on-Sea, Essex, that their recent introduction of four new coil packs, details of which were mentioned in our June issue, brought about a considerable number of requests for similar packs with gram. positions, with the result that they have now designed and are about to manufacture an additional three packs which will be known as :

CP4L/G Pre-set, long and three medium stations, inclusive price 41s. 4d. : CP4M/G Pre-set, four medium stations, inclusive price 41s. 4d. : CP3/G 3-waveband for use with Jackson 500 pF condenser and SL8 scale, price 52s. 0d. All three packs are designed with similar single hole fixing.



Four-station coil pack with gram. position

Swindon Components Division

THE Plessey Company Limited announce that a new division of the company has been established, to be known as the Swindon Components Division. It will be responsible for the development, manufacture and sale of electrolytic and paper capacitors and moulded track potentiometers.

Mr. O. G. Cox, previously in an executive position in the Components Division at Ilford, has been appointed general manager. He will be located at Swindon where the new division's activities, under existing management, are now concentrated.

The address of this new division is : The Plessey Company Limited, Swindon Components Division, Kembrey Street, Swindon, Wiltshire. Telephone : Swindon 3461.

Stabilised Voltage Control

THE new Winston stabilised voltage control equipments—announced a short time ago—are now in full production and more details of their design have just been released.

Designed and produced by Winston Electronics, Ltd., the new stabiliser (now designated Voltastat) incorporates many new advances in voltage control technique.

There are two types of Voltastat which accept all changes in load and changes of up to 20 per cent. in supply voltage, while variations in supply frequency of up to plus or minus 10 per cent. do not affect the output. Stabilisation accuracy is normally plus or minus 2 per cent., but special equipments provide an accuracy of 0.5 per cent. By using a cold cathode voltage reference (which has an indefinite life) a stabilisation accuracy as high as .01 per cent. can be achieved.

Another outstanding advantage of Voltastat is the rapidity of operation. They can correct for sudden changes in load or supply voltages within one-fifth of a second.

The Type B is admirably suitable for use as battery eliminator, battery charger, constant voltage or constant current rectifier set for electroplating, speed control of motors, automatic voltage control of alternators and dynamos, stabilised heaters supplies for D.C., amplifiers, photometry, arc lamps, and any other type of electronic equipment. It can be used for all stabilised laboratory supplies, and if required supplied for rack mounting.—Winston Electronics, Ltd., 1, Park Road, Hampton Hill, Middlesex.

Vidor Portable

VIDOR have added to their already extensive range of portables by introducing an attaché personal set, the "Lady Margaret," which has several attractive features. It is an ultra-light, high performance portable with handbag dimensions, yet packing enough battery power for a season of outdoor listening.

Despite its small size—8in. by 8in. by 4in.—the new receiver takes 90-volt full-power batteries, boasts a 5in. P.M. speaker and employs four low consumption valves. The combination of long-life batteries and low consumption valves reduces running costs to a minimum never before enjoyed by personal models.

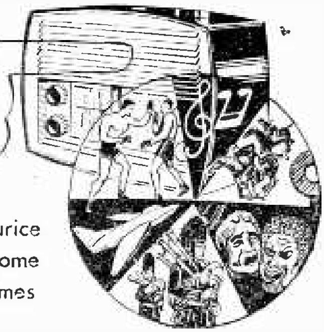
Incorporated in the attaché lid is an external frame aerial with exceptional pick-up properties. Easy accessibility for battery replacement and servicing is provided by the patented hinged front panel. There are two wavebands—187-570 metres and 1086-1986 metres.

The "Lady Margaret" is attractively finished in two-tone silver-grey and scarlet crocodile leatherette. Crystal moulded dials are calibrated in metres and the exclusive Vidor on/off switch is operated automatically by the attaché lid.

Complete with batteries, the set weighs 6¼lbs. The price, lowest in the Vidor range, is 11½ guineas excluding batteries.—Vidor - Burndept Group, Erith, Kent.

The Vidor "Lady Margaret" portable.

Programme Pointers



Our Critic, Maurice Reeve, Reviews Some Recent Programmes

"Should Germany be Re-armed?"

THE programme under the above title was one of the longest and most complicated feature programmes the BBC has put over for some time. It was a two-hour affair with the 9 o'clock news and Eric Barker in "Just Fancy" dividing it in two and aiding digestion, as it were.

A huge "cast" of contributors had been collected —far too lengthy a list to enumerate here—both British and foreign as well as for and against. The narrator was John Snagge, the reporters were Edward Ward for the United Kingdom and Ewan Butler and Colin Wills for abroad, whilst both halves were summarised by Matthew Haltor. Part one, it should be mentioned, was chiefly the views of British leaders and part two of foreign. The programme was started off with a historical background to EDC by Vernon Bartlett and the whole brought to a conclusion by the Foreign Secretary, Mr. Eden.

What was the upshot of it all? Apart from Mr. Eden's concluding words, we were left more or less to form our own opinions and draw our own conclusions. A vast amount of labour must have gone into the compilation and it was most interesting to be veered first from one side and then to the other. High statesmen, soldiers and trade union leaders, peasants and artisans, church dignatories, journalists of distinction; British, French, German, American, etc., all were there and all contributed instructive if not original views. But no one, in my opinion, put forward anything constructive: no one broached the real heart of the matter. It is not for me, of course, on this page, to say what I think that heart was.

I said this feature was punctuated by "Just Fancy." This is written and produced on lines very similar to the recent Peter Ustinov and Peter Jones programmes. The first number was very amusing, with the irrepressible Eric and Pearl Hackney in excellent form. But all first numbers are always good. Will subsequent issues be its equal?

Dame Sybil's Golden Jubilee

Another mammoth production was the tribute to Dame Sybil Thorndyke on the occasion of her Golden Jubilee in the theatre, namely, Shakespeare's "Henry VIII." It seemed as though the whole of the London stage filled the cast. Dame Sybil herself played Queen Catherine; John Gielgud, Ralph Richardson, Laurence Olivier, Ernest Thesiger, Vivien Leigh, Athene Seyler. All were there. This is not one of "our William's" most inspired plays and few of its passages have found their way into the anthologies. Wolsey's "If I had but served my God as I have served my king," etc., is one of the most notable. But many of its pages are scholarly and donnish, even to their real authorship being in some doubt. The production, by Peter Watts and Audrey Cameron, was as good listening as it was a tribute.

"What's It All About?"

Someone wittily remarked fairly recently that, in my own words, one of the most remarkable features of our present civilisation was that small teams were paid large—q.v.—sums to play parlour games to millions of listeners, to whom they were invisible, and to ever-growing numbers of viewers to whom they are static and not actually "playing" at games at all. The latest of these to reach the listening part of the public is "What's It All About?", a "game of detection" in which, to quote the *Radio Times*, "the panel tries to solve a series of curious situations invented by him," namely the deviser, John P. Wynn. The panel is composed of Iris Ashley, Dulcie Gray, Lionel Gamlin and Guy Ramsey, "the characters" being our old friends Charmian Innes and John Cazabon.

From this it will have been gathered that it is run on precisely the same lines as "The Name's the Same," which, I think, is a better show and whose departure from radio programmes is to be regretted. Although witty and amusing up to a point, I doubt if the J. R. Green of the future will give it more than a passing nod. The chairman is the ever-efficient and engaging Brian Johnston.

Mr. V. S. Pritchett, on the Third, delivered an absorbingly searching series of talks under the generic title of "The Comic Elements in the English Novel." A fine novelist himself and obviously a man of wide reading, Mr. Pritchett interested all those who are themselves interested in our vast and famous literature.

Plays

"Arsenic and Old Lace," like all plays of its type, must be seen as well as heard. Those who did see it during its phenominally successful run will remember the essential visual qualities of the quiet comings and goings of the two old ladies in their poisonous machinations. It is not possible to adequately substitute this with the openings and shuttings of "that door" and the various contents of Pandora's "effects" box. Nevertheless, the radio version of Joseph Kesselring's famous farce which Mary Jerrold and Naunton Wayne, with Edmund Willard and Dorothy Green, put over was excellent fun and came off with considerable éclat and punch.

Sophocles' "King Oedipus," in W. B. Yeats' version, made wonderfully powerful entertainment, almost of Third programme quality. Done by the Dublin Abbey Theatre company, it gripped from first to last. The farther back in time we go for our shows, the better they seem.

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We may have the type you require—Drop us a line—Reply by return post.

VALVES GUARANTEED NEW AND BOXED

LOCTALS. 7B7, 7C5, 7C6, 7H7, 7Y4, 7S7, 7Q7. All 8/6 ea.

B7G BATTERY MIDGETS. 1R5, 1T4, 1S4, 1S5. All 7/6 ea. 3S4, 3Q4, 3V4. All 8 6 ea.

BATTERY OCTALS. 1A7GT, 1N5GT, 1H5GT, 3Q5GT. All 10 6 ea. 1C5GT (DL35), 8/6 ea.

MAINS MINIATURES. 6AL5, 7/-; 6AM5, 9/-; 6AM6, 7/6; 6AT6, 9/-; 6BE6, 9/-; 6C4, 8/-; 9D6, 9/-; 12AT7, 9/-; 12AU7, 9/-; 12AX7, 9/-; R12 (EV51), 13/6.

MAINS OCTALS. 5U4G, 8/6; 5Z4G, 8 6; 6A8G, 9 6; 6F6G, 7/6; 6H6GT, 4 -; 6J5GT, 5/6; 6J7G, 6 6; 6K7G, 6 -; 6K8G, 8/9; 6L6G, 9/-; 6L7, 7/6; 6SL7GT, 8 -; 6SN7, 9/-; 6U5G, 8 6; 6X5GT, 7/6.

B8A RANGE. ECH42, 10/6; EF41, 10/-; EF42, 10/6; EAF42, 11/6; EB41, 10 -; EBC41, 11/-; EL41, 10/6; EL42, 11/6; EZ40, 10/6; EZ41, 10/6; UAF42, 11 6; UB41, 10 -; UBC41, 11/-.

MISCELLANEOUS. OZ4, 6/-; 2X2, 5 -; 4D1, 2/9; 954, 2/-; 955, 4 9; 956, 3/6; 9001, 6/-; 9002, 6 -; 9003, 6 -; 9004, 6 -; EF8, 6/6; EK32, 8/-; VR150/30, 9/-; VR105/30, 9/-; AC6 PEN, 5 6; E1148, 2/-; EF36, 6 6; H30, 8/-; KT2, 5/-; PX25, 15/-; MS PEN, 5 -; PEN25, 8/-; VP23, 5 6; PEN46, 8 6; PEN220A, 4/9; QP22B, 7 6; U22, 8 -; U25, 15 -; EF39, 6 6; EBC33, 7/6; SP61, 3/9; SP41, 3 6; EF50, 6/-; EF50 (Syl), 8/-; EF54, 7/-; EC52, 5/9; VU111, 3 6; VU120A, 3 6; X65, 10/-.

RECTIFIERS. VU64 (U14), 8/6; VU39 (MU14), 8/6; U18/20 (FW4/500), 9/9; 35Z4GT, 8 6.

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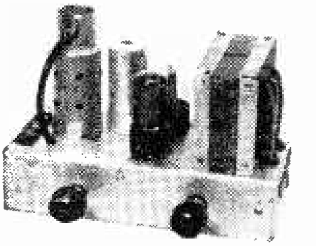
B7G RANGE. EF91, 7/6; EF92, 8/6; EB91, 7/-; EL90, 9/-; EL91, 9/-; EY51, 9/-.

B9A RANGE. PL81, 13 6; PL82, 11/6; PY80, 10 6; EBF80, 11 6; EF80, 11/6; ECL80, 11 6; PY81, 10/6; PY82, 10 6.

12A6, 6/9; 12C8, 8/-; 12K7, 9/-; 12Q7, 9/-; 12K8, 9/-; 12SG7, 5/6; 12SH7, 5/-; 12SJ7, 7/6; 12SK7, 6 6; 12SQ7, 8 6; 25A6G, 9 -; 25L6GT, 8 6; 25Z4, 9/-; 25Z6, 8 6; 35L6GT, 8/9; 35Z4, 8/6; 50L6GT, 8/6; 10LD11, 11/-; CL33, 11/-; EF55, 10/-.



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3 valves (6B8G 6V6GT 6X5GT) A.C. mains fully isolated neg. feed back (voltage and current), controlled, volume and tone, dual input nets. work. for modern crystal or Hi-Fi, magna. Less than 1 per cent. total 2nd and 3rd harmonic distortion at 3 watts output from 1 000 C.P.S. Complete ready for use. 79 6. Post extra.

HEADPHONES

Type CLR. Low resistance 120Ω. 7/6 pair.
Type CHR. High resistance 4,000Ω, 11/- pair.
Type DHR, a super job, 13 9 pair.
Headbands, wide type, 1 9 each.
Headbands, by Trimm Radio Mfg. Co., Chicago, U.S.A., 1,200Ω each earpiece, light headband complete with lead and Igranic jack plug, 13/6 pair.

SPECIAL PURCHASE

Volume controls with switch. All 2/- each

Single Pole switch : 20kΩ, 100kΩ, ¼ megΩ, 1 megΩ, ½ megΩ.
Double pole switch : 50kΩ, ½ megΩ.
All by well known makers. Suitable for TV, etc.

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HYDROMETER by Exide (Canada), complete in wood case, 7 6 each.
BELL TRANSFORMER "CONCORDIA." 3 v., 5 v., 8 v., 1 amp fused. In bakelite case, 8/6 each.

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Control knobs, clearly engraved in gold. Size "A" diameter 1⅝in. : Size "B" diameter 1⅛in. Both in two colours, Walnut or Cream. Inscriptions available.

RADIO : "Volume," "Vol. On/Off," "Wavechange," "On/Off," "Tuning," "SML Gram," "Radiogram," "Tone."

TELEVISION : "Contrast," "Brilliance On/Off" "Focus," "Brightness."

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TAPE RECORDER : Record/Play. Prices : Size "A." 1/6 ; "B," 1 2. Plain knobs can be supplied in either size, 1 - each and 8d. each respectively.

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MT1. Primary 0-210-220-250 v. Secondary 250-0-250 v. 80 mA., 6.3 v. 4 amps., 5 v. 2 amps., with taps at 4 v. on filament winding. **Price 17 6** each.

MT2. Primary 0-210-230-250 v. Secondary 250-0-250 v. 80 mA. 6.3 v. 4 amps. 5 v. 2 amps. Both filament windings tapped 4 v. Price **17/6** each.

MT3. 30 volt 2 amp. tappings as follows : 3, 4, 5 6, 8, 9, 10, 12, 15, 18, 20, 24 v. **17 6** each.

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The following is a selection from our stocks of manufacturers' surplus condensers all by well-known makers. DUBILIER, B.I., BEC (EDISWAN), SPRAGUE, etc.

Aluminium Can Types. Clip Fixing	
8 x 8 mfd. 450 v.	4/-
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16 mfd. 450 v.	3/-
16 x 8 mfd. 350 v.	4/-
16 x 16 mfd. 350 v.	3/3
20 x 20 mfd. 500 v.	4/9
24 mfd. 450 v.	2/9
25 x 16 mfd. 350 v.	3/6
32 x 8 mfd. 350 v.	3/6
32 x 16 mfd. 350 v.	4/6
32 x 32 mfd. 450 v.	6/11
32 x 32 x 8 mA. 350 v.	5/6
32 x 32 mfd. 350 v. 25 mA. 25 v.	5/9
64 mfd. 350 v.	2/-

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B.R.850 8 mfd. 500 v.	2/9 ea.
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2 mfd. 350 v.	1 9
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Contains EK32 ; 4 EF39 ; 6H6 ; 6J5 ; 3 SP61 ; P61 in good condition. Fitted with tuning meter. Slow-motion drive calibrated dial complete with circuit diagram. 49/6 each. Carriage and packing, 7/6.

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8 mfd. 450 v. cardboard covered	1/11
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12 mfd. 50 v.	1/-
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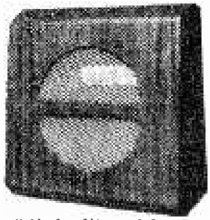
100 mfd. 12 v.	1/9
100 mfd. 25 v.	1/9

Wire Ended Types Cardboard Covered	
25 mfd. 25 v.	1/9
50 mfd. 12 v.	1/9
50 mfd. 50 v.	2/3

LOUDSPEAKER CABINETS



Available for 6½in. and 8in. Speaker units. Polished walnut finish. A very attractive cabinet at quarter of to-day's prices.
Price : 6½in. Type Cabinet. 15/6 each.
Price : 8in. Type Cabinet. 19/6 each.
See page 515 under loudspeakers for suitable speaker units.

"AEROVOX" Condenser Clips, **1d.** each.

HIGH VOLTAGE CONDENSER. .01 mfd. 5 kV. D.C. working.

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PUSH BACK WIRE. Size 7/012. Available in colours, blue, green, red. Price **2½d.** yard.

RECORDING TAPE. 1,200ft. Wound on a "Cyldon" reel. **19/6** each.

NEEDLE CLIPS, 1d. each.

"WHANDA" Wire and Cable Stripper. To strip cable of diameters ⅛in., ¼in., ⅜in., ideal for coaxial cable, **5 -** each.

NYLON BRAIDED DRIVE CORD. 25 yd. reels. **1/9** each.

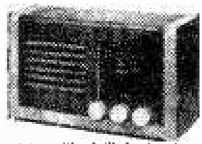
AMERICAN RELAY. 45Ω Impedance with leads No. AZ0545. Price **1/9** each.

IRON LEADS. Black and white flat iron leads, bonded ends. **1/3** each.

POTENTIOMETER PANEL. 4 Potentiometers on panel. 50 k. S.P.S. : 750 W/W : 25 k. carbon ; 5 k. W/W. All with long spindle, with leads of different colours terminating in an 11-pin plug. Price **7/6** each.

SLEEVING. 4 mm. Permanoid insulation. **4d.** yd. Varnished cotton, 1 mm. yellow only. **1½d.** yd. 1 mm. sleeving, various colours **1d.** yd. Regret this has to be our choice of colours at this special price.

FOR BUILDING- T.R.F. OR SUPER-HET. THIS IS THE MOST POPULAR CABINET ON SALE TO-DAY



Complete with drilled chassis, dial, back plate, pointer, dial drive and drum, etc. Price 27/6. Post 2/-.

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Open to Discussion

"The First Twelve Years"

SIR,—Mr. H. E. Adshead, in your issue for July, suggests that I write a postscript to my articles about the early days of amateur wireless.

He refers in particular to the possibility of any museums or collectors who might be interested in early amateur equipment.

This might well be a matter worthy of consideration by the R.S.G.B. and, if time permitted, I would suggest that such a collection might be a most attractive exhibit at the next exhibition held by the society.

In regard to the matter of range of reception of some of this early equipment, both I and one of my friends took signals from Newfoundland in 1913 on a straight crystal receiver. I seem to remember that the wavelength was 10,000 metres!

Finally, I suggest that "early" equipment should be that which was in use before 1914.—C. H. GARDNER (Twickenham).

Valve Tester Request

SIR,—Wholeheartedly I agree with the recent request under "Open to Discussion," namely, for a valve tester. When I look through all my back numbers I cannot find any copy dealing with such an instrument; it does seem to have been sadly neglected.

In my opinion what we need is a first-class mains (A.C.) operated instrument capable of measuring mutual conductance per volt, also emission on rectifiers and diodes with A.C. voltage applied to all electrodes. This arrangement would dispense with electrolytic condensers and rectifier.—J. PETERS (Birmingham, 26).

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 receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of cover.

Germanium Crystals

SIR,—Having recently made up a small local station set for quality, I thought of using a push-pull double crystal for the detector as suggested in the July issue. I used an R.F. stage feeding the crystal combination. The output is high and quality excellent, but the two crystals damp the circuit heavily. It was necessary to apply the crystals to a centre tap and the R.F. feed to the top of the coil through a 100 pF. condenser.

I bought four G.E.C. germanium ungraded crystals, which sell from 1s. 6d. to 3s., and measured them. Other experimenters might like to know the results. 1. Excellent high back res. 2. Not so good—medium back res. 3 and 4. Almost useless; evidently tolerance rejects from crystals made for telephone modulators. These are really non-linear resistances rather than rectifiers. The resistance is low in the forward direction and a bit higher in the reverse direction.

As these types of crystal rejects form the bulk of those on the market, and there is no way of telling the good from the useless, it is better to buy the proper branded rectifiers, probably cheaper in the end.

A peculiarity I noticed about two of these crystals is that the back res. varies. When the reverse voltage is applied the true back resistance takes several seconds to fall to its true value. This is evidently due to the storage of electrons and must cause some distortion.

It is probable that all germanium crystals suffer from this effect to some degree so that the outputs would be less perfect than expected.—WM. J. LAW (Ealing, W.5).

Radio Sales Losses

SIR,—As a subscriber, I read with interest Mr. Gardner's letter in the May issue under the above title.

I recently saw an old advertisement from a 1946 handbook for a communications receiver. In 1946 this cost about £6 (to hams). How about it? I am sure there would be a good demand if price were kept to about £10 to £15.—A. H. MARTIN (Wolverhampton).

Those Old Components

SIR,—I would like to see one or two circuits with 4 volt heaters included. I know nearly all modern technique involves 6 volt heaters, but there are a lot of old radio sets still with 4 volt heaters and it is to this junk that I refer. I come of the lower income group and costly modern equipment is beyond my pocket. It is therefore these old components that I rely on for my practical experience in radio engineering. What about it, P.W. Boffins?—P. L. KNIGHT (Heywood).

"Noisy Reception"

SIR,—With reference to Mr. F. E. Apps's article "Noisy Reception" in your August, 1954, issue, I should like to make a few observations on the paragraph dealing with thermal agitation (Johnson) noise, with particular reference to the expression :—

$$E_{RMS} = \sqrt{4KTR\,(AF)}\text{ Volts.}$$

I should like to point out that K= Boltzmann's constant, is given by 1.37×10^{-23} joules per degree abs. (and not 1.37×10^{-28} as stated). Further, in the above expression we consider the bandwidth (in c/s.) over which the equipment is operating, and *not* the frequency of operation. This is because, as the distribution of noise extends over a very wide frequency range, the value of noise voltage depends on the bandwidth concerned. In practice this is measured between the "half-power points" of the particular apparatus, i.e., between the points on its response curve that are −3 db. with respect to maximum output.

Finally, the above expression may be simplified by considering $T = 290^{\circ}$ K (17° C), hence we have :—

$$E_{RMS} = 4 \times 10^{-3} \sqrt{R.\ (AF)}$$

where E is in microvolts
R is in ohms and
AF is in kc/s.

making substitution into this equation a much easier process.—R. G. MATTHEWS (Billericay).

Amateur Transmitting

SIR,—I am not an amateur but I would like to say a little about the need for tests, etc., for amateur transmitting licences.

In the early days of wireless, anyone could put a few bits and pieces together and go on the air. When the *Titanic* disaster occurred, all the contemporary hams got on the air, plus a few others, trying to " help." Result—chaos ! This affair showed the need, if it really needed showing, for some international ruling on such transmissions.

Our own P.M.G. did not think up what some moronic types consider to be unnecessary regulations when he was in a spiteful mood. It was laid down by international regulations. This includes the regulations concerning morse, too.

A previous correspondent of yours pointed this fact out, and that, to my mind, should have stilled the thoughts of a fairly big proportion of those who have since written to you.

Perhaps Hector Cole, and others like him, consider such things as motor car licences, aeroplane licences, etc., are also unnecessary. Or perhaps they are mentally still of the age which delights in using such phrases as " mutual admiration society," " licking the hand of authority," etc. If so, they are just too young to understand. ARCHD. G. DARLING (Glasgow).

Rotary Switch Hint

SIR,—I have a practical hint which you may consider to be of interest to constructors.

It concerns the well-known four-pole three-way miniature rotary switch which appears to be in good supply. With a little modification, any one of the following switching combinations can be made :— 2 p. 4 w., 2 p. 5 w., 1 p. 6 w., 1 p. 7 w., 1 p. 8 w., 1 p. 9 w., 1 p. 10 w., and 1 p. 11 w., mostly types which I believe to be unobtainable in the miniature range and yet very handy for use in compact items of test equipment.

Inspection of the standard 4 p. 3 w. type shows that a number of unused stop tabs are available, also the wafer can be easily removed to facilitate clipping off sliders and replaced.

By bending up appropriate stop tabs, clipping off one, two or three sliders (dependent on switch combination required) and strapping pole tags together, any one of the above switch combinations can be made. Care should be taken with the 2 p. 5 w. combination to ensure that the selected slider does not rotate over three of the original poles.—R. A. POOLE (Newark).

"Mathematics and the Service Engineer"

SIR,—I read with some surprise and amusement the article " Mathematics and the Service Engineer " (May, 1954), in which the author assumes that a person holding the O.N.C. is capable only of solving simple arithmetical problems and that he requires something more. The subjects that he suggests necessary are in fact covered in the first year of the O.N.C.—T. MASON (Chadwell Heath).

Plastic Containers

SIR,—With post-war developments in the plastics industry a large variety of plastic containers have become used in the retail of toilet and cosmetic accessories, etc. I have found that by drilling small holes in the bottoms of suitably designed boxes and inserting terminals, useful fuse boxes and protection caps for high potential terminals can be constructed quickly and cheaply.—M. BASSEY (Orpington).

Beginner's Guide to Radio

SIR,—The first article in the new series introduced me to your journal and also to the joys of radio construction. I suppose the series must come to an end sometime, but I, for one, shall regret it.—K. V. H. (Hampstead).

MAINS SUPPLIES FOR BATTERY VALVES

(*Continued from page* 562)

3. Apply H.T. but with a milliameter and a 10 kΩ potentiometer in series with the H.T. positive lead. The series resistance may be gradually shorted out and it will soon become apparent whether or not the normal H.T. current is going to flow. In a standard four-valve superhet this should be between 7 and 10 milliamps with 69 volts H.T. and 10 to 14 milliamps with 90 volts.

4. When checking voltages on the B7G valveholder tags, slip a piece of insulating sleeve over the probe (or screwdriver shaft) so that only about 1/32in. of bare metal is showing at the tip. This will minimise the risk of inadvertent interconnection of tags at H.T. and L.T. potentials.

5. When first trying out a mains unit, always disconnect the valve heater chain and H.T. leads and substitute dummy resistive loads. (150Ω and 10 kΩ should be used in place of the valve heaters and H.T. drain respectively in the case of the A.C./D.C. unit described above.) Voltage measurements should then be made to ascertain whether it is safe to operate the valves.

6. Mount sockets from old batteries in the receiver. When no batteries are available and it is desired to run the set from the mains, the leads normally plugged into the batteries may be safely housed in the sockets and possible damage prevented.

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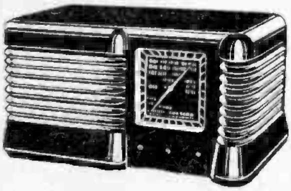
The Editor will be pleased to consider articles of a practical nature suitable for publication in " Practical Wireless." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts,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

PLASTIC CABINET as illustrated, 11½ x 6½ x 5½in., in walnut, cream, or green. ALSO IN POLISHED WALNUT, complete with T.R.F. chassis, 2 waveband scale, station names, new waveband, backplate, drum, pointer, spring, drive spindle, 3 knobs and back, 22/6. P. & P., 3/6.

As above with Superhet Chassis, 23/6. P. & P., 3/6.

As above complete with new 5in. speaker to fit and O.P. trans., 35/-. P. & P. 3/6 with Superhet Chassis, 36/-. P. & P. 3/6.



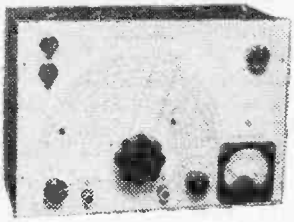
Used metal rectifier, 230 v. 50mA., 3/6 ; gang with trimmers, 6/6 ; M. & L. T.R.F. coils, 5/- ; 3 Govt. valves, 3 v/h and circuit, 4/6 ; heater trans., 6/- ; volume control with switch, 3/6 ; wave-change switch, 2/- ; 32 x 32 mfd., 4/- ; bias condenser, 1/- ; resistor kit, 2/- ; condenser kit, 4/-.

M & L Superhet Coils with circuit, 6/6 ; iron cored 465 IFs, 7/6 ; min. gang, 5/6 ; volume control with switch, 4/- ; wave-change switch, 2/6 ; heater trans., 7/6 ; 4 v/h, 1/6 ; 4 Ex Govt. valves, metal rectifier and Xtal diode with circuit, 14/6 ; 25 x 25 mfd., 1/- ; 16 x 16 mfd., 3/3 ; condenser kit (17), 7/6 ; resistor kit (14), 3/6.

All dry A.C. mains battery unit, 200/250 v. Metal case size 8 x 5 x 3in., by famous manufacturer incorporating Westinghouse metal rectifiers, 3 500 mfd., 16+24 mfd. mains trans., 3 smoothing chokes, output 90 v. 10 mA., 1.4 v., .25 amp. P. & P. 2/6. 39/6.

COMPLETELY BUILT SIGNAL GENERATOR

Coverage 120 Kc/s-320 Kc/s., 300 Kc/s-900 Kc/s., 900 Kc/s-2.75 Mc/s., 2.75 Mc/s-8.5 Mc/s., 8.5 Mc/s-25 Mc/s., 17 Mc/s-50 Mc/s., 25.5 Mc/s.-75 Mc/s. Metal case 10 x 6½ x 4½in., size of scale 6½ x 3½in., 2 valves and rectifier. A.C. mains 230/250 v. Internal modulation 400 c.p.s. to a depth of 30%. Modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel. £4/19/6, or 34/- deposit and 3 monthly payments of 25/-. Post and Packing 4/- extra.



High impedance plastic recording tape by famous manufacturer. 1,200 feet complete on spool, 17/6. P. & P. 1/6. 600 feet 8/-. P. & P. 1/-.

Pr. 200/250 v., secondary 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volt at 2 amps. 13/-.

Drop thro' 280-0-280, 200 mA., 6 v. 5 amps., 5 v. 3 amps., 27/6.

Heater Transformer. Pri. 230-250 v. 6 v. 1½ amp., 6/- ; 2 v. 2½ amp., 5/-.

R.I. MAINS TRANSFORMERS, chassis mounting, feet and voltage panel. Primaries 200/250.

350-0-350 75 mA. 6.3 v. 3 a. tap 4 v. 6.3 v. 1 a., 13/6.

350-0-350 70 mA. 4 v. 5 a. 4 v. 2.5 a., C.T., 18/6. P. & P. on above transformers 2/-.

500-0-500 120 mA. 4 v. C.T. 4 a. 4 v. C.T. 4 a. 4 v. C.T. 2.5 a., 27/6.

500-0-500 250 mA. 4 v. C.T. 5 a. 4 v. C.T. 5 a. 4 v. C.T. 4 a., 39/6.

P. & P. on the above transformers 3/-.

32 mfd., 350 wkg.	2/-
16 x 24 350 wkg.	4/-
4 mfd. 200 wkg.	1/3
40 mfd., 450 wkg.	3/6
16 x 8 mfd., 500 wkg.	4/6
16 x 16 mfd., 500 wkg.	5/9
8 x 16 mfd., 450 wkg.	3/9
32 x 23 mfd., 350 wkg.	4/-
32 x 32 mfd., 350 wkg. and 25 mfd., 25 wkg.	6/6
25 mfd., 25 wkg.	11d.
250 mfd., 12 v. wkg.	1/-
16 mfd., 500 wkg. wire ends	3/3
8 mfd., 500 v. wkg., wire ends	2/6
8 mfd., 350 v. wkg., tag ends	1/6
50 mfd., 25 v. wkg., wire ends	1/9
100 mfd., 350 wkg.	4/-
100+200 mfd., 350 wkg.	9/6
16+16 mfd., 350 wkg.	3/3
Ex Govt. 8 mfd. 500 v. wkg., size 3½ x 1½, 2 for	2/6
60+100 mfd., 280 v. wkg.	7/-
16+32 mfd., 350 wkg.	6/-
50 mfd., 180 wkg.	1/9
65 mfd., 220 wkg.	1/6
8 mfd., 150 wkg.	1/6
60+100 mfd., 280 wkg.	8/6
50 mfd., 12 wkg.	11d.
32+32 mfd., min., 275 wkg.	4/-
50 mfd., 50 wkg. 8 mfd., wkg., wire ends	1/9
Miniature wire ends moulded 100 pf., 500 pf., and .001 ea	7d.

CONSTRUCTOR'S PARCEL, comprising chassis 12½ x 8 x 2in., cad. plated 18 gauge, v/h., IF and trans. cut-outs, backplate, 2 supporting brackets, 3 waveband scale, new wavelength station names. Size of scale 11½ x 4½in., drive spindle, drum, 2 pulleys, pointer, 2 bulb holders, 5 paxolin international octal valve holders, 4 knobs, and pair of 465 IFs, 16/6. P. & P. 1/9.

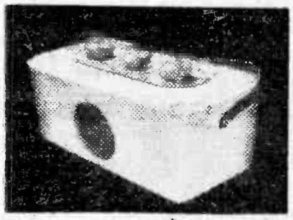
AS ABOVE, but complete with 16+16 mfd. 350 wkg. and semi-shrouded drop thro' 250-0-250 60 m a., 6 v. 3 amp. Pri. 200-250, and twin-gang, 31/6. P. & P. 3/-.

Trimmers, 5-40 pf., 5d. ; 10-100, 10-250, 10-450 pf., 10d.

Germanium crystal diode, 1/6, post paid.

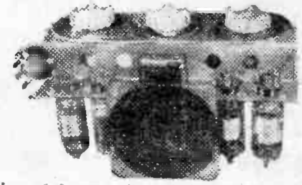
PATTERN GENERATOR 40-70 Mc/s. direct calibration, checks frame and line time base, frequency and linearity, vision channel alignment, sound channel and sound rejection circuits, and vision channel band width. Silver plated coils, black crackle finished case, 10 x 6½ x 4½in. and white front panel. A.C. mains 200/250 volts. This instrument will align any TV. receiver. Cash price, £3.19.6 or £1.9.0 deposit and 3 monthly payments of £1. Post and packing 4/- extra.

TV. CONVERTER for the new commercial stations, complete with 2 valves. Frequency :—can be set to any channel within the 186-196 Mc/s. band. I.F. :—will work into any existing TV. receiver, designed to work between 42-68 Mc/s. Sensitivity 10 Mu v. with any normal TV. set. Input :—arranged for 300 ohm feeder. 80 ohm feeder can be used with slight reduction in R.F. gain. Circuit EF80 as local oscillator, ECC81 as R.F. amplifier and mixer. The gain of the first stage, grounded grid R.F. amplifier, 10 db. Requires power supply of 200 v. D.C. at 25 mA., 6.3 v. A.C. at 0.6 amp. Input filter ensuring complete freedom from unwanted signals. 2 simple adjustments only. £2.10.0 Post and packing 2/6.



PERSONAL PORTABLE CABINET in cream-coloured plastic, size 7 x 4½ x 3in. Complete 4-valve chassis. Scale and 3 knobs. Takes miniature 90 v. and 7½ v. batteries. 10/-. P. & P. 2/-.

3in. P.M. SPEAKER to fit above, 10/-. Miniature output transformer, 5/-. Miniature wave-change switch, 2/-. Miniature 1-pole 4-way used as Volume and Off, 2/-. 4 B7G valveholders, 2/4. Midget twin gang 1in. dia., 2in. long and pair medium and long-wave T.R.F. coils 1in. long x 1in. wide ; complete with 4-valve all-dry mains and battery circuit, 2/6. Condenser Kit, comprising 11 miniature condensers, 3/6. Resistor Kit, comprising 15 miniature resistors, 4/6. 25 x 25 mfd., 1/6. P. & P. 2/6. Valves to suit above 10/- ea. Point to Point Wiring Diagram 1/-.



View of chassis as it would look when assembled with valves inserted.

Extension speaker cabinet, in contrasting walnut veneers, size 15 x 10½in. Will take 6½ or 8in. speaker, 17/6. P. & P. 2/-.

Volume Controls. Long spindle less switch, 50 K., 500 K., 1 meg. 2/6 each. P. & P. 3d. each.

Volume Controls. Long spindle and switch, ¼, ½, 1 and 2 meg., 4/- each ; 10 K. and 50 K., 3/6 each. ½ and 1 meg., long spindle, double pole switch, miniature, 5/-.

Standard Wave-change Switches, 4-pole 3-way, 1/9 ; 5-pole 3-way, 1/9. Miniature 3-pole 4-way 4-pole 3-way, 2/6.

Valveholders. Paxolin octal, 4d. Moulded octal, 7d. EF50, 7d. Moulded B7G, 7d. Loctal amphenol, 7d. Loctal pax., 4d. Mazda Amph., 7d. Mazda pax., 4d. B8A, B9A amphenol, 7d. B7G with screening can, 1/6. Duodecal paxolin, 9d.

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Midget .00037 dust cover and trimmers, 8/6.

P.M. SPEAKERS

	with trans.	less trans.
3½in.		13/6
5in.	16/6	12/6
6½in.	16/6	12/6
8in.	18/6	15/-
10in.		19/6

Post and packing on each of the above, 1/6 extra.

RADIOGRAM CHASSIS.—5 valve A.C./D.C. 3-way band superhet, 195/255 volts 19-49, 200/550 and 1,000-2,000 metres, fly-wheel tuning frequency, 470 K/cs iron-cored coils and IFs. Size of chassis, 13 x 6½ x 2½. Complete with valves and 8in. P.W. speaker, p. & p., 5/-, £8/17/6.

Terms of business : Cash with order. Dispatch of goods within three days from receipt of order. Where post and packing charge is not stated, please add 1/6 up to 10/-, 2/- up to £1, and 2/6 up to £2. All enquiries S.A.E. Lists 5d. each.

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