POCKET RECEIVER DESIGN

Practical Wireless

9D EVERY MONTH

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PRINCIPAL CONTENTS

Practical Wireless

15th YEAR OF ISSUE

EVERY MONTH
VOL. XXIII. No. 488. FEBRUARY, 1947.

and PRACTICAL TELEVISION

Editor F. J. CAMM

COMMENTS OF THE MONTH. BY THE EDITOR

Television Screens

THE sizes of the screens of television sets for home use are almost entirely dependent on what can be produced by means of the cathode-ray tube as the reproducing medium. Opinions are still divided as to what constitutes an ideal picture size and no one has yet decided on a standard.

At present picture sizes range from 8in. to 12in. wide, and the public reaction to this is that the pictures are too small.

It has been suggested that the problem can be attacked along three main lines of approach. In the first an average size of a viewer's sitting-room is assumed and also that the picture is required to fill the angle of vision within which the eye can concentrate its attention.

At a recent discussion at a meeting of the Radio Section of the I.E.E. supporting figures were given which show that the picture size and technical standards required for this line of approach are both excessive.

In the second method of attack, which also assumes average sitting-room dimensions, the size of the picture is based on the attainment of true perspective, and this is an aspect which has hitherto been neglected.

The third method, with a viewing distance standardised as above, selects the technical standards of values which are assumed to be the maximum economically possible, and from these the picture size will be determined.

Figures were given to prove that the picture size resulting from this approach whilst giving reasonable results does not attain true perspective. It would, therefore, appear to be feasible to endeavour to attain true perspective by adjusting the conditions of television production to suit the picture size deduced in this way.

In all cases, it has been found that pictures produced by directly-viewed cathode-ray tubes in this way are not practicable, as the minimum size picture suggested is 2ft. 6in. wide.

The discussion shed light on the possibility of producing at reasonable costs television receivers for the home giving pictures of this width, presumably by some means involving projection.

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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.

Most of the speakers in the discussion agreed generally with these views. It was agreed that the comfort of the viewer was the primary consideration, and that it was more restful to look at a large picture at an appropriate distance than at a small one close at hand, because the eyes are more nearly then focused to infinity.

In the case of the cinema it has been found that the optimum viewing distance varies from four to eight times the picture height. Applying this fact to television a picture size of 20in. by 16in., for viewing at 8ft., is arrived at, and this is considered a convenient distance for average living-rooms.

There was lack of unanimity of experiences with various viewers and cases were quoted where the viewing distance preferred by individuals varied from 18in. to 6ft., for a picture of 12in. width. There was some evidence that the preferred distance decreases with the age of the viewer, and hence it might be expected to be a function of the individual eyesight.

Other speakers felt that the viewing distance should be based on the acuity of the eye, and be such that the line structure was just invisible. This leads, however, to impractically great viewing distances, unless the number of lines is greatly increased. The lines needed are inversely proportional to the acuity, and when this is one of arc about 900 lines are required.

It was also suggested by one speaker that special spectacles should be used to give the effect of long-distance viewing from a conveniently short distance. Other speakers pleaded for a standardised picture size, so that the studio producer could work to a known standard, and take into account the differences between the camera and the viewer's viewing angles when arranging the set.

Another suggested that the picture size desired was largely determined by psychological considerations.

We think, however, that the general public will decide what size of picture it wants. In any case we are astonished that the discussion did not deal with the very low depth of focus, and the edge distortion, which are defects of all television receivers we have seen to date.

ROUND THE WORLD OF WIRELESS

Post Office Appointment

THE Postmaster-General, the Right Honourable the Earl of Listowel, has appointed Mr. R. E. German to be his Principal Private Secretary, Secretary of the Post Office Board and of the Post Office Advisory Council.

Commercial Television Contract

TWO U.S. business firms have signed a contract by television and described the deal as the first of its kind. The contract is between the Chevrolet motor division of General Motors and Du Mont television for a series of 1947 television programmes which Chevrolet will sponsor.

Broadcast Receiving Licences

THE following statement shows the approximate number of licences issued during the year ended October 31st, 1946.

Region	*Number*
London Postal	2,041,000
Home Counties	1,363,000
Midland	1,543,000
North Eastern	1,644,000
North Western	1,415,000
South Western	890,000
Welsh and Border	617,000
Total England and Wales	9,513,000
Scotland	1,032,000
Northern Ireland	153,000
GRAND TOTAL	10,698,000

Radio Control

THE G.P.O. announce an additional frequency band for the use of radio control transmitters. Although only a provisional allotment they state that "frequencies that may be definitely assigned for this purpose at a later date will be, so far as can be seen at present, of the same order."

The new band is 27.66 to 28 Mc/s. The original frequency was 460.5 Mc/s.

Radiolympia

THE Radio Industry Council have announced the official date for the first post-war Radiolympia exhibition. This will be held in the Olympia Grand and National Halls from Wednesday, October 1st until Saturday, October 11th, with a possibility of a trade pre-view on Tuesday, September 30th. It is stated that with costs nearly three times their pre-war figure it will not be possible to decorate and illuminate the exhibition on the same scale as preceding shows, but as a compensation working exhibits and demonstrations will be employed on a much greater scale to attract and interest visitors.

A.R.R.L. Official News

AS most amateurs know, official A.R.R.L. bulletins are broadcast from station W1AW. A new schedule recently came into force as follows:

Tuesday-Saturday, 01.00-04.30 G.M.T.
Sunday, 06.00 G.M.T.
Monday, 01.00 G.M.T.

The frequencies used are:

C.W.:	3.555 Mc/s	'Phone:	3.950 Mc/s
	7.145 ,,		7.145 ,,
	14.150 ,,		14.280 ,,
	29.060 ,,		52.000 ,,
	52.000 ,,		

U.N.O. Broadcasts

REGULAR broadcasts can be heard in this country from the United Nations Assembly proceedings. There are three broadcasts: (1) continual broadcasts of the proceedings with official running commentaries in English and French beamed to Europe, S. America and the Far East; (2) official reports on the day's progress in the other three official languages—Russian, Chinese and Spanish—beamed to the respective countries; and (3) broadcasts of other U.N.O. material, especially despatches by European radio correspondents, beamed to Europe.

The live transmissions carrying the proceedings may be heard between 4 p.m. and 6.30 p.m. on the 13, 16, 19 and 22 metre bands, and between 10 p.m. and 11.30 p.m. on the 19, 22, 25, 30 and 48 metre bands.

Multiple Relay System

A DEMONSTRATION was recently given at an inauguration of a relay service in Rugby designed and perfected by Multi-Broadcast (Eng.), Ltd., in conjunction with the B.T.H. Co., Ltd. In this system subscribers are provided with a cabinet speaker and a 3-valve (plus rectifier) receiving unit designed for A.C. operation. The controls comprise a 6-way programme selector switch and a volume control. Between the subscribers' homes and the central diffusion point there are only the standard single pair of wires. Over this single pair up to six programmes may be carried. It is understood that gramophone pick-up sockets will be fitted to the receiving units.

During rescue work in the underground railway accident in London at the end of the recent year, firemen above ground kept in touch with rescuers underground by walkie-talkie radio.

Centimetre Waves

THE G.P.O. have released for amateur use the 2,300 to 2,450 Mc/s band. Input power is limited to 25 watts, and F.M., but not pulse, transmission is permitted.

Licence Check-up

WHEN it was recently announced that the G.P.O. would make a broadcast licence check-up in the Preston area, 282 people renewed their licences and 82 took out new licences. These figures compare with a daily average of 180 renewals and 12 new licences.

P.A. to be Banned?

A SUGGESTION has been made in Glasgow that loudspeaker publicity of various kinds can be an annoyance to the public. The magistrates have therefore ordered a sub-committee to investigate the activities of publicity concerns using this method with a view to later action.

N. American Amateur Bands

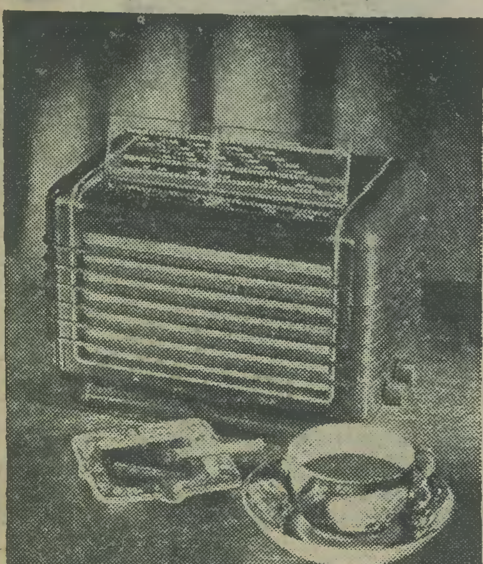
THE F.C.C. has restored the full widths of the 20 and 40 metre bands for American amateurs. The additional frequencies (at the moment for C.W. only) now give the following frequency ranges for use: 14.0 to 14.4 Mc/s and 7.0 to 7.3 Mc/s. The question of permitting 'phone in the 40 metre band and of extending the permitted 'phone portion of the 20 metre band is being given consideration.

Philips 209U Receiver

PHILIPS LAMPS, LTD. (Radio Division), announce the introduction of a new radio known as the 209U, illustrated below.

Although much smaller in size than the usual Philips design, its performance leaves nothing to be desired. It is in no sense a "midget" set although it will cover no more than a quarto sheet of writing paper. It has three wavebands, short, medium and long.

The 209U has an internal plate aerial which makes an outdoor aerial unnecessary in most cases, and is therefore a truly "portable" mains receiver.



A new receiver by Philips.

Fishing by Radio

A DEVELOPMENT of the Echo sounding device has been produced to aid fishing. The system was discovered during the war by British warship crews when they were detecting U-boats. They noticed that the recording device located shoals of fish with great accuracy. More than 500 orders from Scandinavia have been received for the apparatus and hundreds of British ships are also being fitted.

Radio Telephone Links

NINE radiotelephone circuits now connect the West Indian islands, Cable and Wireless (West Indies), Ltd., having recently opened a direct circuit between St. Kitts and St. Maarten in the Leeward Islands.

A Novel Receiver

RECENTLY exhibited at the "Export Only" Show in London was a new type of receiver, seen here. A chromium ball contains the receiver and speaker. The "dial" or waveband scale runs round the centre of the sphere, and the loudspeaker is situated at the top, with a grille worked into the general design. The controls are on the supporting stem. The receiver should be available in this country later, and the price will be 14 guineas.

A novel new type of receiver—the Emor.

Radiotelephone Service with s.s. "America"

THE Postmaster-General announces that telephone service is now available with the s.s. "America."

The service is operated from 7.15 a.m. to 9.15 a.m. and from 12 noon to 8 p.m., G.M.T., daily except Sundays, and the charges for calls are the same as in the telephone service with British liners, namely £1 16s. (minimum for a three-minute call) until the vessel is approximately halfway across the Atlantic and £3 12s. when the ship is beyond that distance.

Vice-Admiral J. W. S. Dorling Honoured

THE President of the United States of America has honoured Vice-Admiral J. W. S. Dorling, C.B., M.I.E.E., Director of the Radio Industry Council, by conferring on him the Legion of Merit, Degree of Commander.

This award is for services on the Combined Munitions Assignment Board in Washington, the Naval Munitions Assignment Committee, and as British Admiralty Supply Representative in the U.S.A.

R.F. Couplings

An Explanation of the Various Forms of Coupling Which May be Used in All-wave Receivers

By F. G. RAYER

THE type of R.F. coupling used in a receiver can have quite a large influence on the results obtained. Furthermore, wave-change switching considerations, and the use of the receiver on one or more short-wave ranges, in addition to long- and medium-wave ranges, can also influence the choice of coupling. Because of this it is intended here to deal with the various possible R.F. couplings, and the results which will be obtained from them, together with other circuit factors they introduce.

R.F. Transformer Coupling

A typical circuit, with component values suitable for long- and medium-wave reception, is shown in Fig. 1. The R.F. valve is coupled to the detector by means of a primary winding on the second coil connected to R.F. anode and H.T. plus. This is a very stable coupling, requires the minimum number of components, and gives both reasonable selectivity and sensitivity when used with well-designed coils. Wave-change switching is simplified by all the switched coil windings being common to earth. To benefit fully from this (which simplifies switch wiring and design) the V.M. bias is applied through a leak so that the grid winding of the aerial coil may be directly earthed.

This is a good circuit for a short-wave set when plug-in coils are used. With all-wave receivers, however, it is necessary to have switching in the anode circuit of the R.F. valve, with the possibility of increasing losses or reducing stability.

If screened coils are used, no further screening will be necessary unless a bad layout is employed. With unscreened (e.g., plug-in) coils the erection of a metal screen between the R.F. and detector stages is usually sufficient. Alternatively, one tuning-coil assembly may be below the chassis, and the other above.

Because each primary winding is proper to its own coil, this coupling is very satisfactory in use in multi-band receivers, and is often employed on account of its economy and stability.

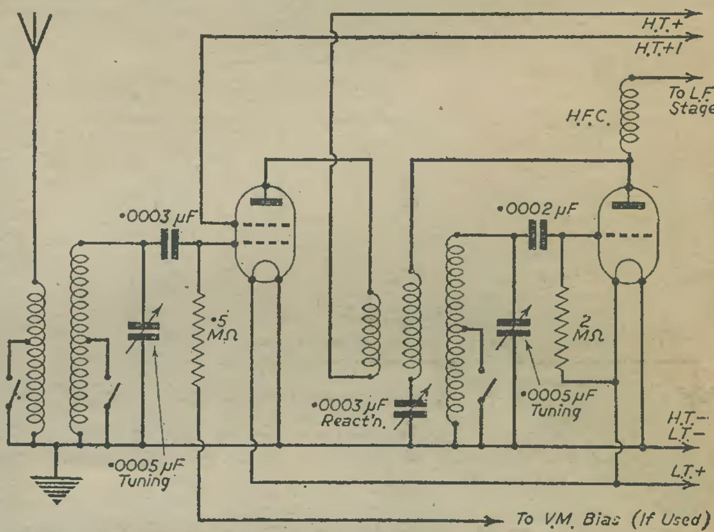


Fig. 1.—Standard H.F. transformer coupling, for dual-range operation, showing switching.

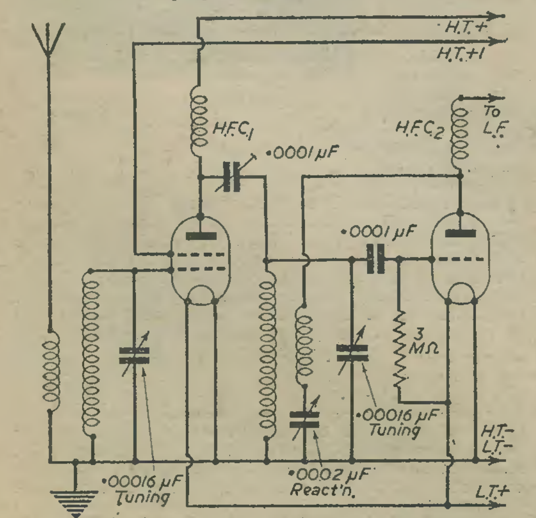


Fig. 3.—A further type of coupling, sometimes referred to as a parallel-fed tuned-anode, but more often as tuned-grid coupling.

Tuned-anode Coupling

As Fig. 2 shows, the anode of the R.F. valve is taken directly to the grid coil of the detector, the latter being connected to H.T. plus, with a by-pass condenser to earth. As a result this gives the greatest gain, but any feed-back to the R.F. stage will result in instability. It will be realised that both the grid and anode circuits of the R.F. valve are tuned to the same frequency—and as this is one method of making a valve oscillate (which is not desired here) a good layout and adequate screening are required.

The anode lead of the R.F. valve should not be screened if it can be avoided, as this throws additional capacity across the detector coil and may cause difficulty in ganging, especially in a short-wave receiver. With a sound layout, screened coils and the *reaction* leads screened (the by-pass capacity of the screening will not matter here) the circuit is stable without anode-lead screening.

Selectivity is lower than with an R.F. transformer, but the use of iron-cored coils will give both good selectivity and high sensitivity.

Fig. 2 also shows the method of applying V.M. bias through the R.F. coil, the switching for the circuit depicted then requiring three separate on-off switch contacts.

The circuit, even with suitable component values, is not recommended for short-wave reception, as the anode of the R.F. stage rather heavily damps the detector coil on wavelengths below 15 metres and may, as a result, cause lack of reaction.

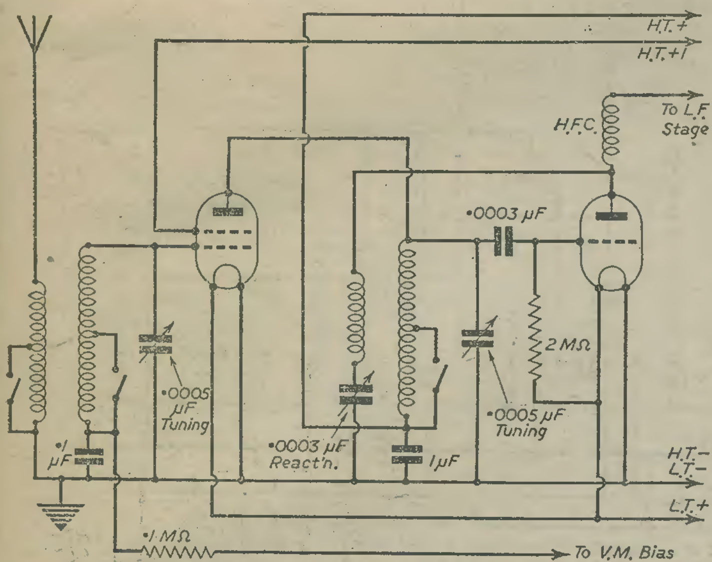


Fig. 2.—In this circuit the H.F. transformer is replaced by a tuned-anode arrangement. This is tricky to stabilise.

Tuned-grid Coupling

In Fig. 3 component values suitable for short-wave use are shown. The use of an anode choke and pre-set condenser to couple the R.F. and detector stages introduces both advantages and disadvantages. Selectivity may be adjusted by altering the capacity of the coupling condenser, and when wave-change switching is used this is simplified as there are no R.F. primary windings to switch (as with a multi-band set with R.F. transformer coupling), and long-wave sections of the coils may all be shorted to earth, a separate switch section not being required as with tuned-anode coupling.

The main disadvantage is that the choke H.F.C.1 must be really efficient over the wavelengths tuned. This is not difficult to arrange in a receiver for long- and medium-wave reception, with one or two short-wave ranges, but if it is desired to tune down to 10 metres, or lower, a suitable choke is not easily found. In addition, a coupling condenser capacity suitable for, say, 15 metres, will almost certainly be of too small a value for best results on long waves. Consequently this circuit is best for a general-purpose receiver where very short-wave ranges are not tuned; for a long- and medium-wave set; or for a receiver for short waves only.

Fig. 3 also shows the method of connecting the aerial coil when it is not desired to use V.M. volume control.

Mixed Coupling

Occasionally a combination of couplings is used in an attempt to benefit from the advantages of two methods. In Fig. 4 (which has component values suitable for long- and medium-wave reception, with one or two general-purpose short-wave ranges down to about 15 metres) the lead from the coupling condenser is returned to a tapping on the coil. This imposes less damping on the detector grid winding. If this lead were taken to the point "X" on the primary of the detector coil a type of transformer coupling would result. The advantage of doing this would lie in simplified switching if the primary were required to be switched when changing from long to medium waves.

With the circuit as shown, a 3-point switch only is needed for long- and medium-wave reception. As the lack of a primary winding on either coil rather reduces selectivity, a condenser (.0003 mfd. maximum) may be added in the aerial lead at the point marked with a cross. (This may also be done with the circuits in Figs. 1, 2 and 3, although the presence of a coupling winding frequently renders this unnecessary here.)

As in Fig. 3, H.F.C.1 should be of high quality (the small chokes used for reaction purposes are not very suitable) and capable of efficient operation over all the wavelengths tuned.

Two R.F. Stage Receivers

A suitable circuit for a receiver with two R.F. stages is shown in Fig. 5. It is usually best to mix the couplings,

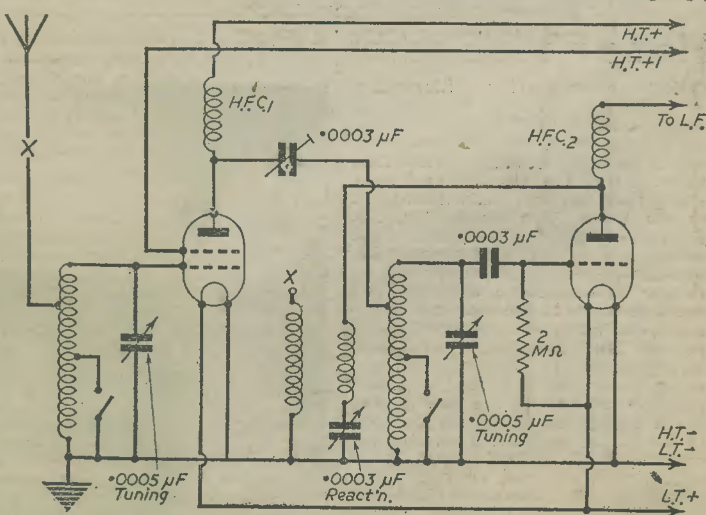


Fig. 4.—A scheme which enables the advantages of different methods to be obtained, according to conditions.

and tuned grid is used between the two R.F. valves, with R.F. transformer between the second R.F. valve and detector. Tuned-anode coupling is not employed because of its inherent instability when considerable R.F. gain is used.

The necessary V.M. bias circuit is shown in full, and the bias supplies are decoupled to avoid introducing instability through them. The anode circuits are also decoupled for a similar reason, although this is not always necessary in both stages unless an attempt is

If plug-in coils were to be used, transformer coupling could be employed between the R.F. stages, with tuned grid between the R.F. and detector stages. Ordinary two-circuit (4-pin) coils would then provide the necessary windings for aerial coupling, H.F. transformer, and tuned grid with reaction. Otherwise a 6-pin coil will be required in the detector stage.

Such a circuit will give a high degree of gain, with selectivity sufficient for most purposes. As with all the circuits shown, the layout should be chosen with care,

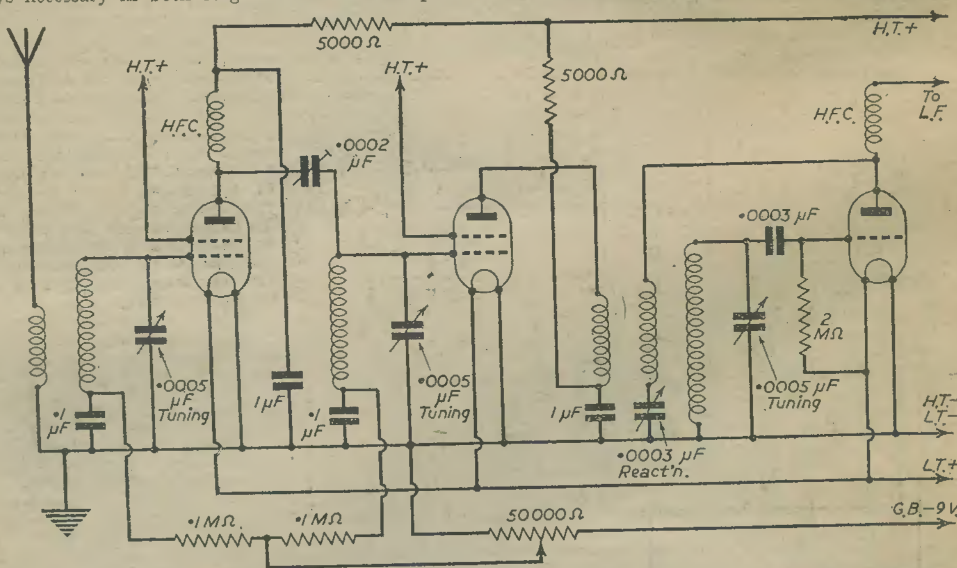


Fig. 5.—Two H.F. stages in which a combination of couplings is used in the interests of stability and high gain.

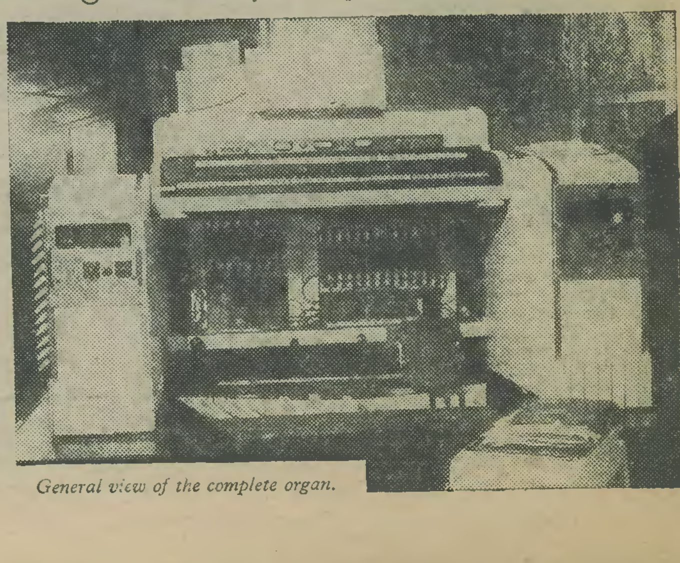
being made to secure the greatest possible gain, with a resultant increase in dangers of instability. In addition, it is frequently wise to by-pass the screen grids of the R.F. valves by .1 mfd. condensers; complete decoupling may be added by including a resistor of about 10,000 ohms in series with the H.T. feeds to the screens.

screened coils used (or ample screening provided between coils, if they are unscreened), and any wave-change switching which may be used so wired that interaction does not arise between the connections. In Fig. 5, for example, a switch with 3 sections on a common spindle would prove most suitable if fairly comprehensive switching were used.

Home-made Electronic Organ

THE accompanying illustration shows a very elaborate electronic organ built by a Londoner. Based on the Hammond organ, it was made out of two pianos and a table tennis table. All of the constructional work was carried out in a small front room of his home. The constructor, Mr. Beaven, of Palmers Green, took about seven months in the construction and it was recently demonstrated by George Saull. There are over two hundred valves in the complete equipment, and many of these may be seen beneath the two-manual keyboard. Reproduction is effected through separate amplifiers feeding 12 loudspeakers stacked at the sides. The small white projections on the left of the picture are louvres covering the sound chamber.

This type of organ is really quite simple to build, the main difficulties lying in the tuning of the various circuits, the methods of coupling to provide harmonics, and switchable couplings to provide tone contrasts. Volume may be controlled by a foot-operated L.F. volume control.



General view of the complete organ.

An Add-on A.C. to D.C. Unit

A Cheap and Reliable Method of Operating D.C. Receivers from A.C. Mains.

Described by LEN MILLER

THERE are still a large number of old D.C. receivers being used to-day. They were usually well built, quite expensive when new, and incorporate paper dielectric smoothing condensers which are usually more robust and trouble-free than their electrolytic counterparts. Provided the valves and components are in good condition the owner of a D.C. receiver usually refrains from buying a new set if he moves to an A.C. district.

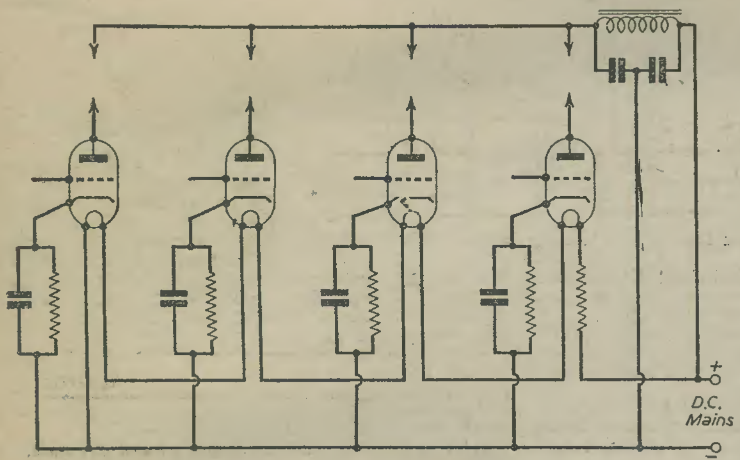


Fig. 1.—Heater circuits of a standard D.C. receiver.

The principal snag of having the set converted to A.C. is that of expense.

If the average D.C. receiver was built on standard A.C. set principles, the conversion would be comparatively simple, and correspondingly very much cheaper. If the D.C. receiver was designed along the lines depicted in Fig. 1, it would only be necessary to add a rectifier valve and decrease the value of the heater dropping resistor, as shown in Fig. 2.

But now take a glance at Fig. 3, showing the heater and biasing arrangement of what could be described as a typical D.C. set, and one which would certainly provide a large headache for the service-man converting it to A.C. operation.

It will be noticed that the set designer decided to utilise the surplus volts in the heater circuit to energise the loudspeaker field. This was a wise plan, as it provides comparatively smooth D.C. for the heaters, which can also be used for bias purposes, as shown. The set designer should not be blamed for producing such a complicated circuit—in fact, due praise must be given, as he has eliminated most of the power-wasting dropper resistor or "line-cord" used in all present-day A.C./D.C. sets.

Parts to be Scrapped

The circuit in Fig. 3 may be an "extreme" in D.C. set design, but most D.C. receivers embody one or more of these principles. Consequently the service-man confronted with the task of such a conversion will invariably decide to rewire and redesign the entire heater and bias circuits—probably scrap the valves and fit A.C. types and incorporate a mains transformer. The speaker will also have to be scrapped, as it will be of the low-resistance-high-current type, usually around 200 ohms, and would have to be replaced by a high-resistance field or P.M. type. Also, if the original circuit diagram is not available, it will be necessary to trace out the entire heater and bias circuits, which is a tedious task, to say the least! Hence the expense.

The writer recently had occasion to convert a Murphy D.C. radiogram for A.C. operation, and it was found that the energising current for the speaker and bias supplies were all taken from the heater circuit, something similar

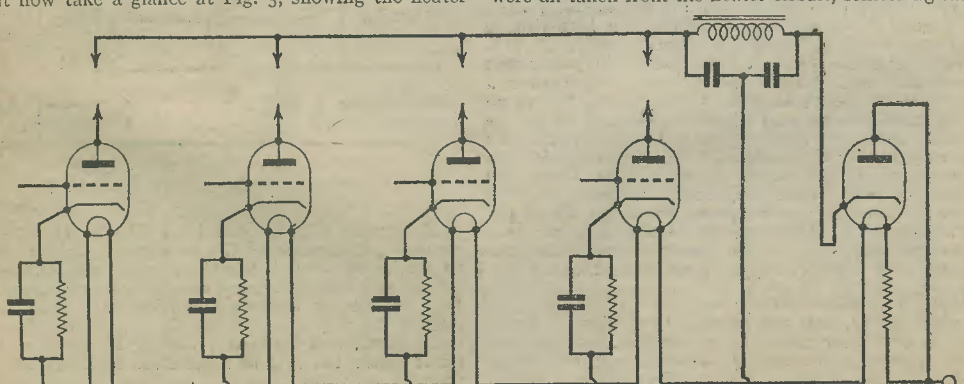


Fig. 2.—The arrangement of Fig. 1 modified for A.C. operation.

to Fig. 3. The speaker was an exceptionally good one, and the writer hesitated to scrap it.

It was therefore, decided to adopt the simple method of making no alteration to the set, but to build an "Add-on" unit which would rectify the A.C. and so supply the entire set with pulsating D.C. The set naturally has its

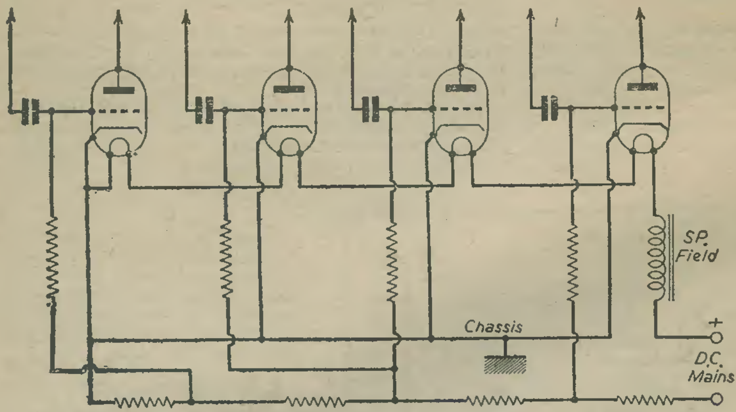


Fig. 3.—Heater arrangements in a D.C. receiver recently serviced by the writer.

original smoothing equipment built in, and it was anticipated that this would be sufficient to smooth out any hum. This turned out to be quite satisfactory.

The anticipated H.T. consumption was 50 mA, which had to be added to the heater consumption, viz., 0.2 A. or 200 mA. Therefore the unit had to supply about 250 mA. at 200 or so volts.

If a normal full-wave rectifier circuit had been used, the mains transformer would have been a very bulky and costly item, so it was decided to try out the circuit shown in Fig. 3, the transformer being used to heat the two rectifier filaments only, and need only supply 5v. at 4 A., if 5Y3s or 80s are used as the rectifiers. English type 4v. rectifiers could, of course, be used if desired, in which case a 4v. secondary would be required. Suitable valves are the RV120/350 or UU120/350, etc.

The adaptor, as shown in Fig. 4, has now given many months' service and is perfectly satisfactory in all respects. The original hook-up used a single 5U4G, which is rated for 250 mA. at 500 volts, but the voltage drop across the valve proved to be too high. The two 5Y3s with the four anodes wired in parallel turned out to be ideal for the job. An old mains transformer was used for heating the filaments (the high-voltage secondary windings being left disconnected).

The value of the reservoir condenser C is of paramount importance, and controls the voltage output over a very wide range. Whilst it is not within the scope of this article to go into rectifier theory, it should be sufficient to remind the reader that a half-wave rectifier with *no* reservoir condenser will never give more than 50 per cent. output—that is, with 240v. input the no-load output would be 120v. When connected to the D.C. receiver, the output would be about 90-100v. The bigger the capacity of the reservoir condenser the higher will be the voltage output (until the peak value of the A.C. supply is nearly reached).

Finding the Condenser Value

Unfortunately, it is not possible to specify the exact value of condenser required, as the D.C. receiver will almost certainly incorporate a condenser across its input, and this condenser will now become part of the reservoir C.

Provided a voltmeter is available, it is quite an easy matter to ascertain the right value. The set itself will be provided with input tappings, usually in 10 or 20 volt steps between 200-250 volts.

Using for a start an 8 mfd. condenser for the reservoir C, plug the tapping lead of the set into the *highest* tapping, and switch on the mains. Measuring the D.C. voltage at the input to the set (or the output voltage from the unit which is of course the same thing) it will almost certainly read very much too low—probably around 150v. If this is so, it will be quite safe to use 16 mfd. for the reservoir. The voltage will now read between 200-250 volts. Once the voltage is within the operating range of the receiver (that is, 200-250v.), it is no longer necessary to experiment with different values of reservoir condensers, as the set tappings can now be adjusted until the required voltage is obtained.

As an illustration, if the receiver input voltage reads 220v. when on the 240v. tapping (of the set), reduce the tapping to 220v. This will have the effect of reducing the input voltage slightly, as more current is now being consumed, and it may be found that the input voltage is now 210v. So long as the input voltage is within 10v. of the voltage marked on the set tapping, the receiver will function normally and satisfactorily. If this state cannot be reached, it is best to have the input voltage *lower* than the voltage indicated on the tapping.

Even if the input voltage is 20-30 volts lower than the tapping voltage, the set will in all probability function quite satisfactorily. Many present-day A.C./D.C. sets are designed to operate off any voltage between 200 to 250v. without any provisions for tapping!

If it is found that even 200v. cannot be reached, the reservoir should be increased to 24 mfd. As the maximum voltage rating need not be higher than 350v. working, condensers of quite small physical dimensions can be used.

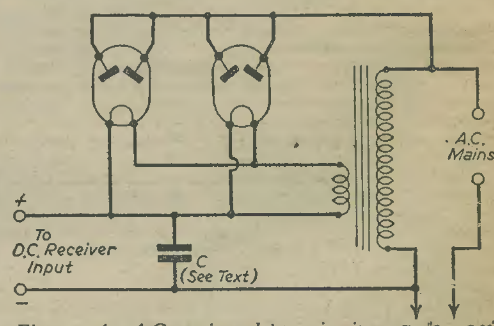


Fig. 4.—An A.C. mains adaptor circuit

The entire adaptor can be built for less than £3, assuming that none of the required parts are already to hand, and what is most important, the set does not require any modifying, and can easily be reconverted to D.C. should the owner move back to a D.C. district (simply by removing the adaptor!). It can be made quite small, and there will usually be found room to fix it inside the set, as most D.C. receivers are large anyway.

A Warning

One word of warning. The normal on/off switch must be left in the "On" position, and the set switched by means of a separate switch in the mains lead, as shown in Fig. 4. If the receiver on/off switch is used to switch off, no harm is done, but the rectifier valves are left on, consuming unnecessary current, and shortening the life of the valves.

The writer decided to make the required small modification so that the receiver on/off switch could still be used. This is quite simple, provided the reader is prepared to take the set out of its cabinet, disconnect the leads from the switch and join them together. Now connect a length of twin flex to the two switch terminals and wire the other two ends of the flex in the same position as the external switch would be in Fig. 4.

As the chassis is live to the mains the same precautions against shock must still be observed as when the set was used on D.C. mains.

Indirectly-heated rectifier valves such as the 5Z4G, APV4, MU12, etc., may be used, the only disadvantage being that the set will take an abnormally long time to "warm up," as the receiver valve heaters will not start to warm up until the rectifiers are operating. Unless the reader already possesses suitable indirectly-heated rectifiers and wishes to use them, it is advisable to buy directly-heated valves.

The "Add-on" unit described herein was, of course, designed to operate any D.C. receiver using 0.2 A. range valves, but will operate quite satisfactorily on sets using the 0.18 A. range. The *very* old D.C. sets using either the Mazda 0.5 A. or 1 A. valves present rather a problem for conversion, and the "Add-On" unit could not be used for these sets.

The Experimenter's Valve-voltmeter

An Easily Built Accessory for the Keen Amateur

A VALVE-VOLTMETER is usually looked upon as a costly and highly exacting piece of test gear, only to be found in the laboratory of the serious experimenter. The instrument about to be described must not be looked upon as a substitute for the laboratory model, but rather as a very useful and reasonably accurate valve-voltmeter that can be easily built and *calibrated*, by the home constructor at an extremely low cost.

The uses of the valve-voltmeter are many and varied, and should appeal to the service mechanic and ham alike. It is possible, for instance, to measure the anode and screen voltages of a R.F. or A.F. pentode to a far greater accuracy than would be obtained using a 1,000 ohm per volt multi-meter. Accurate indication of stage gain can be measured, and A.V.C. voltages can be read direct. It may be used as an output meter, insulation tester, field strength meter (by connecting the input to a tuned loop), besides all the usual D.C. and A.C. voltage measurements.

The Circuit

The basic circuit is shown in Fig. 1. In the interests of portability and weight, a low anode voltage of 18 v. (two 9v. G.B. batteries in series) is used. Consequently the anode current is small, which must be offset by using a valve with a comparatively heavy anode current (to obtain a satisfactory meter deflection). A small power valve is ideal. The Tungsram LP220 was used by the writer, suitable B.V.A. alternatives being the LP2, P220, PM2A, 220P, etc.

The filament is heated with a unit cell (1.5 v.). This gives satisfactory emission, reduces filament consumption, lasts for several months with normal use, saves the bother of accumulator charging, and keeps down the size and weight of the complete meter. The two bias cells can be the smallest obtainable, as the current taken from them is extremely low. The writer uses a 3 v. "fountain pen" battery, with the cardboard cover removed (revealing two 1.5 v. cells in series). These three cells may be held in position by making suitable spring clips, cleats, or be made self-supporting by soldering short lengths of 18-gauge tinned copper wire to the case and the positive contact. This will be left to the ingenuity of the individual constructor.

A lay-out sketch is not strictly necessary, as the instrument may be housed in any convenient box providing there is sufficient room to accommodate the components and batteries, and there is very little to lay out, anyway! The easiest method of construction is to mount all of the parts on the panel, improvising a bracket to which to fix the valveholder.

How It Operates

Referring now to Fig. 1. The valve V is biased to operate as an anode-bend detector, bias adjustment being made by means of the potentiometer P1, the potentiometer P2 normally being set at the extreme right-hand position (in the diagram), the switch being set on position 1 ("Adjust").

The principle of operation will be more easily understood by referring to Fig. 2, which shows the circuit minus P2 and the switch Sw. Note the polarity of the meter movement. This is wired in the negative lead of the H.T. line so that it can serve the dual purpose of valve adjustment and voltage reading.

Using the type of valve specified, complete anode current cut-off is secured with a negative bias of a little under 1.5 v., and the potentiometer will be near the extreme left-hand position (on the diagram).

The meter works on the "slide-back" principle. In practice, the potentiometer P1 is adjusted until the

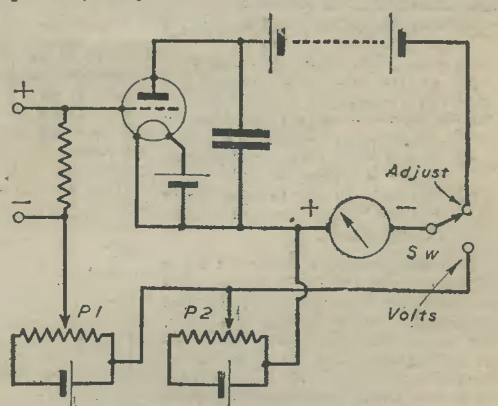


Fig. 1.—Basic circuit of the valve-voltmeter.

anode current is of some pre-determined value very near to cut-off—let us say one *division* above zero on the meter movement. The actual current is quite unimportant (providing it is somewhere near zero), and the first division on the meter is simply used as a reference point. The instrument as shown in Fig. 1 is capable of measuring any voltage, A.C. or D.C., up to a maximum of about 1.25 v.

Now, say a D.C. voltage of about one volt is applied across the "Input" terminals, observing the polarity as marked. This voltage will alter the grid bias supplied by P1 and will in effect cause the grid to go less negative (or more positive, if you prefer!). The anode current will now increase, and this is where P2 plays its part. This control is now rotated (towards the left, in Fig. 1), which makes the grid *more* negative again—until the meter movement reads the original value (one division on the dial—remember ?). It should now be apparent that the voltage introduced by bringing P2 into play must be equal (and opposite in polarity) to the voltage applied across the input terminals, as the meter needle is now back to its original position. It now only

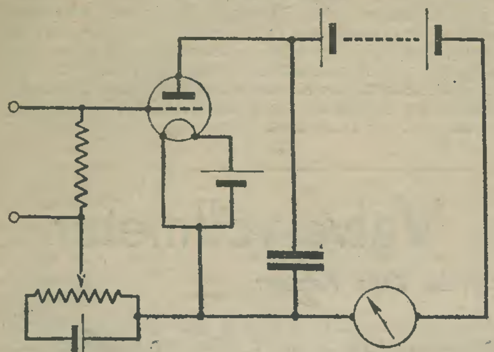


Fig. 2.—Simplified circuit with P2 and the switches removed.

remains to read the voltage that has been introduced into the grid circuit by P2, and this reading will correspond to the voltage applied across the input terminals.

To obtain this reading, the switch Sw is thrown to position 2 ("Volts") which now places the meter between the slider and the positive end of P2. The meter now reads the input voltage direct.

This operating procedure may sound complicated as it has been explained in detail, but in actual practice the procedure is as follows:

(1) Put switch Sw. to position 1 ("Adjust").
(2) Turn P2 to extreme +ve end.
(3) Adjust P1 for "reference point" reading.
(4) Apply "voltage-to-be-read" across input terminals.
(5) Adjust P2 for "reference point" reading.
(6) Put switch Sw. to position 2 ("Volts") and read required voltage direct.

It should be noted that once P2 is adjusted, as at (5), the voltage-to-be-read may be removed from the input terminals. In practice, of course, flex leads terminating into test prods would be attached to the input terminals; operations (1), (2) and (3) carried out. The test prods would then be applied across the voltage to be measured, and operation (5) carried out, and the test prods then removed.

Parts to be Used.

Now for the more practical points. The higher the "ohms per volt" of the meter used, the more accurate will be the readings. A voltmeter with 1,000 ohms per volt sensitivity is ideal for the purpose. As 1.5 v. is the highest voltage that will be read on the meter, a low reading voltmeter—as near to but more than 1.5 v.—is desirable. A 0-2 v. movement is very suitable. If the ohms-per-volt sensitivity of the meter is too low, the accuracy of the final readings will suffer, but even if a cheap moving-iron movement is used, the readings are still useful. The values given for the input potential divider hold good irrespective of the type of meter used, and the only reason why the accuracy suffers when using a cheap meter is that there is a small voltage drop across part of the potentiometer P1 which is in circuit when a voltage reading is taken, and if the resistance of the voltmeter is high (as it is with a 1,000 ohm-per-volt movement) the voltage drop will be negligible. The ingenious constructor wishing to use a cheap moving-iron meter could re-calibrate the meter readings by applying known voltages across the input and noting the meter readings. If a milliammeter is available, this may be used, providing the appropriate multiplier is incorporated.

If the constructor possesses a multi-meter, such as the AvoMinor, and wishes to use this, connections may be made by means of flex leads, using the multi-meter switched to the 0-5 v. range.

This type of valve voltmeter is not dependent on correct operating voltages for its accuracy—the batteries need not be renewed until it is found that the "reference point" cannot any longer be reached.

The potential divider system is provided to enable various voltages from about .01 to 2,000 v. to be read, as in Fig. 3, and the reading should be multiplied as stated thereon. A.C. voltages are R.M.S. values.

The instrument as a whole is reasonably fool-proof. No harm is done to the meter if a D.C. voltage is applied the wrong way round, for instance, as this would simply bias the valve well below cut-off and the meter will read zero. If the potential divider switch is wrongly set, and too high a voltage applied, the resistance of the voltmeter will tend to limit the current flow, and so protect the meter movement. However, it *is* possible to burn the meter out, but the chances are very much less than would be when using an ordinary meter.

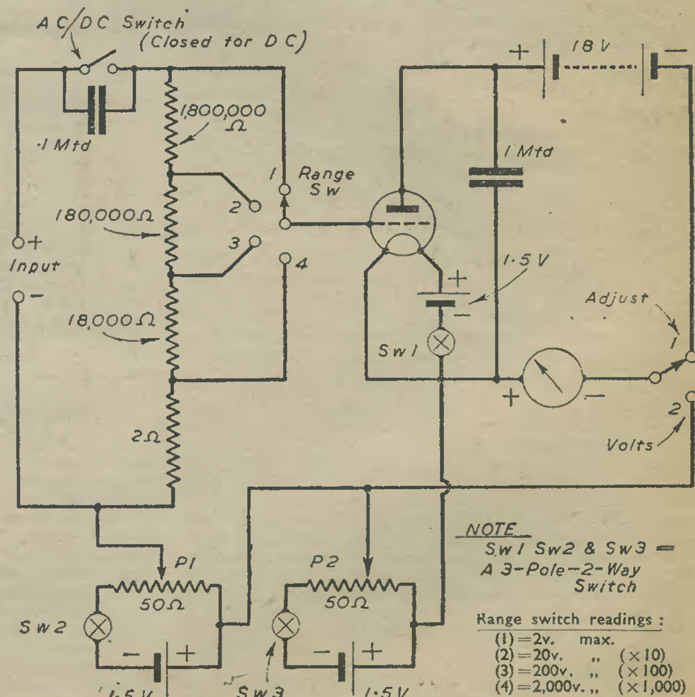


Fig. 3.—Final complete circuit of the valve-voltmeter.

ON YOUR WAVELENGTH

By THERMION

More About Frauds and Quacks

THE paragraph I wrote last month on the smart Alecs who knock at doors posing as radio experts has brought me a large batch of letters from all over the country giving details of similar forms of fraud. I pass them on as a warning to other readers, and in turn they should pass the information along to members of their families.

A reader from Preston says that his wife handed out a portable receiver for repair to a man who left his card. As some weeks went by he wrote to the address and the letter came back marked "No such address."

A van called to collect the receiver owned by E. K., of Dorking, and that is the last he saw of it.

"Once Bitten," of Birmingham, had his receiver returned minus everything except the knobs, which had been carefully tied on behind the panel.

Another reader had the chassis of a well-known commercial receiver removed, and an old and broken one substituted.

These few examples from a large number of letters typify the type of fraud which is going on. If any of my readers can trap one of these gentry by sending for the police he would be performing a great service to trusting and unsuspecting members of the public.

An equally serious aspect of the correspondence is the large number who complain of sharp practice on the part of alleged radio service engineers with business premises. They not only rob one receiver to repair another, but also grossly overcharge for mild repairs and the remedying of small defects. It is very difficult to bring a charge against these gentry because it would be almost impossible to lay a definite accusation. Readers might mark the valves, speaker, etc., in a certain way, but even then that would not be proof.

Of course, the component shortage and the shortage of labour are responsible for a lot of this trouble. I have no doubt that a large number of dealers do their best to get a receiver working and are compelled to adopt methods which they would not use in normal times. Even so, I think that it would be far better to leave the receiver alone; otherwise, if it is finally sent back to the makers, they will either have nothing to do with it or charge for a new chassis.

A wise plan is to ask the makers to recommend a service agent.

Valve Prices

THE Central Price Regulation Committee has issued its report on the prices of radio valves. The report is addressed to the President of the Board of Trade. An extract from it is given here:

"If the level of profits earned by the manufacturers of any product is to be regarded as the objective test to be applied in considering whether the prices paid by consumers are fair prices, then we are of opinion that the prices at present charged for radio valves are fair. If the profit earned by the manufacturers on the sale of valves for replacement purposes alone is considered, then in some cases excessive profits are made. But these excessive profits are absorbed by the losses incurred in sales to the set makers, leaving the final position one in which the industry in the period under review has earned only a reasonable reward."

When American valves were imported during the war their prices to the British public were considerably lower than those charged for British valves of equivalent types. Before the war an even greater disparity existed, although the prices of British valves over a period of years have been greatly reduced.

We must also remember that the important changes in technical developments and in broadcasting policy considerably affect the production policy of manufacturers, and this, of course, also affects the demands on the valve industry for the production of appropriate types of valves. In this country designers of receivers favour dual-purpose valves in an effort to reduce the number required. It is often overlooked that American sets make use of a large number of simpler types of valve. The result of this is that the American valve manufacturer can produce simpler valves to wider limits and much more cheaply. In this country we produce valves to very close limits and this would account for the higher price of the British products.

Also our manufacturers have to cover their costs and make their profits out of a total number of 12,500,000 valves per year, whereas America manufactures 150,000,000 valves a year.

Another point is that American receivers are designed for short life and the consumer, as with the car trade, is invited to buy a new model every year. British receivers are made to last a number of years.

The New B.B.C. Charter

THE B.B.C. charter is to extend for a further five years from January 1st, last; the charter as laid down in the draft follows the line of previous charters and endows the B.B.C. with powers to carry out sound and television broadcasting in this country under the control of a Board of Governors.

In view of the recent announcement that salaries were to be cut it is interesting to record the salaries to be paid as laid down in the charter.

Chairman, £3,000 per year.
Vice-chairman, £1,000 per year.
Other governors, £600 per year.

An interesting reference in the charter is that which relates to the powers now given to the B.B.C. to produce films for television purposes.

More Appropriate

ARE we not getting too many "recordings" in the programmes to-day? If this continues and increases, might not "Recording House" become more appropriate than merely "Broadcasting House"?

Oh, the weariness, the dreariness,
Of the programmes soporific,
With "recordings" of the Old Gangs
Which have now become terrific;
And with licence-holders so despised
That they scarcely dare to grouse
At the oft-repeated hash-ups
Sent out by "Recording House."
Here's a practice of economy
With which we don't agree;
What may have pleased at breakfast-time
Is stale at next day's "tea."
And those who are responsible
We'd really like to scupper,
Who serve the same dish up again
Day after next for supper!
"Variety's the spice of life"—
Their slogan makes us grin,
When items heard so oft before
Again keep butting in!
This saves them brass, and saves them work,
On that we will agree,
But there's mighty small variety
For our doubled licence fee!—"TORCH."

A Two-programme Receiver

Details of a Receiver Which Will Give the Third Programme at the Same Time as Any Alternative.

By WM. NIMMONS

SINCE the opening of the Third Programme many households have been split in two. While one member is interested in the "highbrow" material emanating in the Third Programme, others may not have the slightest interest in such fare. Hence the strained relations when the lowbrows have to listen to high-class fare, or *vice versa*.

The obvious solution is for the highbrow to have a set of his own, but the prospect of two rival loudspeakers going is not conducive to settling domestic differences, besides the added inconvenience of arranging for two aerials.

The problem thus arranges itself round one loudspeaker and one pair of headphones—the headphones being intended for the minority interest, the item with the least popular appeal, or, in other words, the Third Programme.

With this end in view, experiments were conducted to see if a practical design could be worked out. The ideal aimed at was a set which would give, *on one aerial*, two programmes free of mutual interference, one on headphones and the other on the loudspeaker. This has been accomplished with a fair amount of success, and the design finally adopted is the subject of this article.

The Wave-trap Idea

In the ordinary way you cannot use two sets on one aerial without a considerable amount of "pulling" and interaction between them. One or the other is apt to monopolise the tuning of both, either giving increased signal strength at one particular frequency or else giving poor signals all round the dial. A consideration of the behaviour of a rejector wave-trap, however, pointed the way to a solution of the problem.

A rejector wave-trap is simply a coil and condenser in parallel inserted in series with the aerial. When tuned to resonance with a signal, voltages are developed across the coil and condenser at this particular frequency. The energy may be said to be absorbed, so that there is very little to pass on at this frequency; other frequencies are not affected by the insertion of the wave-trap.

If the wave-trap were tuned to the Third Programme this station would effectively be prevented from reaching the main tuning inductance. At the same time, if we connected a crystal and a pair of headphones across the wave-trap coil we should get rectified signals from the station to which the wave-trap was tuned, for the simple reason that H.F. currents are circulating in the oscillatory circuit comprising the coil and condenser, and have nowhere else to go except through the crystal and headphones.

A Valve Unit

A crystal detector would be very little use, however, partly because of the comparative weakness of the signals and partly because the heavy damping of the crystal would negative the results.

A valve is a much more practical proposition, especially as we can utilise reaction to strengthen the signals. A valve was accordingly tried in this position, i.e., in the position of a wave-trap in the aerial lead to the set proper, the normal tuning coil and condenser acting as the wave-trap. In this position it was found that the coil and condenser gave the ordinary rejection effect on a resonant frequency, and that the valve gave rise to much less damping than would a crystal. Also, it was possible to strengthen the H.F. energy by the ordinary process of regeneration.

A Practical Design

The first practical design was as shown in Fig. 1. The wave-trap-cum-receiver was made up in the form of a separate unit, which was placed in the aerial lead to the loudspeaker receiver. It had its own accumulator and H.T. battery, and was quite independent of the main set except that the aerial lead to the main set was taken from the low potential end of the coil (or from L.T. negative).

With this arrangement it was possible to set the aerial unit to receive the Third Programme without in any way interfering with the working of the main set. Thus the main set could be tuned to the Home Service or the Light Programme, and these could be heard all over the room via the loudspeaker; and at the same time the Third Programme could be heard on the headphones.

With the particular receiver in use the Home Service spread a little on the dial, so a wave-trap was fitted between the aerial unit and the receiver to cut down the volume of this station, with beneficial results to the headphone wearer.

Common H.T.

The previous unit used a separate H.T. battery, and an effort was then made to work the unit off the H.T. battery supplying the receiver. This was considered

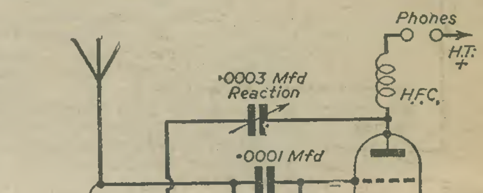


Fig. 1.—The aerial tuning unit acts as a wave-trap, the "suppressed" station appearing in the phones in the anode of the valve.

essential on the score of economy and neatness. This led to the incorporation of the resistance, R1, in Fig. 1, which is essential for proper working.

At first sight it might seem that all that is necessary is to connect the far side of the headphones to H.T. positive, and the filament to H.T. negative. Further consideration will show, however, that this would short-circuit the tuning arrangements of the receiver proper; whilst if the H.T. negative return were left open the unit would be inoperative.

These difficulties can be overcome by the resistance, which provides a return for the H.T. current, whilst at the same time offering a path of high resistance to the H.F. currents, or, in other words, having no effect on the tuning arrangements of the main receiver.

A Final Design

The design finally adopted is shown in Fig. 2. It will be seen that this is a straightforward three-valve receiver, with the addition of the aerial tuning unit and also an additional wave-trap, the purpose of which will be discussed presently. The valve chosen for the aerial tuning unit is an Osram Z21. This valve was chosen because it is the type which employs the full voltage of the H.T. battery on the screen when in ordinary use; when used as a detector with about half this voltage on the screen it gives fine results. If preferred, however, an ordinary triode may be used in this position with some sacrifice in efficiency.

The resistance, R1 (Fig. 2), is most important, and should be chosen carefully. It must be high enough to prevent the short-circuiting of the tuning arrangements of the receiver, and any value from 1,000 ohms to 5,000 ohms is suitable. The writer has used a 2,000 ohms resistor in this position with every satisfaction. A composition or carbon resistor should be used, since a wire-wound one might resonate over the band of frequencies covered.

The rest of the circuit follows normal practice, and need not be gone into.

Operation

The operation of Fig. 2 may be a little tricky to the uninitiated, but once you have got the hang of it, it is really very simple. Bearing in mind that the reason for its existence is that a person may listen to one station on headphones whilst the loudspeaker is reproducing another, it is easy to see that once the preliminary adjustments have been made, the set behaves just like an ordinary three-valver.

These preliminary adjustments are two in number. One: set the wave-trap L3 and VC3 so as to cut out or reduce the strength of the strongest station. This will probably be the Home Service. Two: tune in to the Third Programme by means of VC1, manipulating the reaction condenser, VC2, if necessary. Adjustment to VR1 should bring the programme up to good strength.

In making these adjustments the headphones should be plugged in at P1, i.e., at the set itself. When the Third Programme is coming through satisfactorily, the headphones may be removed from P1 and plugged into P2, which may be some distance away, not necessarily in another room but as far away from the loudspeaker as possible, preferably in a quiet corner. It will be of assistance in keeping out the sound of the loudspeaker if a layer of felt or flannel is glued to the earpieces, or the special rubber cushions employed.

It will be found that the inclusion of the aerial tuning unit cuts out the Third Programme on the main receiver, but this is of little consequence. If at any time it is

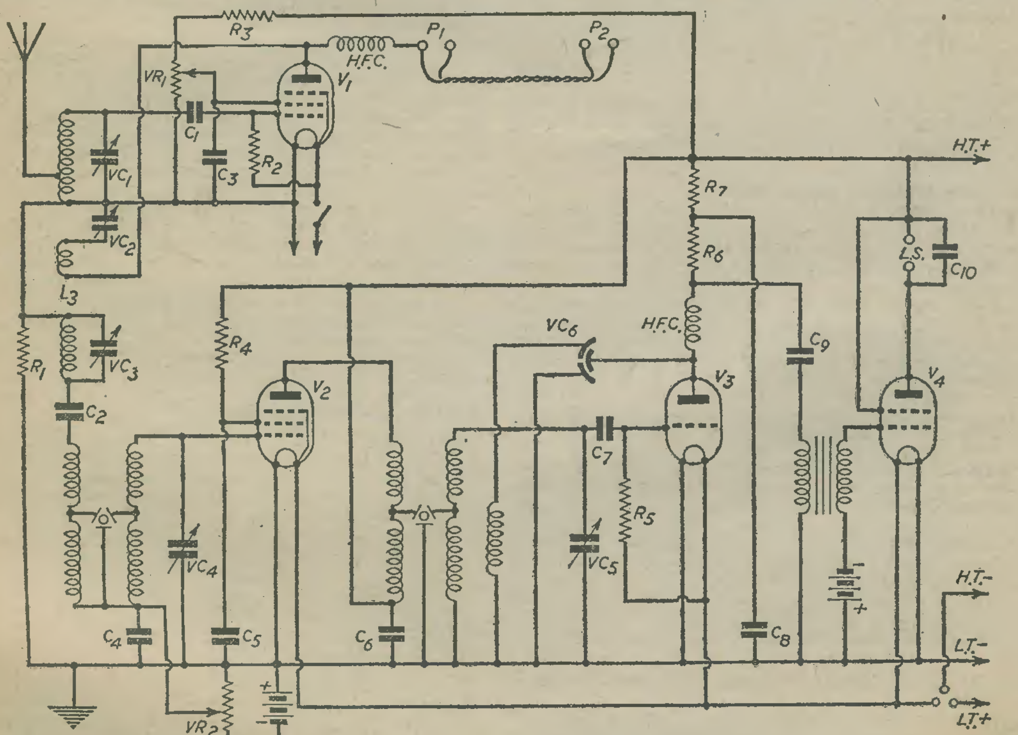


Fig. 2.—Circuit valves for the above are as follows: VC1, .0005 mfd.; VC2, .0003 mfd.; VC3, .0005 mfd.; VC4 and VC5, .0005 mfd., ganged; VC6, .0003 mfd., C1, C2, C7, .0001 mfd.; C3, C4, C5, C6, .1 mfd.; C8, 2.0 mfd.; C9, .5 mfd.; C10, .005 mfd.; VR1 and VR2, 50,000 ohms; R1, 2,000 ohms; R2, 1 megohm; R3, 50,000 ohms: R4, *75,000 ohms; R5, 1 megohm; R6, 30.000 ohms; R7, 20,000 ohms.*

required to have the Third Programme on the loudspeaker and the Home Service or Light Programme on the headphones, this can be easily accomplished. Simply set the aerial tuning unit to the desired station, when the Third Programme will be "freed" and can be tuned in, in the usual way on the main set.

Additional L.T.

It will be necessary to employ an additional accumulator to light the filament of V1. The valve cannot be lit from the L.T. battery supplying the rest of the set, as this would short-circuit the tuning arrangements of V2. As the valve only consumes .1 amp. a small cell will be sufficient, or a larger one of mass plate type will last a long time.

Note also that a three-point on-off switch is employed, with a separate point isolating H.T. negative; this is necessary because of VR1, a potentiometer arrangement which is connected across the H.T. battery and would run it down if the isolating switch were not included.

Additional Uses

Although not specifically designed for such a job, the aerial tuning unit has the property of enhancing the signal strength of distant stations. To do this the tuning condenser, VC1, must be kept a little above the main tuning condensers, VC4 and VC5, and in step with them, at the same time applying reaction by means of VC2. It is sufficient to tune in the station in the usual way on the loudspeaker, and then rotate VC1 with the reaction applied but short of oscillation point. A decided increase in signal strength will be noted when the two circuits are in resonance. In fact, in many cases stations which normally require the reaction condenser, VC6, to be well advanced, will come in strongly with this condenser at zero.

The reason for this is a trifle obscure, since one would normally expect the aerial tuning unit to cut out instead of build up. Of course, you cannot apply reaction twice in the one circuit, but experience proves that a little reaction on both VC2 and VC6 gives increased strength on distant stations, as well as increasing the selectivity. An increase in signal-strength comparable to an additional H.F. stage is possible, but the controls require careful handling in order to avoid oscillation.

Notes from the Trade

Pertrix and Exide Showcards

TWO new-type showcards are announced, advertising the Pertrix and Exide batteries. The former is 20in. by 30in., printed in four colours over three impressions of white, on 30G, satinised aluminium. Edges are folded over a cardboard back and the card is fitted with hanger and strut. Pins are supplied for mounting out-of-doors; the estimated outdoor life is five years plus. Lower part of card is printed in Pertrix colours, yellow, red and black.

The Exide card is 19½in. by 29¾in., printed in nine colours over three impressions of white, on 30G. satinised aluminium and has the same mounting details.

Whiteley Electrical Endow Beds

TRIBUTE to the public spirit shown by the directors, staff and employees of the Whiteley Electrical Radio Co., Ltd., of Mansfield, in giving three beds to Mansfield Hospital was paid when the beds were dedicated recently.

A plaque over the bed in the men's ward was unveiled by Mr. Whiteley, the one in the women's ward by Mrs. Whiteley, and that in the children's ward by one of the younger employees of the Whiteley Electrical Radio Co., Ltd.

British Standard Specification for Air-depolarised Primary Cells (B.S. No. 1335 : 1946)

THIS specification prescribes the minimum rating of air-depolarised type primary cells on continuous discharge, and gives the methods of test on which the rating is based.

A system of nomenclature is prescribed by which the type and size of cell are expressed by a sequence of two or three letters and a number.

Details of the quality of materials to be used, and also dimensions of electrodes, containers, connecting wires and terminals are also given.

Philips (South Africa) to Supply Equipment for Royal Train

SOUTH AFRICAN Philips (Pty.), Ltd., of Johannesburg have asked Philips Industrial (Philips Lamps), Ltd., of London, England, to supply 16 motor generator sets to South African Railways and Harbours.

These motor generators sets are for installation on South African railways and two of them are for the Royal train, which will be used by their Majesties the King and Queen when they visit South Africa early in 1947.

The Royal train motor generator sets will supply all the current necessary to operate the radio transmitters and receivers installed, and are required to be interference free on all frequencies. They will be controlled by an ordinary tumbler switch in the radio cabin.

These motor generator sets are being specially made to suit the requirements of South African Railways and Harbours. The Royal train sets will operate on a 65v. D.C. supply with a tolerance of 55 to 86 volts. They will have an output of 150 watts at 220 volts single phase. Revolutions 1,500 r.p.m. Automatic speed governors will be fitted capable of maintaining constant speed within ± 3 per cent. of pre-set value.

Two trains, each of 14 coaches, will make up the Royal entourage. One will be a pilot train to precede the Royal train and will accommodate Government and railway officials and the Press. It will be in constant and direct radio communication with the Royal train.

The pilot train will be equipped with high speed short-wave radio transmitting apparatus, and keying equipment and a short-wave radio receiver.

Eight of the coaches for the Royal train will be new vehicles.

W/B Speakers Price Increase

WHITELEY ELECTRICAL announce that they have been compelled, through force of circumstances which are doubtless now only too well known to readers, to increase the prices of all Stentorian Loudspeakers as follows:

Model	*Type No.*	*Revised Retail Price.*
Baby	BC	59/6
,,	BX	53/6
Minor	MC	45/6
,,	MX	39/6

Raw Materials Guide

THE Board of Trade has published a revised Raw Materials Guide, which sets out all the raw materials controlled by them and by the Ministry of Supply, giving brief details of the types of control in force and the addresses to which any inquiries should be addressed.

It is obtainable, price 1s. 6d., through any bookseller or newsagent or direct from H.M. Stationery Office, Kingsway, London, W.C.2, and branches.

Analysis of the Television Receiver—7

Power Supplies and Incidental Details are Dealt With in This Concluding Article on Modern Equipment

THE outputs of V_{14} and V_{15} appear respectively across R_{29} and R_{31}, whence they are applied via C_{16} and C_{17} to the frame deflecting plates of the cathode-ray tube. Both plates are returned to final anode via R_{44} and R_{45} and the instantaneous plate potentials are therefore equal and opposite with respect to this mean value.

The frame amplifier is therefore quite conventional, and the selection of component values may accordingly be carried out just as though an ordinary audio amplifier was in hand. The H.T. supply (point C) might be anything between 500 and 1,000 volts depending upon the amplitude of the sweep demanded by the tube. For most work however, an anode potential of 500 volts will prove sufficient, and valves of the power variety, such as the Mazda AC/P, or preferably the special AC/P4 may be employed. Suitable component values, using the latter valve are given by the manufacturers as follows: $C12 = C14 = 1\ \mu F$, $C13 = 0.25\ \mu F$. $C16 = C17 = 0.1\ \mu F$, $R27 = R31 = 2 M\Omega$, $R28 = 500\Omega$, $R29 = R32 = 200{,}000\Omega$, $R30 = 8M\Omega$, $R44 = R45 = 5M\Omega$. The bias resistances, which are not by-passed, should each be 10,000Ω. All voltage and wattage ratings are worked out in the usual way, special care being taken over the coupling condensers C16 and C17. With the tube connected as shown the final anode is some 3,000 volts above earth, and the insulation of C16 and C17 must accordingly be capable of withstanding this potential.

Turning to the line amplifier, stages V17 and V18, a modification of the frame circuit is employed to deal with the much greater frequency response requirements, and while the input to V17 is quite conventional with the exception of the series resistance R38, the method of feeding V18 has one or two interesting points about it. A grid resistance tapping cannot be used here, and so a capacity potentiometer is employed consisting of a small variable condenser in series with the input capacitance of V18. Taking the latter capacity to be Ci then the input to this stage will be $C22/(C22 + Ci)$ times the output of V17. The transferred hum from the anode of V17 has little effect on the grid of V18 for at low frequencies the grid resistance R42 takes over most of the coupling work and greatly attenuates any such voltage variations. C22, which has a maximum capacity of 10 $\mu\mu F$. is set up so that the outputs of V17 and V18 are equal, its exact final capacity depending upon the input capacitance of V18. This latter varies with the stage amplification, and for that reason C22 would probably need slight readjustment on replacement of a valve.

The remainder of this circuit is conventional, and the line deflector plates of the cathode-ray tube are fed in exactly the same manner as the frame plates. Using AC/P4 triodes, suitable component values are as follows: $C20 = 0.005\mu F$, $C21 = 0.003\mu F$, C23, $C24 = 0.002\mu F$, $R38 = 300\Omega$, R39, $R42 = 1M\Omega$, R40, $R43 = 500\Omega$. The anode resistances are each 85,000Ω, with bias resistances each 5,000Ω by-passed by $0.01\mu F$ condensers. R46 and R47 may each be 2MΩ.

Centralising.—It is general to provide the receiver with picture centralising controls, and these may be arranged as shown by R1, R2, R3 and R4 in Fig. 42. This diagram also shows a complete tube power supply circuit.

The outputs from the line and frame time-base amplifiers are fed to their respective plates via coupling condensers as described in the previous section, but instead of simply returning the deflector plate leak resistances to final anode, they are taken to the sliders

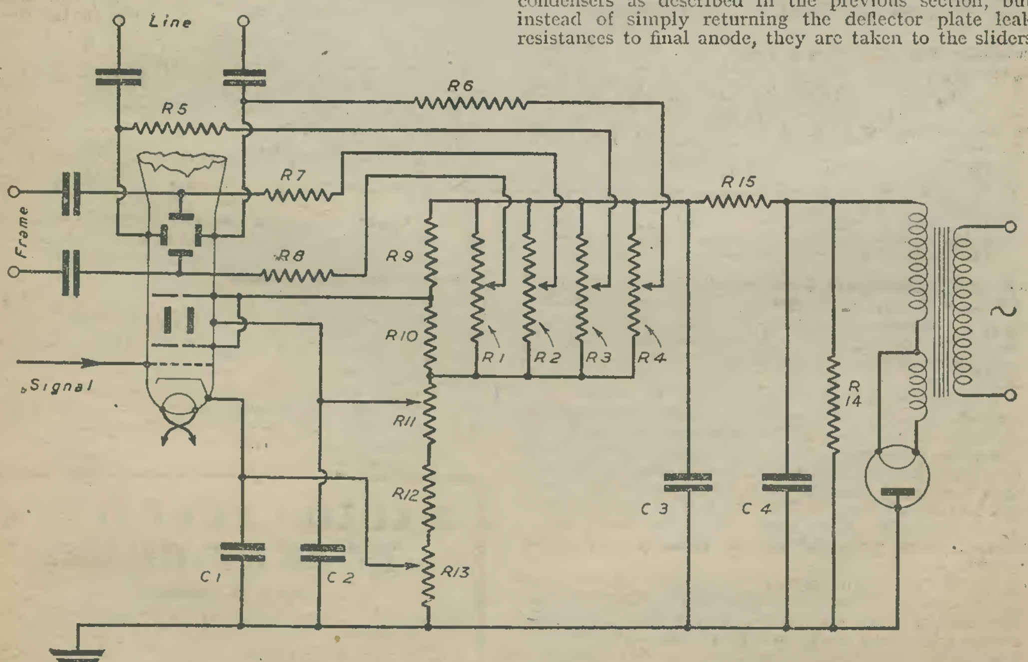


Fig. 42.—A complete tube power supply unit with centralising controls.

of four potentiometers connected in parallel across part of the tube supply network, R9 to R13, as shown. The final anode itself is taken from the centre point of R9 and R10. As a result, the potential of any deflector plate can be varied above or below that present upon the final anode by an amount equal to the voltage present across R9 or R10, usually in the order of 100 volts. These variable controls, considered in pairs, constitute the horizontal and vertical shift controls and enable the operator to centre the picture on the screen. They are generally pre-set inside the receiver and are not externally accessible to the ordinary viewer.

There is an optimum mean value for each pair of deflector plates with respect to the final anode and this may be in a positive or a negative direction. The setting of the four shift potentiometers does not end with the centralising of the picture, therefore, but includes the determination of the optimum mean potential so that defocusing of the image is not excessive. A deflector that is widely above or below the optimum mean value will defocus the electron beam seriously as it passes close by, and although a picture may be accurately centred on the screen, intolerable blurring may occur around its edges. In the figure R1 and R2 constitute the frame or vertical shift controls, and R3 and R4 are the line or horizontal shift controls.

The method of accurately setting up the picture for centre and maximum definition is quite simple, and the following drill is suitable for most receivers. First of all centre the picture on the tube and adjust the focus control, R11, for maximum clearness. The result may be perfect to begin with, but is unlikely. If defocusing is occurring on parts of the picture, shift the whole image upwards or downwards an inch or so by R1 and then recentre it by the other vertical control, R2. Refocus by R11 and note the result. If the definition is worse, reverse the procedure and shift the mean potential in the opposite direction. If the definition has improved, carry on in the same direction. When the best results have been obtained between R1 and R2, repeat the procedure with R3 and R4, adjusting R11 after *every* movement of the shift potentiometers. With care a well-defined image will be the result.

It is not always necessary to have four variable potentiometers as shown in Fig. 42, as centralising can be accomplished with two, say R1 and R3, only, the other deflector plate return leads going directly to final anode. This system reduces the number of pre-set controls but takes away the great advantage of being able to accurately focus the whole of the picture as described above.

Power Supplies.—The tube supply circuit of Fig. 42 is a good one and will do for almost any electrostatically focused and deflected cathode-ray tube. The exact voltage output will, of course, depend upon the tube, as also will the values of R11, R12 and R13, the various electrode voltage points.

In the figure, the first and final anodes of the tube are strapped together and go to maximum H.T. Some tubes are designed to work in this manner, but others require a much lower first-anode supply. In this case, a tapping along R12 is taken to the first anode, other connections remaining the same.

The smoothing arrangements of the supply are condensers C3 and C4 with a resistance R15. Good general values for these components are C3, C4 = 0.2 μF. (of correct working voltage), with R15 = 100,000Ω. If the potentiometer system (R9 to R13) is set up so that its overall value is from 2 to 3 MΩ. the current drawn from the rectifier is negligible and the separate resistance values can be regarded as being proportional to the voltages required. R9 and R10 should be chosen, taking into account the parallel effect of the shift potentiometers, so that about 100 volts appears across them. A resistance (R14) is sometimes included across the H.T. supply so that C3 and C4 are discharged after switching the receiver off; this is additional to the normal leakage through R9—R13 and is simply a safety precaution. The value of R14 should be at least 5MΩ. so that the current drain is negligible under working conditions. Condensers C1 and C2 may each be 0.5 μF.

The other power supplies for a television receiver are quite conventional and circuit diagrams need not be given here. In Fig. 1 the points A and B may be conveniently strapped together and taken to a 250 volts point capable of delivering sufficient current; the time-base supply point C is a separate supply of some 500 to 1,000 volts, depending upon the sweep requirements of the tube. The tube H.T. supply across D has just been discussed.

Conclusions.—We have now worked through the receiver circuit of Fig. 1, explaining its operation, discussing alternative design. Suitable experimental component values and valve types for a circuit built on these lines have been given where possible, and the circuit has been simplified in parts to make the explanations simple. While the analysis has been by no means exhaustive, sufficient details have been packed into the space to enable the home constructor to "get cracking" on experiments of his own. There are several good books on the market dealing with separate units like power packs cathode-ray tubes and time-base amplifiers. Back numbers of PRACTICAL WIRELESS are full of such things.

Magnetostriction Pickup

A GRAMOPHONE pickup which works on an entirely new principle has recently been announced. That principle is torsional magnetostriction—the variation of magnetic reluctance in a magnetostrictive wire when subjected to torsional stress in the presence of a magnetic field.

Magnetostriction is that property of certain ferromagnetic metals, such as nickel, iron, cobalt and manganese alloys which cause them to shrink or expand when placed in a magnetic field. Conversely, if subjected to compression or tension, the magnetic reluctance changes, thus making it possible for a magnetostrictive wire or rod to vary a magnetic field in which it may be placed. This is true for lateral as well as longitudinal strains, and on this principal the magnetostriction pickup works.

In one form a permanent reproducing stylus is fastened securely at right angles to the centre of a piece of nickel or other magnetostrictive wire. Two pickup coils, each wound with 100 turns of fine wire, are placed over the magnetostrictive wire on each end of the stylus. The ends are then looped over themselves and the wire given a slight twist and fixed between the poles of a horseshoe magnet. The wire is held in place and prevented from untwisting by looped ends that fit snugly into slots in the poles of the magnet. With the twisted wire in place, any motion of the stylus will cause the halves of the wire to twist in the same direction but the previous 90 deg. twist will cause the torsion on one half of the wire to increase as that on the other half decreases. This twisting and untwisting motion in the halves of the wire will increase the leakage flux factor around one coil and reduce it around the other. It is this varying magnetic field that causes voltage to be generated in the pickup coils. (*Radio-Craft, November.*)

Practical Hints

A Handy Test Prod

TO the end of a steel crochet hook, solder a length of insulated wire; terminate this in a clip or plug to suit the test instrument used. Cover the hook and joint with systoflex or small rubber tubing, leaving the business end bare.

This prod comes in very useful for adjusting wiring, pulling wiring apart, or holding wires to be soldered, as well as serving its usual purpose. —R. H. ALDERTON (Pudsey, Leeds).

The idea is clearly shown in the illustration below, and many other uses will no doubt reveal themselves to users of this idea.

A test prod made from a crochet hook.

All-purpose Tool

HERE is a tool capable of performing many really useful purposes.

A few of its applications are:

(1) Removing nuts from places that would otherwise be difficult to get at.

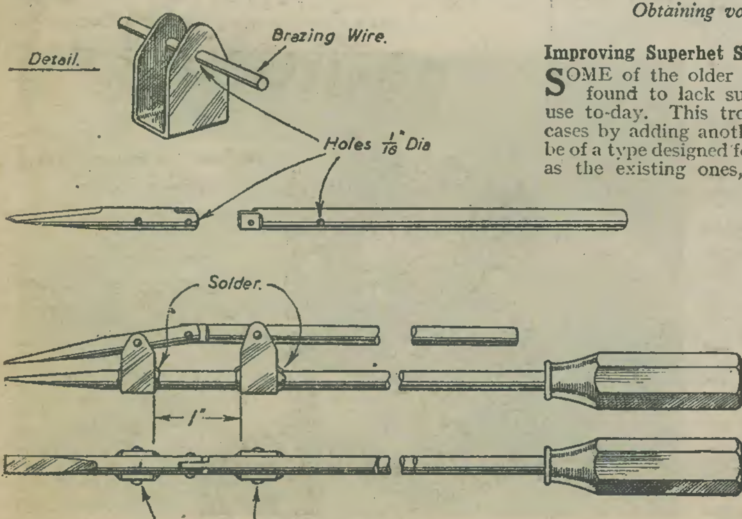
(2) Removing grub-screws from which one half of the head has been broken.

(3) Holding wires in awkward positions while soldering.

(4) Removing spring-clips from volume-control spindles.

It is made from two old insulated screwdrivers (the handle sawn off one), a piece of sheet metal (from an old radio chassis), and a short piece of brazing wire (1/16in. dia.).

To drill and file the screwdrivers, it was found necessary to remove the temper by heating the appropriate points to red-heat and allowing them to cool slowly.—F. S. ROBERTS (Southport, Lancs).



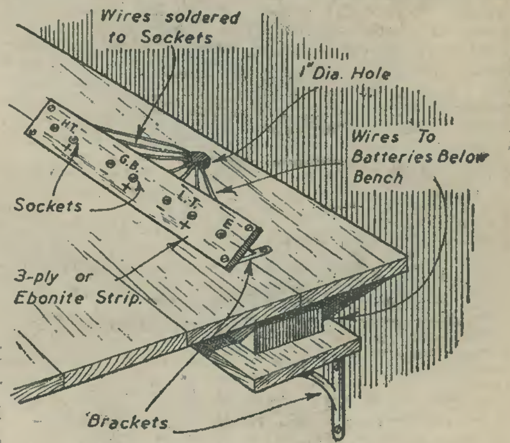
Mr. Robert's handy idea for an all-purpose tool.

Valve Type Numbers

IN many valves the number is printed on the glass envelope, and through frequent handling this number is often unreadable. I have overcome this by dipping the glass envelope in ammonia and allowing it to dry. The number will then stand out quite clearly.—M. PLEETH (Malta).

Bench Voltage Supplies

THE arrangement illustrated is quite useful on the repair bench. It takes up only a fraction of the space that the batteries themselves would, therefore allowing more space to work on. The sets to be tested can be simply plugged in when necessary. The sketch explains itself.—G. W. MERRITT (Pallion, Sunderland).



Obtaining voltages at the work-bench.

Improving Superhet Selectivity

SOME of the older types of superhet now in use are found to lack sufficient selectivity to be of great use to-day. This trouble may be overcome in many cases by adding another I.F. transformer. This should be of a type designed for the same intermediate-frequency as the existing ones, and all that is necessary is to disconnect the secondary from the grid or second detector and connect it through a small variable condenser to the primary of the new transformer. The secondary of the new transformer is then joined to the grid in the usual way. Selectivity may be adjusted by varying the capacity of the small condenser. It will be seen that this is really a slight modification of the crystal filter scheme, where the preset condenser is replaced by a special crystal. — B. WATTS (N.W.9).

Special types of transformer may be obtained for this purpose from advertisers in these pages.

On the Amateur Bands

A Monthly Report of Results and Conditions Experienced on the Short Waves. By "KAYAK"

International D.X. on 50 Mc/s.

THE highlight of the month's DX is the news of the spanning of the Atlantic on 50 Mc/s by W1HDQ, Connecticut. W1HDQ was heard in this country by G5BY and G6DH. G5BY heard W1HDQ at 16.17 and G6DH came across the signal a minute or two later. G5BY, South Devon, therefore has the distinction of being the first amateur to hear a 50 Mc/s signal across the Atlantic. Both British stations, working on the 28 Mc/s band, effected a "cross-band" QSO with the American.

How it came about is explained in the following extracts from letter received from G6DH:

"The limit of F2 propagation was only just about 50 Mc/s and consequently our band of 58.5-60 Mc/s was out of the question. Knowing that the F layer peaks around October-November, early in November I arranged schedules with W1HDQ on 29 Mc/s with a view to daily exchange of data on upper frequency limits (we explore the frequencies over 30 Mc/s each day to find limit). When I considered the maximum useable frequency was going well over 45 Mc/s and the American frequency modulation stations around 44 Mc/s were coming in well, I arranged for W1HDQ to transmit on 50 Mc/s.

"We had several tests before November 24th (the day upon which W1HDQ was heard on 50 Mc/s), but these proved unsuccessful. On Sunday 24th I was at home for the first Sunday for some time—my lucky day! The maximum useable frequency was not peaked until around 16.00. At that time I arranged with W1HDQ to call at fifteen-minute intervals commencing at 16.15. Searching around 50 Mc/s at 16.17 I heard a carrier which I thought was a shade lower than 50 Mc/s, but I was not sure of my receiver with 0.25 Mc/s at that frequency, so I tuned a little higher, and hearing nothing returned to the carrier which, to my surprise, was calling me on C.W. It signed W1HDQ!"

G6DH then tells how he immediately returned to 28 Mc/s and told W1HDQ that his 50 Mc/s signals had got across. By this time the American's signals had built up to QSA5, R6-7. Afterwards W1HDQ went on 'phone and was a fine signal, peaking at 16.30 to QSA5, R9. He remained audible until 17.00.

G5BY writes as follows:

"By receiving W1HDQ on 50 Mc/s 'phone at 16.17 on November 24th, I became the first person to hear a 50 Mc/s signal across the Atlantic. Here is the time-table of subsequent events:

"16.20.—W1HDQ signed-off after his five minutes' 'phone transmission by giving his call on C.W. and then listened on 28 Mc/s for G6DH.

"16.21.—I put out urgent CQ call on 28 Mc/s 'phone. W1BEQ replied and message for W1HDQ in his hands by 16.26.

"16.45.—W1HDQ announces on 50 Mc/s 'phone receipt of message from me and stands by for me on 28 Mc/s."

A cross-band QSO between G5BY-W1HDQ then resulted. W1HDQ faded out at 17.25, reception having lasted one hour and eight minutes. Signal strength at maximum, 10 to 20 db. above S.9 on the meter.

News from America indicates much 50 Mc/s activity during November, and DX results are eagerly awaited. The American Radio Relay League made special arrangements with amateurs in Australia and New Zealand to attempt 50 Mc/s contacts with the U.S.A.

G6DH informs us that since his contact conditions have fallen off, and no further signals have been heard in this country. He says that another good period of conditions is expected at the end of February, but it is just possible that one or two "peak" days may happen before then.

We must congratulate W1HDQ, G6DH and G5BY upon their fine work. It is another instance of the fine work being done by amateurs in the field of ultra-high frequencies.

The 14 Mc/s Band

DX conditions on this frequency have fallen off slightly. However, the band has produced its full share of interesting stations.

A new station to appear was CR4BQ (c/o British Sea Cable Station, Cape Verde Islands). On "key" CR4BQ was a steady R9 signal over a period of several days. Input was stated to be 1,000 watts. EK1AZ, Tangier, was heard on several occasions, though a very poor signal. QSL's should be sent to A.R.R.L.

Others of interest (on C.W.) were OX5JJ, East Greenland (cards to Jorgensen Cap, Adelaer); VE7ZM, British Columbia; CR9AG, Macao; and XZ2KM. QTH of the latter station was given as 379, Dalhousie Street, Rangoon. KL7AD, Alaska, was a good signal on several occasions as was W9MVF/KG6 operating from Guam Island. Good 'phone stations were many and varied, the best being VS9AR, Aden; XU1YY, Tientsin; and Chinese C4KH. The latter two DX stations were coming through early afternoons, but suffered considerable QRM from high-powered transmitters operating from Europe!

Dennis Tyler reports a flock of Pacific coast Canadians and Americans, and HH3L, Port au Prince; Haiti; OY3IGO, Thorshavn, Faroe Islands; VP4TB, Trinidad; and ZA2D, Albania. Dennis was puzzled by the number

Radio Amateur G5BY—first to hear 50 Mc/s signals across the Atlantic.

of "W" and "VE" stations (on key) calling "CQ SS" over a recent week-end, and asks what it was all about. The answer is that "SS" is short for "Sweepstakes," and this latter is the name of an annual DX contest run by the A.R.R.L. Entry is open to only American and Canadian amateurs, who have to work as many stations as possible inside their own countries.

A new contributor to these columns is BRS 5360, who sends along the following data: ZC1AR/ZC6, operating "under cover" near Jerusalem—QTH given as Box 360, Cairo; PZ1A, Rene Kowsoleea, Box 679, Paramaribo, Surinam; XACP, Signals Officer, R.A.F. Station, Elmas, Sardinia, A.P.O. S 497; and FM8AC, Robert Martinon, Box 260, Fort-de-France, Martinique.

The 28 Mc/s Band

This frequency has been erratic, but nevertheless remains full of interest. Best 'phones have been VS9AB, Aden; VU2CQ, 82, St. Andrew's Road, Bombay; YI2WM, Iraq; ZB1L, Malta; ZS6A, Johannesburg; and KP4AJ, Puerto Rico. Best Pacific coast 'phones were W6PDB and W6PCK, who were outstanding signals on a band full of "local" Americans.

G6BW still spends most of his time after the elusive DX on this frequency, and tells us of VE7AJN, British Columbia; ZL2BE, Hastings, New Zealand; VE6WC, Alberta; VE5JV, Regina, Saskatchewan; and XE1LE, P.O. Box 907, Mexico City. G6BW runs daily schedules with VS9AB and W8KYY. The latter station has been worked 495 times! G6BW notices, as we have, of the little use made of the H.F. portion of this band. We endorse his remarks that more British stations make use of this part of the 10-metre band.

BRS 7594 sends in a nice log of 28 Mc/s 'phones, including CN8BA, KP4CM, VO2N, XZ2YT, W6IDY, W7DTB, W7ILL and W7JPN. There are also some nice Americans from the more difficult States in the American 5th district. He also sends us the following DX QTH's: FG3FP, c/o Pan American Airlines, Dakar, French West Africa, A.P.O. 194, U.S. Army; CE3AE, P.O. Box 1544, Santiago, Chile; J3HRP, Kyoto, Japan, A.P.O. 201, c/o Postmaster, San Francisco, California; LU1ZX, yacht "Gaucho," c/o Radio Club of Argentina, B.A. This latter station was heard while it was in harbour at Las Palmas, Canary Islands.

The 7 Mc/s Band

This band is producing good DX for those who like early rising! Around 0400 hours we have heard W6VDB, W7ZK, Washington; VE4DX, Winnipeg; HC2CV, Ecuador; and Cuban CO5FL. An unusual one was JK3OL, of whose whereabouts we are uncertain.

Some good DX is reported by BRS 5360, who is a specialist in 40-metre matters. He recommends this band to short-wave listeners, pointing out that reports of DX heard on this band are always welcomed by the station concerned, whereas on the higher-frequency bands transmitting amateurs are inundated with reports. However, 7 Mc/s is mainly a C.W. band and it has no great appeal to the DX 'phone listeners. BRS 5360 quotes from a card received from W3GPP: "Your report card was a surprise to me, words cannot tell how I appreciate it." Most American stations will be genuinely pleased to receive reports on their 7 Mc/s transmissions, as due to the intense QRM from stations in their country, they have very little chance of hearing European signals, and consequently wrongly assume that their signals are not getting across.

Reports on DX stations for inclusion in these columns will be appreciated. Send to "Kayak," c/o this magazine. All for this month. Good listening!

An Efficient Dipole Aerial

MANY amateurs fight shy of constructing a dipole aerial in the belief that such an aerial is difficult and costly to erect. Continuing to use a single (Marconi type) aerial for receiving, they are robbing their sets of some of the results which are possible with an efficient dipole.

It is generally agreed that a dipole is necessary on V.H.F. of the order of 30 Mc/s to 60 Mc/s, corresponding to a wavelength of 5-10 metres. This is because of the critical behaviour of such high frequencies, but also because the actual aerial on these frequencies is of small dimensions. For example, the arms of a dipole for 5-metre work are 4ft. long; this lends itself to easy manipulation, whereas the corresponding length for 40-metre work would be over 30ft., which is not quite so convenient.

The arms of the dipole are generally straight, but it not necessary for them to be so; in fact, the folded ole gives good results, and is to be recommended for se situations where space is at a premium.

t can be located on the chimney of a house, or in the n air as high up as possible. But if this is not feasible t it can be placed in an attic or other high room, se height is the most important consideration, and ey endeavour should be made to get the aerial as high assible.

Sie Design

olded dipole can be built quite cheaply. It is small an mpact for 5- or 10-metre work, while for 20-metre wo it need be only 8ft. square.

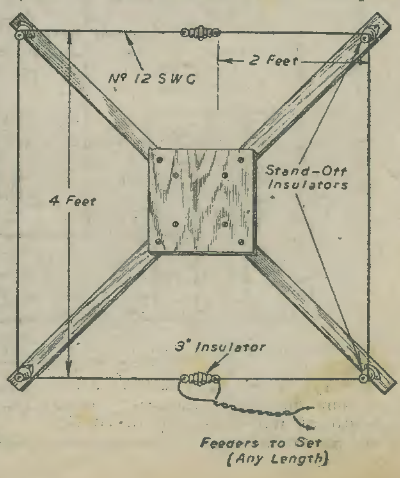
advantage of this type of aerial is that the feeders ca of any length. These consist of twisted wires, and ey can be led to the set by the most convenient rou It is unlikely that the feeders will be more than 50ft ng, but if so it will not matter.

T actual construction of the folded dipole is extremely simple. Two pieces of 3in. by 2in. timber are crossed at right-angles, and supported by a square of wood nailed to the centre at each side. The length of the pieces will depend upon the wavelength of the proposed aerial. That shown in the accompanying illustration is for 10-metre operation, and it will be seen that they are a little over 7ft. long. This gives a 4ft. square.

A stand-off insulator is placed at each corner, and No. 12 or 14 s.w.g. copper wire is run on in the manner indicated. Each of the arms is approximately 8ft. long, made up of the 4ft. vertical stretch, and two 2ft. horizontal stretches.

Corresponding sizes for the 5-metre and 20-metre dipoles are 2ft. and 8ft. respectively for the sides.

In use, the aerial must be pointed broadside to the desired station, and to facilitate this the entire dipole can be mounted on a gimbal for securing free rotation, or it might even be moved by hand. When using this dipole it will be found that in many cases an R6 signal will be brought up to R8 by its use.—WM. NIMMONS.



Mr. Nimmons' dipole aerial construction.

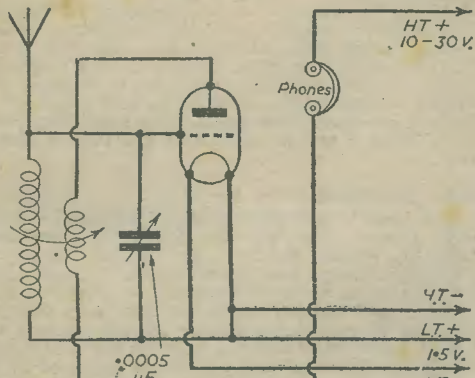


Fig. 1.—A simple one-valve circuit suitable for pocket receivers.

Pocket Rece

Some Useful Hints on the Construc

NOW that midget valves are more easily obtainable, it is possible to build many interesting miniature receivers. In the constructional work there is special scope for ingenuity, and the use of valves such as the well-known Hivac midgets enables extremely small receivers to be built. Such receivers can give very good results, and it is intended here to discuss some of the best circuits and layouts. Midget receivers such as those described in the pages of PRACTICAL WIRELESS recently will not be dealt with, but true *pocket* sets—which may be smaller even than matchbox size.

Circuits to Use

The circuit should use as few parts as possible consistent with the results required. A single-valve set such as that shown in Fig. 1 occupies a minimum of space and will provide fair earphone reception of the local stations with a short throw-out aerial and about 20 volts H.T. In this circuit moving-coil reaction is used to avoid wasting space on a reaction condenser. For the purpose in mind, the absence of grid-leak and condenser does not have any ill-effect, but in some cases it is necessary to by-pass the 'phones by a condenser of about .0005 mfd. to secure sufficient reaction.

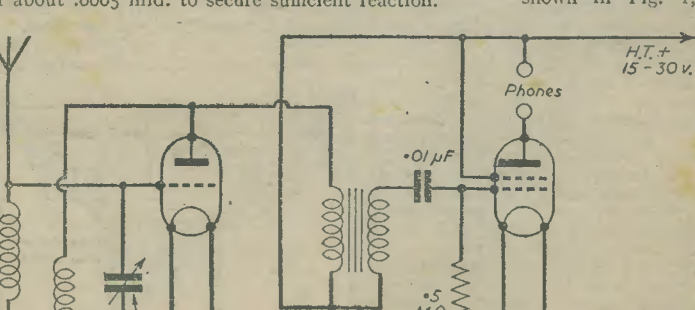


Fig. 2.—A more powerful circuit incorporating an L.F. stage.

H.F. stages are scarcely worth the space they occupy, but an L.F. stage using a pentode or triode is worth adding if really good 'phone volume is required. Resistance-capacity-coupling is not suitable because of the low H.T. voltage available. A parallel-fed transformer may be connected as shown in Fig. 2, or the transformer may be re-wound with the primary and secondary independent if a midget transformer for direct coupling cannot be obtained. As the detector anode current will not exceed .5 mA., there will be no danger of damaging the winding, although these small components are not intended to pass direct current.

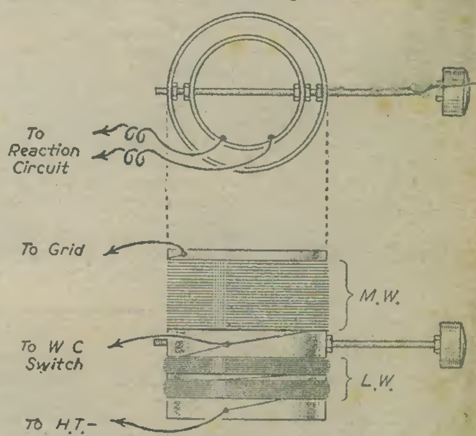


Fig. 3.—An easily made coil assembly, with moving-coil reaction.

As in Fig. 1, 1.5 volt valves should be used, and as the set will be somewhat larger, an on-off switch and reaction condenser have been added. When using the circuit shown in Fig. 1, with dimensions reduced to the minimum, on-off switching is accomplished by disconnecting the cell providing L.T. current.

More than two valves may be used, of course, but are scarcely necessary for earphone reception. By using the minimum number of valves the size is kept down, and small batteries will give ... service.

Moving-coil Reaction

This is worth using becaus... the reduction in size which it makes possible. Fig. 3 shows ... way of making the coil. The ...g- and medium-wave windings re placed upon a former in the ...al way, a smaller coil inside, sited between the sections of the ...d coil, providing reaction.

The reaction coil should be ...able of being rotated throug...80 degrees, connections to it be... of thin flex. A length of 6 B.A. rod forms an axle, a small knob ...uch

ceiver Design

of Midget Receivers

as a vae anode-terminal secured with a lock-nut, being used to turn the coil when listening.

Unfortunately, it is not easy to construct such a coil when its diameter is less than ¾in. In this case the arrangement shown in Fig. 4 may be used. Here the coils are flat. The grid coil is secured to the case, and the reaction coil to the lid. If the receiver is stood with case and lid vertical, it is possible to adjust reaction by moving the lid as required. The reaction will be found not very critical, and a minimum of space is used. When the lid is completely closed, the two coils should be almost touching.

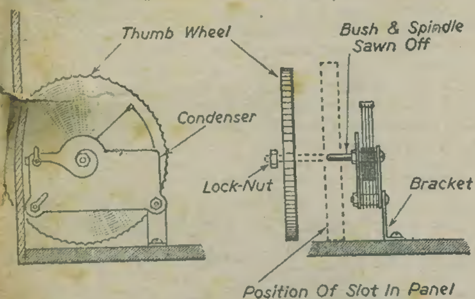


Fig. 7.—End-on or thumb-tip tuning may be provided as shown in this illustration.

The coils may be wound upon discs of cardboard with seven slots cut almost to the centre, the wire being passed back and forth through the slots when winding. Seventy turns of 36 S.W.G. wire on a disc about 1½in. in diameter is suitable for both grid and reaction windings for medium-wave reception. For long-wave reception, 200 turns of 42 S.W.G., wound on two discs fixed together, with 150 turns for reaction, may be used.

Capacity-controlled Reaction

Where a reaction condenser is to be used, it is often possible to use an ordinary ready-made coil of small size. In some cases the coil may be arranged so that one of the valves is inside it to save space. It is also possible to wind the coil round the box containing the receiver in the same way as a frame-aerial is wound. As the cabinet may not exceed 2in. by 2in., the winding should not be expected to function as a frame-aerial, but stouter wire may be used, and some increase in efficiency obtained. For medium-wave reception, 50 turns of 28 S.W.G. wire may be used if the case is about 2in. by 2in. Thirty turns of finer wire are suitable for reaction.

Fig. 5 shows another way of winding the coil which occupies little space. It is wound upon a piece of card cut to fit the inside of the receiver. The card has an odd number of slots, and the wire is passed from side to side when winding. If the card is about 2½in. by 3in., 35 turns may be used between grid and H.T. minus, with 25 between H.T. minus and reaction condenser. But as the coil should be as large as convenient, an increase in dimensions, with less turns, may be used. Because of its convenience and efficiency such a coil is worth while if possible.

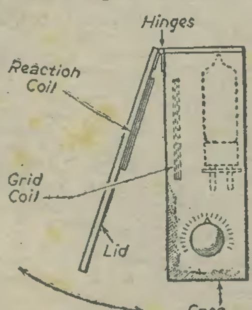


Fig. 4.—A novel method of obtaining reaction control by moving the lid of the containing box.

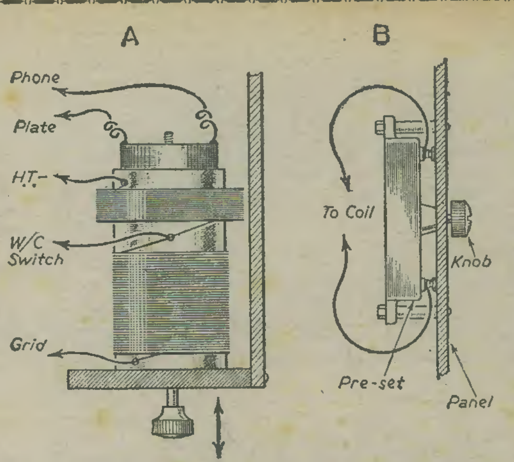


Fig. 6.—Another form of reaction control, and a method of mounting a pre-set condenser for tuning purposes.

Tuning and Reaction Arrangements

In Fig. 6 an easily-arranged and compact form of reaction control is shown at A. The reaction coil merely slides inside the grid coil, being near the earthed end of the grid winding when the small knob is pushed right in. Withdrawing the knob brings the reaction winding nearer the grid end of the tuning winding, increasing reaction.

B in Fig. 6 shows how a pre-set may be used for tuning. It should be bolted behind the panel with a screwed rod, complete with insulated knob, to permit adjustment. As the knob is screwed home, so will the capacitance be increased. The use of a trimmer or pre-set condenser of this kind (or two, if reaction is capacity-controlled) will allow dimensions to be considerably reduced.

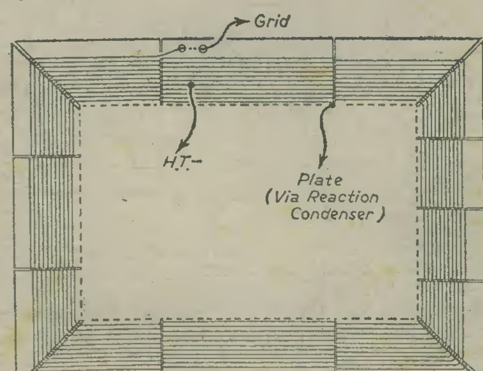


Fig. 5.—How to wind a coil on a slotted piece of insulating material.

Thumb-wheel Tuning

As shown in Fig. 7, this is arranged by mounting a small solid-dielectric condenser on brackets by the panel. The condenser should have its fixed bush removed, and the spindle cut down to about ¼in. long. The spindle may then be threaded to fit a hole tapped in a disc of ebonite, which is secured by a lock-nut. The disc is notched round the edge and protrudes slightly through a slot in the panel. By this means the thickness of the complete receiver may easily be kept down to ⅜in. Numbers may be marked upon the disc to facilitate tuning.

Coils, etc.

The size of the grid coils naturally influences the wavelengths tuned, and if a pre-set is used for tuning it will have a fairly high minimum capacitance compared with an ordinary tuning condenser. Because of this, the coils used may need adjusting to obtain the desired results.

If more turns than are thought necessary are put on all windings to begin with, turns may subsequently be removed from the grid windings if the desired minimum wavelength cannot be reached. Similarly, turns may be removed from the reaction coil if reaction is too fierce. More turns than necessary should not be used upon the reaction coils (and certainly not more than upon the grid coils) or peculiar r lts due to absorption will arise.

Reaction coupling should not be too ht when reaction is controlled by a pre-set, because , pre-set will have a minimum capacitance possibly in region of .0001 mfd. In consequence, it may be i ossible to stop the receiver oscillating.

When winding small tubular coils, 40 S.W.G. ngle-silk-covered wire may be used throughout. ety turns is suitable for the medium-wave winding, wi 90 for reaction, and 200 in a pile for long waves. is not wise to use a coil of less than ½in. diameter. If e coil exceeds ½in. less turns will be needed.

Batteries and Aerials

A single dry-cell should be used for L.T. A larg cell is not required except for a receiver with two or three valves, as the filament consumption is only about .06 amp. For H.T., torch cells or grid-bias batteries may be used. As the H.T. used will influence the ease with which the detector oscillates, it should be decided what voltage will provide the results required, and this voltage used in the initial tests also.

For the aerial, about 2 or 3 yds. of thin flex placed along the floor, over a chair, or as convenience dictates, will be suitable. A long aerial is not required, and should not be used or it may prevent the detector oscillating, unless a small condenser is included in series with the lead-in.

A New Sub-miniature Valve

A SUB-MINIATURE thyratron valve designed specifically for amateur and intermittent service, the RK61, is now being manufactured by the Special Valve Section of Raytheon Manufacturing Co., Newton, Mass.

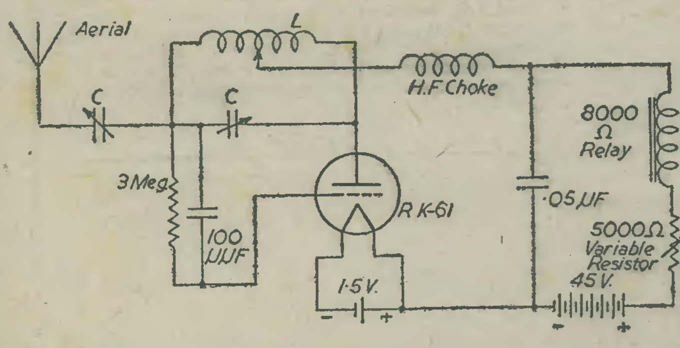
For remote control circuits, particularly radio control of model aircraft and boats, the RK61 is ideal in applications requiring extreme economy of space, weight and battery drain. Similar in characteristics to the popular Raytheon RK62, the RK61 is much smaller and lends itself to ultra-compact design.

Raytheon's type RK61 is designed for use as a self-quenching super-regenerative detector which will operate a high resistance relay in the anode circuit upon reception of a radio signal. The flexible terminal leads may be soldered directly to circuit components without the use of a socket. Standard sub-miniature sockets may be used by cutting the valve leads to .20in. length.

Electrical characteristics of the Raytheon RK61 are:

Filament Voltage (D.C.), 1.4 Volts.
Filament Current, .05 Amperes.
Average Valve Voltage Drop (at 1.5 mA), 30 Volts.
Anode Voltage, 45 Volts.
Relay Resistance, 5,000 to 10,000 Ohms.
Anode Current (no signal), 1.0 to 1.5 mA.
Anode Current (with signal), 0.1 to 0.5 mA.

The RK61 must always be operated with sufficient series resistance in the anode circuit to limit the anode current to the maximum rated value. The useful life of the valve depends upon the anode current, and may be prolonged by operating the valve with as low an anode current as possible.



A remote control circuit recommended by the makers of the valve described in these notes. L and C are adjusted for the frequency band desired.

A Suitable Circuit

The circuit illustrated is recommended for use with the Raytheon RK61 for remote control purposes. If it is desired, the 45-volt anode supply battery can be removed, and the circuit adapted for use with a 50-cycle A.C. anode supply. When operating properly, the valve should be oscillating at audio-frequency except during reception of a radio-frequency signal, under which condition the audio-frequency oscillation should disappear. The average anode current may be increased by increasing the aerial coupling, by decreasing the L/C ratio of the tank circuit, or both. The maximum controllable current may be increased by increasing the anode by-pass capacitance, by decreasing the grid leak resistance, or both.

If the capacitance of the anode by-pass condenser is reduced and the relay replaced by a pair of headphones, the circuit will operate as a conventional super-regenerative receiver with an anode supply voltage as low as 30 volts. Anode supply voltages higher than 30 volts require the use of a series resistor to limit the anode current to the maximum rated value. Operation at frequencies above 100 Mc/s is not recommended.

Frequency Modulation—6

In Concluding This Series, C. A. QUARRINGTON This Month Deals With Some Practical Considerations

SOME readers who have followed this series of articles on frequency modulation may not be interested in the principles governing the design of the transmitter, but are nevertheless strongly advised to read this article, as a description of transmission technique serves as an alternative approach to the understanding of basic frequency modulation principles.

The problem is to evolve a circuit which will allow the audio frequency output from the microphone, duly amplified, to modulate the carrier in such a way that *volume* controls the *extent* of carrier deviation, and *pitch* controls the *rate* of carrier deviation, in a linear manner. This requirement may seem to call for a most complicated circuit, but in actual fact this conversion from amplitude variation to frequency modulation can be carried out quite simply by two valves, or perhaps, more correctly speaking, one valve, since the other valve takes the form of the normal oscillator which must be an integral part of any transmitter.

The usual method of achieving frequency modulation is by employing a reactance valve modulator (sometimes called the quadrature valve), the broad principle of which can be explained very simply, though unfortunately a closer approach to exact working details is a little complicated. If the audio input to be transmitted is fed to the grid of a suitable valve the anode current will vary in sympathy with the input voltage, the *greater* the change in amplitude of the input, the *greater* will be the change in anode current; the more *rapid* the change of input, the more *rapid* will be the change of anode current; in brief, a condition exists whereby current is being varied in exactly the manner that it is desired to vary frequency. Frequency is normally dependent upon inductance and capacity; it follows therefore, that if the change of current could be exchanged for a change in either inductance or capacity, then frequency modulation is an accomplished fact. In practice the reactance modulator almost performs this imaginary change from current to inductance, the reactance valve, in fact, behaves like an inductance from the point of view of the grid circuit of the following valve (which is the oscillator).

The Reactance Modulator

Fig. 1 shows a very bare skeleton circuit of a reactance modulator; the valve chosen for this illustration is a hexode, though a more simple type of valve with a single controlling grid could be used; it happens, however, that a hexode is advantageous from the points of view of both circuit efficiency and easy explanation, since radio-frequency and audio-frequency circuits are automatically separated. Dealing with the function of the Reactance modulator in greater detail, its action may be summarised by the following sequence, which should be followed in conjunction with Fig. 1.

(i) The oscillator inductance, L, which is part of the oscillator valve circuit, is shunted by a resistance and condenser in series, R1, C1. Providing that the value of R1 is large compared with the reactance of C1 (say by five times or so), the current flowing through R1, C1 will be virtually in phase with the voltage across the oscillator inductance L, but the *voltage* across C1 will lag behind this current by 90 deg.

(ii) The voltage across C1 (which lags behind the oscillator current by 90 deg.) appears across the grid cathode circuit of the reactance valve and thereby causes a corresponding change in anode current.

(iii) The reactance valve anode current flows through the oscillator circuit, but lags 90 deg. behind the existing current; this superimposed current has the same effect on the frequency of LC, as if an inductance had been placed in parallel. Pure inductance causes current to lag 90 deg.

(iv) An increase of reactance valve anode current brings about a proportional frequency increase; since the magnitude of the former is directly proportional to the grid voltage, it will also be proportional to the audio-frequency input.

(v) The sequence (i) to (iv) results in a change of audio-frequency current having the same effect (on the oscillator frequency) as a change of inductance and direct frequency modulation is achieved.

To recapitulate in very loose language, the excuse for which is ready intelligibility, the audio-frequency input varies the reactance valve anode current, which varies the apparent value of the "phantom inductance" which in turn varies the frequency at which the oscillator circuit L, C, will oscillate.

Three Important Factors

Clearly, R1 and C1 in Fig. 1 require chosen values in order that the reactance modulator may deviate the oscillator frequency by the required extent. There are three factors to be borne in mind, when selecting these values: (a) the capacity of C1 will affect the oscillator deviation frequency; (b) the resistance at R must be large when compared to the reactance of C1, say, by five times or so; (c) the total series impedance of R1 and C1 must be large enough to avoid excessive damping of the oscillator circuit. Before replacing Fig. 1 by a more complete circuit, which includes the bare necessities required to enable a reactance modulator to function, it is necessary to digress on a matter which greatly influences the design of the reactance modulator circuit.

The initial oscillator deviation frequency as brought about by the reactance modulator will not necessarily be the same as the final carrier deviation frequency; in fact, in practice, the latter is almost certain to be at least several times greater than the former. A deviation frequency of ± 75 kc/s would be very hard to achieve by an ordinary reactance modulator in a linear manner, and furthermore, it is difficult to arrange for an oscillator valve to work at a very high frequency with acceptable frequency stability; it is convenient, therefore, that

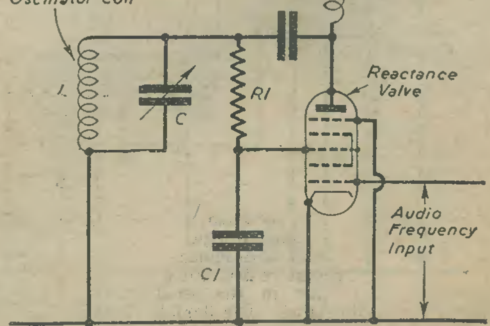


Fig. 1.—Skeleton circuit of a reactance modulator.

the oscillator functions at a lower frequency than the carrier frequency, the former being increased to the latter by frequency multiplication in accordance with normal high-frequency transmission practice. The advantages of frequency multiplication are very apparent with amplitude modulation, but with frequency modulation an additional and very important benefit is derived since such multiplication also multiplies the deviation of frequency. An example will clarify this point. Assume an ultimate carrier frequency, of 50 Mc/s and a maximum carrier deviation frequency of $\pm$ 75 kc/s; if frequency multiplication of four times is to be used, then the initial oscillator will oscillate at only 12.5 Mc/s, and the initial oscillator deviation frequency will only be 18.75 kc/s; if greater frequency multiplication is used, for example 16 times, then the carrier frequency (50 Mc/s) and the deviation frequency (75 kc/s) will both be divided by 16, and will be only 3.125 Mc/s and 4.6875 kc/s respectively. Clearly, the problem of designing a reactance modulator to bring about a deviation frequency of less than 5 kc/s is a very much more simple undertaking than would be the case if the deviation had to be $\pm$ 75 kc/s.

Practical Considerations

The importance of frequency multiplication having been made clear, some practical consideration can be given to reactance modulator design, and attention is therefore directed to Fig. 2. The reactance modulator valve V1 is arranged in a similar manner to the already familiar skeleton circuit Fig. 1. The vital network R1, C1 remains unchanged, although a grid-return resistance R2 and a bias resistor without attendant de-coupling condenser have been added, together with suitable arrangements for obtaining a screening-grid potential. It is unavoidable that the grid resistance R2 is in parallel with the condenser C1, but as the value of the former will be kept high, .5 – 1 MΩ, this point can be neglected. The choice of the valve V1 is governed by the fact that the "phantom inductance" combines with the oscillator inductance in such a manner that the resultant frequency is proportional to the square of the total inductance. In order that linearity is preserved, the reactance modulator must have a square law grid-voltage anode-current characteristic. It is also necessary that the anode current variation is linear with respect to the audio-frequency voltage input. These conditions are both met by the use of a pentode or hexode, providing that the audio-frequency input is kept small enough for the valve to function on the right part of the characteristic curve; if a reasonable multiplication factor is used this latter requirement is easily met, as a circuit such as that shown at Fig. 2 will produce a frequency deviation up to 10 kc/s per audio-frequency peak volt input. The hexode has the great advantage over the pentode that automatic separation of the radio and audio-frequency circuits is achieved.

It has been stated above that the values of R1, C1 must be chosen with due care. Clearly, however, the value of C1 is related to the maximum frequency deviation required from the initial oscillator V2. It is equally apparent that the effect of the "phantom oscillator" R1, C1, will depend on the inductance of the oscillator coil L. With a view to limiting the action of the reactance modulator to bring about the required change, it appears desirable that L should be as large as possible, and C as small as possible, consistent with oscillating at the required frequency. Unfortunately, however, relatively large inductance and small capacity is unfavourable to good frequency stability. It is, therefore, necessary to effect a compromise between making C large in the interests of frequency stability, and restricting the action of the reactance modulator V1 in the interests of linearity; if a high value of frequency multiplication is used, the problem is much simplified, as the maximum deviation of the initial oscillator frequency is proportionately reduced and the task of the reactance modulator correspondingly eased.

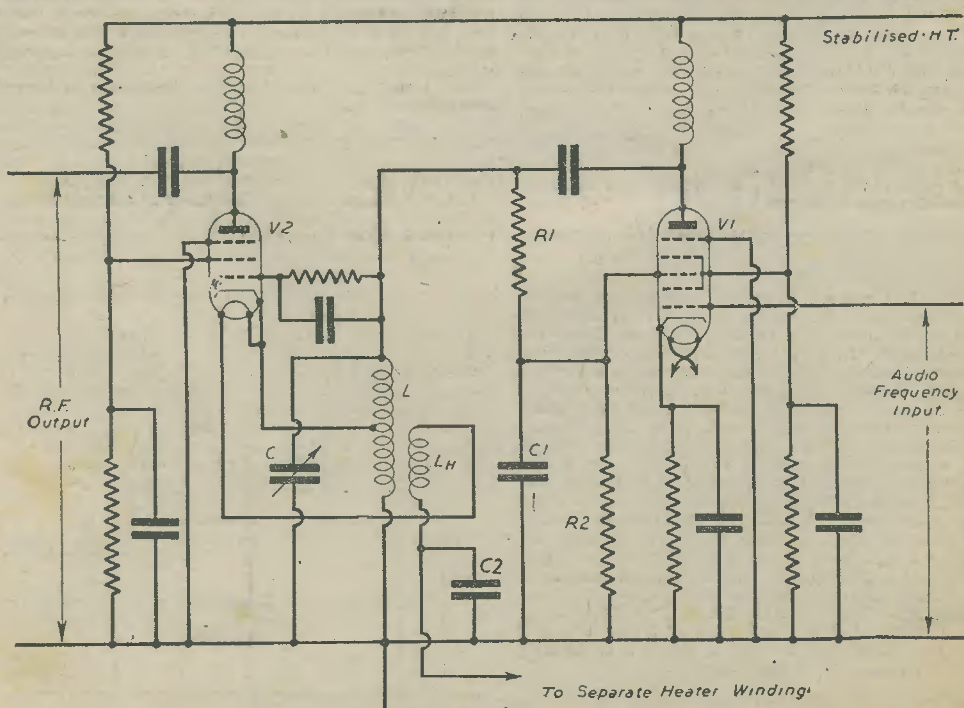


Fig. 2.—A complete reactance modulator circuit as described in the above notes.

There are a variety of oscillator circuits that could be used but the arrangement Fig. 2 was selected as a ready means of fulfilling two conditions which are, (i) the convenience of having one side of the oscillator inductance at earth potential, so that the "phantom inductance" can be connected directly in parallel, and (ii) good isolation between oscillator and amplifier. The arrangement adopted is an electron-coupled Hartley oscillator, which in itself gives good isolation, but is followed by an untuned anode coupling which gives greater effective isolation than the more efficient tuned coupling.

There is a disadvantage with the use of this circuit. The heater cannot be held at earth potential from the R.F. point of view, and consequently there is danger of mains hum appearing as a frequency modulation component in the output. This danger can be avoided by supplying the heater with D.C. or by adopting the modification incorporated in the circuit at Fig. 2, whereby one side of the heater is joined to cathode and taken to the tap on the main inductance, the other side of the heater being taken through the special inductance L_H, which is equal to and tightly coupled to the appropriate portion of the main inductance; preferably, L_H should be interwound with the appropriate portion of the main inductance L. As one side of the heater is at earth potential, a separate heater winding is suggested in order that the heaters of other valves employed may have a symmetrical earth connection by means of the usual centre tap on or across the appropriate transformer secondary. The condenser C_2 which joins the high potential side of the heater to earth, can consist of a paper condenser having a capacity of about .5 mfd. and, like all other decoupling and by-pass condensers shown, should be shunted by a small flat type mica condenser of low value, say about .0001 mfd., to act as a very high frequency by-pass.

It is essential that the reactance modulator and oscillator should have a stabilised high tension supply controlled within very close limits by some means that responds with a very small time delay such as the electronic voltage regulator circuit, the principle of which is well known. This precaution is vital in the case of the reactance modulator, as a change of anode voltage will bring about a change in anode current which in turn would bring about a change in the apparent value of the "phantom inductance," and in turn cause frequency deviation of the initial oscillator. For similar reasons it is equally essential that the circuit should have negligible hum pick-up.

The audio-frequency amplifier which must necessarily be used between microphone and reactance modulator will be of conventional design, attention being paid to the necessary wide audio-frequency characteristics, say 25 c/s. to 15 kc/s., the very best possible signal-to-noise ratio and freedom from mains hum. The output of the amplifier will not need to be large unless frequency multiplication is restricted, since, as already stated, a reactance modulator of the type illustrated will give a deviation ratio of the order of 10 kc/s per audio-frequency peak volt input. The multiplier and radio frequency amplifier circuit can be quite conventional except that correct tuning is more important with frequency than with amplitude modulation, and neutralising must be carried out with especial care to avoid the possibility of phase shift, which may result from incorrect adjustment.

The reactance modulator circuit shown at Fig. 2 and the suggested conventional multiplier and radio frequency amplifier stages, represent the minimum requirements of what is so often vaguely referred to as a simple transmitter. Where economy and other considerations do not limit the scope of the designer, numerous refinements can be incorporated, two of which are worth mentioning from the interest point of view. The possibility of slight amplitude variation occurring in the output of the initial oscillator is usually checked in the more elaborate transmitter by a limiter stage immediately following the initial oscillator which performs the same office for the transmitter as the already familiar limiter performs for the receiver. Another refinement is a means of keeping the entire carrier "structure" on its proper frequency. This sometimes takes the form of a frequency amplitude converter circuit arranged to work backwards, the R.F. side being fed by a crystal stabilised oscillator and a fraction of the initial oscillator output which combine to bring about a D.C. potential across the diode loads, when necessary, which voltage is used to bring about a change of bias on the reactance modulator valve which in turn corrects the initial oscillator frequency.

Regulation of Power Supplies

Some Useful Information on Mains Unit Working.

By C. A. HOOLEY

FOR a power supply to have perfect regulation it would have to have zero output impedance. In practice this cannot be achieved, and therefore some means of voltage stabilisation or regulation of the power supplies to a critical circuit, may be necessary.

The simplest form of voltage regulation is a circuit which incorporates a cold cathode gas-filled valve. The characteristics of this type of valve is such that for a varying current the voltage drop across the valve remains sensibly constant. It can be seen from the characteristics of these valves that the "firing voltage" (the voltage at which the gas ionizes) is much higher than the normal working voltage, and hence it is necessary to have a supply voltage which is equal to, or preferably higher than, the "firing voltage." This supply voltage must be applied to the valve through a suitable series resistance so as not to cause overloading.

Therefore the value of the resistance "R" in Fig. 1 must be such that for maximum rated current through the valve, the voltage developed across the valve will only equal the normal working voltage.

It can readily be seen then that $R = \frac{Ei - Eo}{I \text{ max.}}$ where Ei is the supply voltage, Eo is the normal working voltage, and I max. the maximum current rating of the valve.

It should be emphasised that the current through the valve should not be allowed to fall below the minimum rated current specified by the makers, as below this value the valve becomes unstable and results are likely to become erratic.

Example.—It is desired to obtain a stabilised supply of 90 volts from a power supply of 200 volts.

A V.R.90 could be used. From the valve characteristics

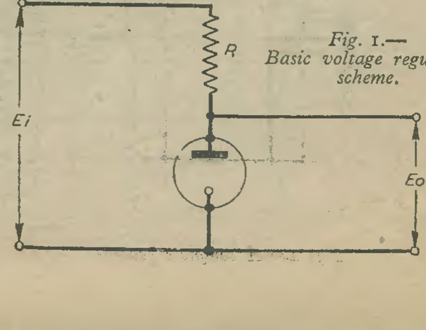


Fig. 1.—Basic voltage regulator scheme.

we find that the minimum starting or firing voltage is 125 volts, the operating voltage is 90 volts, and the operating current 10 mA's min. and 30 mA's maximum.

$$\text{Therefore } R = \frac{Ei - Eo}{I\,max.} = \frac{200-90}{.03} = 3{,}666 \text{ ohms.}$$

A resistance of 3,700 ohms could be used with good effect.

The maximum safe current to draw from this circuit would be 20 mA's since the total current through R should not exceed 30 mA's and the minimum current rating of the valve is 10 mA's.

Valve Voltage Regulation

Valve voltage regulators are divided into two types, series regulators, and shunt or parallel regulators. Series regulators are used to supply currents up to 300 mA's while shunt regulators are used for currents over 300 mA's.

The series regulator is, basically, a device which varies the output impedance of the supply in sympathy with the attempted variations of the output voltage, i.e., if the output voltage tends to fall, the output impedance of the regulator falls also, tending to build the voltage up again. This is achieved in the following manner:

A suitable power triode or beam tetrode is placed in series with the supply. The output voltage Eo is then dependent upon the dynamic impedance of the series valve, this impedance being controlled by the grid potential of this valve. If the grid potential then is controlled by the output voltage so that when Eo falls the grid goes more positive the valve will act as a regulator. It is obvious then that the variations of Eo must be inverted before being applied to the grid of the series valve, and to achieve good regulation should also be amplified. A circuit such as that shown in Fig. 2 could be employed.

The battery is used as a negative bias and reference voltage. Any fluctuations in Eo are developed across R1 and R2 and hence applied to the grid of V1. Let us assume that Eo decreases; the grid of V1 will go more negative, the anode current will decrease and the anode voltage will rise. This will reduce the voltage bias on V2 and the anode current of V2 will rise to bring Eo back to the original value. It can be seen from the circuit that the supply voltage, output voltage and maximum output current depend upon the characteristics of valve V2, Valve V1 and it's associated circuit is essentially a voltage amplifier. The greater the amplification of this stage the greater will be the degree of regulation. Therefore, to increase the degree of regulation the voltage amplification of this stage must be increased. In cases where an absolutely stable voltage is required the first stage may be replaced with a 3-valve cascade D.C. amplifier which has a small amount of negative feed-back to ensure stability. A circuit of this type would give extremely fine regulation,—.016 per cent. regulation with A.C. ripple less than .001 volts having been obtained. Such fine regulation is not usually necessary.

It should be noted that the resistances R1, R3 and R4 are very critical and should be of the ± 1 per cent. stabilised type. The potentiometer R2 is a wire-wound type. It is obvious that if these resistors were normal carbon ones any increase in their temperature would cause the output voltage to drift; hence stabilised resistors must be used.

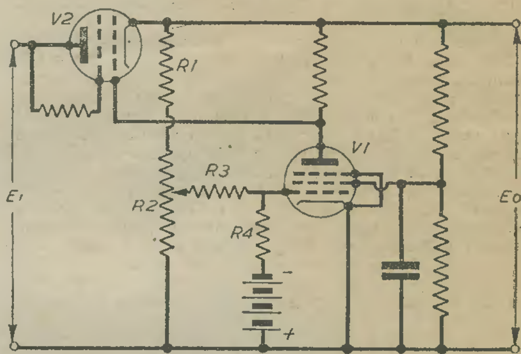


Fig. 2.—A series voltage regulator circuit.

Parallel regulation is basically a dummy load on the power supply which varies in an inversely proportional manner to the actual load variations. This is achieved as shown in Fig. 3:

In this circuit it will be seen that the output voltage Eo depends upon the current flowing through the resistance R1, R1 being of low value and high wattage rating. The valves V1 and V2 act as a dummy load. It can be seen that variations of their grid potential will cause variations of their anode currents, which in turn will cause variations in Eo. If Eo falls, it is clear that the grid potential of valves V1 and V2 should also fall to cut down the current consumption of these valves and hence lift Eo back to it's original value. It would not be much use tapping off part of Eo and feeding the grids with that. Some degree of amplification is essential. Therefore, valve V3 which is a twin triode is used to provide the necessary amplification of the variations of Eo. Let us consider what happens in the circuit when Eo rises. The battery is providing a negative bias and a reference voltage to the first half of V3. The voltage across R2 and R3 rises, and therefore the voltage applied to the grid of the first half of V3 will also rise. Its anode voltage will fall and thus increase the bias on the second half of V3 causing its anode voltage to rise. This lifts the bias on V1 and V2 and their anode currents rise causing a larger volt drop across R1 and bringing Eo back to its original value. Thus regulation is achieved. The degree of regulation can be increased by increasing the amplification of V3 or adding further voltage amplifiers as necessary.

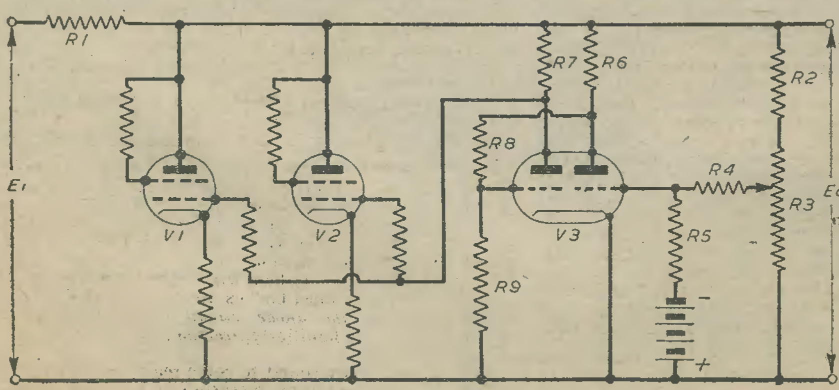


Fig. 3.—A circuit for parallel regulation.

Note.—R2, R4, R5, R6, R7, R8 and R9 are all ±1 per cent. stabilised resistors, R3 being a wire-wound potentiometer.

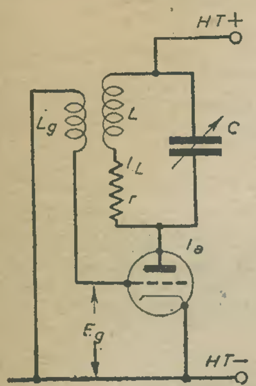
Technical Notes—4

Some Interesting Information on the Performance of Oscillators. By "DYNATRON"

THERE are two ways of regarding the action of oscillators. Probably there are many more, but they reduce to one or other point of view.

The first consists in trying to give simple pictorial analogies of the actions taking place. For example, an oscillator may be compared with a synchronised "triggering" device, which releases energy from the high-tension source at exactly the right moments to sustain a sine-wave oscillation in an LC circuit placed in series with the valve.

From the standpoint of *phase*, the words "right moments" are the relevant ones here. The mechanical analogue is a pendulum or a swing kept oscillating by timed impulses delivered at the right intervals. Or, in general, there are two methods of maintaining a constant amplitude of "swing."



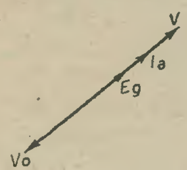


Fig. 1 *(Left).—Simple oscillating circuit; and Fig.* 2 *(above), a basic vector for the circuit functions.*

Energy may be supplied as impulses, as described, corresponding to Class B or Class C operation of a valve—"flick" impulsing. Or, alternatively, a *continuous* force whose frequency is the same as that of the pendulum may be applied; this is equivalent to a valve working in Class A, and so delivering a nearly sine-wave (instead of a "pulse") current which is in step with the sine-wave voltage swings taking place across the LC load.

In each case, there are at least two quantities to bear in mind. First, there is the considerable amount of energy "stored" in the pendulum, or in the electric and magnetic fields of a coil-condenser combination—the energy of the oscillation. Secondly, there is the energy supplied to maintain the oscillation.

Thus, in the valve circuit of Fig. 1, an oscillatory current Io is circulating in the closed circuit formed by L and C—which is the current "oscillation." Then there is the A.C. component Ia supplied by the valve, to maintain Io at a steady amplitude. Actually, Ia is the familiar "make-up" current of a parallel rejector, and it will generally be much smaller than the circulating current Io. Alternatively, the valve may supply current impulses, equivalent in their effect to a sine-wave current of lesser amplitude.

Io also develops a sine-wave *voltage* across the LC load. An easy way to get some ideas on *phase* in valve oscillators is to say that Eg must cause to be developed across the LC circuit a supply voltage V, *in phase with the existing sine-wave voltage due to Io.*

This suggests the limitations of the "pictorial" method. In referring to "the existing sine-wave 'voltage' due to Io," do we mean the *back E.M.F.* in the load? If so, then the supply voltage is at 180 deg. to this E.M.F.

Pictorial analogies have their uses—provided they are not more complicated than the effect they purport to simplify! The name "pendulum circuit," or "flywheel circuit," which the Americans apply to an LC load, is quite a useful picture portraying energy "stored", and energy "supplied" to make up losses. Equally, "tank circuit" is a term which helps to convey right ideas on the subject.

But when it comes to giving an accurate account of the various phase-shifts in a network, pictorial analogies either become terribly involved, or fail completely as adequate descriptions. Indeed, what may look like a simple valve network becomes amazingly complicated at high radio-frequencies—too much so even for vector treatment.

Many so-called "simple oscillators," such as the Tuned Anode/Tuned Grid, are quite complex affairs to try to analyse. They are simple enough to construct and to operate, but their theory is definitely not easy to follow. Things are more complicated in this type of oscillator because there is usually a combination of magnetic and electrostatic (interelectrode capacity) couplings, whose vector relations are fundamentally different.

However, if vector principles are thoroughly understood, they convey a much more accurate picture of phasing requirements in the simpler types of oscillators than, let us say, pictorial accounts which go into great detail about the directions of "electron flow," the "signs" of various potentials, and so forth.

It may be important from an academic point of view to make the fullest use of electron conventions where valve circuits are concerned, and to "chase" the potential signs on the plates of condensers in terms of electrostatics, etc. Enough has been said in previous articles of this series to show how a good understanding of A.C. phase relations can be got with the aid of a few easy vector conventions of a kind long agreed upon in electrical engineering.

In what follows, the reader will be presumed to know the basic conventions frequently stated and summarised in the other articles, including the writer's "Technical Notes," which appear periodically in PRACTICAL WIRELESS. Let us look again at Fig. 1.

The Self-driven Amplifier

In an ordinary amplifier, Eg would be called the "signal" or "driving" voltage applied to grid-cathode. It is an alternating voltage derived from an extraneous source, such as an aerial, a crystal drive, or some audio-frequency source. Eg is the voltage it is desired to "amplify"—which word may mean *voltage* or *power* amplification. It reappears as a much enlarged voltage across some impedance forming an anode load.

In the self-oscillator, Fig. 1, there is no "extraneous source" of drive. The valve with its LC circuit is a *generator* of H.F. oscillations (or sometimes L.F.). As such, it must necessarily be a *self-driven*, power-amplifying stage. The grid must be "excited" by an alternating Eg *derived from the anode circuit* by using positive feedback, or, more familiarly, *reaction.* The reaction coil is shown by Lg.

Now, all this may sound to some readers like arguing in a circle. First, we want to *generate* an H.F. oscillation, then we assume it already exists for the purpose of providing our Eg. Or, if Eg (=" drive ") is necessary to generate the oscillation, how on earth does the said oscillation build up in the first place—since no extraneous drive is employed?

The textbooks will tell you that at the instant when the H.T. is switched on the LC circuit is " shocked " or " disturbed " in some way, which immediately brings about an oscillatory state. Of course, the oscillatory circuit is quite indifferent to " shocks " in the more human sense. What is really meant is that starting a current flowing in L will, according to the laws of Faraday or Lenz, set up a back E.M.F. in the coil turns —because a magnetic field comes into existence.

With a small valve and an inductance of a few turns, this E.M.F. will be exceedingly small—possibly only a few microvolts, or at most millivolts. Nevertheless, it will divert a few electrons into C by virtue of the " opposition " they meet in the inductance. The condenser will automatically receive a minute " charge " at the instant of switching on.

At the same instant, there will be a momentary E.M.F. induced in the coil Lg, which will be applied to the grid of the valve. If Lg is connected the right way relative to L, this momentary " kick " will have the effect of causing a larger current change in the anode circuit than would otherwise be the case, and hence giving an added fillip to the number of electrons and the charge which C receives.

The rest is a story that should be familiar. If a charged condenser is discharged through an *inductance* (not a resistance!), it can be proved—though we shall not do so now—that a natural oscillation will be set up, whose *frequency* is given near enough by:

$$f = \frac{1}{2\pi\sqrt{LC}} \text{ cycles per second,}$$

if L=*henries*; C=*farads* of capacity.

In other words, a very minute *alternating current* Io, frequency f cycles per second, will be generated in L and C, and there will also be a very small *alternating voltage* of the same frequency existing across the coil and condenser respectively.

But don't forget the coil Lg! An alternating current, however minute, flowing in L will induce an E.M.F. of the same frequency in Lg. Even if the E.M.F. returned to the grid in this way is only *one-ten-millionth* of a volt, it will be amplified by the valve—perhaps about 10 or 20 times in an ordinary triode.

When we talk of a valve " amplifying," we signify something more than a mere *voltage* step-up. Amplification, proper, means that D.C. *energy* is released from the high-tension source, and converted into *A.C. energy* by the valve action. So, one-ten-millionth volt returned to grid reappears as a larger voltage, and considerably larger amount of energy, in the LC circuit.

The initial minute oscillation is boosted up to something more respectable. Simultaneously, a bigger E.M.F. is induced in Lg, giving the grid a bigger " swing," and causing the valve to convert still more H.T. into oscillatory output. The initial shock-oscillation rapidly builds up into one of large amplitude. In fact, it will go on building up until limitations set by the valve and power supplies finally restrict the amplitude to a steady value.

Does this make it clear what is meant by a " self-maintained," or self-driven oscillator? We are not getting something for nothing! In a sense an oscillator is a sort of " perpetual motion " machine, but only as long as energy is supplied to it from a battery or mains unit. It is not the sort of " self-driven " machine with which perpetual motion enthusiasts once hoped to solve most of the world's troubles!

You should observe another point about the type of oscillator we are considering. The mechanism above described assumes that part of the circuit comprises a network capable of initiating *a sustained sine-wave oscillation*. The tank circuit LC has a " natural period," which, of course, can be altered by tuning by means of L or C. All oscillators employing tuned circuits are *sinusoidal* types. Other types, such as multivibrators, generate highly distorted oscillations, usually determined by capacitance-resistance (CR) constants of the network.

It is possible in these non-sinusoidal types to extract a *sine-wave harmonic* by inserting an LC circuit tuned to its frequency. In fact, one of the advantages of multivibrators is the wide selection of harmonics which can be obtained, but we shall make little or no further reference to them in the present article.

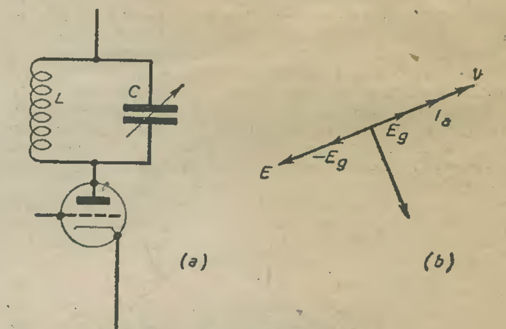


Fig. 3.—An " ideal " oscillator, having no resistance, and its vector.

The Phase of Eg

The easiest way to grasp " phasing " of an oscillator is to consider, first, straightforward amplifying conditions, then inquire what phase Eg should have to *self-maintain* this state if the extraneous driving E.M.F. were removed.

If the stage in Fig. 1 were driven from outside, maximum Io (and voltage) would be developed in the tank circuit when it is tuned exactly to resonance with the applied grid-E.M.F. It is now a simple amplifying stage, where the frequency is that of the applied signal. Detuning the anode circuit cannot alter the *frequency*, but only the amplitude of the alternating output current and voltage.

Clearly, we could make this state self-sustaining if it were possible to feed back, via the coil Lg, an alternating E.M.F. Eg *exactly in phase with the extraneous Eg which is being amplified.* The outside source of drive may then be removed, when a self-oscillation will be maintained at the original frequency to which LC was tuned—or very nearly so.

But this means: *the relative phase of Eg in an oscillator must be exactly the same as in the corresponding amplifier* for maximum output. At its resonant frequency, the tuned circuit will look like a pure resistance, and, therefore, by our vector rules, Eg will be in phase, with Ia (no matter what the load impedance—resistive, inductive, or capacitive), and both will be in phase with the A.C. supply voltage V existing across the load.

The textbooks make no mention of V, and consequently the usual statement runs: Eg must be at 180 deg. (in an oscillator, as for an amplifier with pure resistance load) to the valve *anode-to-cathode* voltage Vo.

So ambiguous is the basic literature on these questions that we read in one leading textbook: " the voltage fed back . . . must be approximately 180 deg. out of phase with the voltage existing *across the load impedance* in the plate circuit. . . ."

The italics are mine. Evidently by " voltage existing across the load impedance " this authority meant the anode-to-cathode voltage Vo. The question has been covered at considerable length in my articles in PRACTICAL WIRELESS, e.g., see " Technical Notes," November, 1946. I am still waiting to hear any valid criticism of my view that V and Vo are at 180 deg.!

So, the simpler statement, both for amplifiers and oscillators, is to say that Eg is *in phase* with the applied voltage V existing across the load. Also, Eg and Ia are always necessarily in phase with each other, at ordinary frequencies.

As long as we may assume the tank circuit resonant, therefore, our basic vector diagram becomes that shown in Fig. 2. In an amplifier, Vo will be the output voltage fed to the grid of the next valve. In oscillators it becomes of importance only when considering feedback through the valve anode-to-grid capacity. At present, we are concerned with *magnetic* feedback due to the coupling between anode and grid coils, so we shall generally refer only to V as being the "load voltage."

The next question is whether it is possible to get an Eg in the phase relationship shown, by using magnetic feedback.

Remember that Fig. 2 is a vector diagram which is automatically fulfilled in an amplifying stage having independent drive, and a resistive load. For it to function as a self-driven oscillator, we must feed back an Eg *from the anode circuit* which will also meet this fundamental phase condition for supplying A.C. power into a "load."

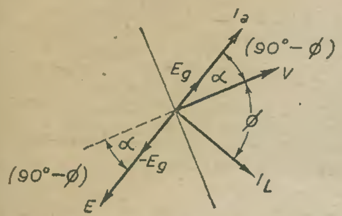


Fig. 4.—Complete vector for the function of the circuit in Fig. 1.

To give the answer, we must look at other phase-shifts in the network.

Phase-shift in the Tank Circuit

You will notice that a series resistance *r* is included in the inductive branch of the tuned-circuit, Fig. 1.

We might consider an "ideal" oscillator which has no resistance, Fig. 3 (a). If we do, it should be taken with "a grain of salt," since, in the first place, there is always some *loading* on a stage required to develop R.F. power. Secondly, no valve or power supply would be necessary to sustain an oscillation in a loss-free circuit! Like a flywheel without friction, an oscillation would continue indefinitely, once started.

However, we will vectorise this fictitious case, and modify our diagram afterwards.

Let us suppose an oscillation *is* taking place. The problem, then, is to deduce the phase conditions. In Fig. 3 (b), we start with Eg. It is, of course, obtained via "reaction" coupling between L and Lg. After we have completed the vector diagram, we should be able to get an Eg vector which coincides with the one we started from. If not, the hypothetical oscillation, assumed, can *not* take place. This is always the best way to commence investigating oscillatory conditions.

Well, then: Eg sets-up an A.C. component Ia, in phase with Eg. Next, Ia develops a "supply" component of the H.T. across the tank load, also in phase with Ia, and consequently with Eg. Here is our load voltage V. Can it be sustained by feedback to the grid?

At this point there are one or two phase-shifts to consider due to the tuned circuit and mutual coupling. First, since L is a pure inductance, there will be a current IL flowing in it, and *lagging* 90 deg. on the applied voltage V—this is really the oscillating current Io, *in the inductive arm.*

While IL lags 90 deg. on V, it at the same time sets up a *back E.M.F.* E in the inductance, opposing V, and thus at 180 deg. to V—or lagging on IL *another* 90 deg. Follow these angles out in Fig. 3(b). Finally, the same magnetic field which induces E in the anode inductance will induce an E.M.F. Eg in the *grid* coil Lg. Hence E and Eg will be of the same phase—both at 180 deg. to V, Ia, and to the *original* Eg we assumed.

This means: if the coils L and Lg are wound and connected up in the *same* sense, the induced E.M.F. in Lg will be of the *wrong* phase to maintain an oscillation. Instead of coinciding with the original Eg, it is a vector of opposite phase.

But the remedy is easy. Simply *reverse the connections to the grid coil.* This will not alter the phase of the *induced* E.M.F. in Lg, but will turn the vector representing the Eg applied to grid-cathode by 180 deg. So we return to starting-point. By reversing the reaction coil, or winding it in opposite sense to the anode coil, the correct vector relations for sustaining a self-oscillation will hold good.

All this may be put a little simpler. The *induced* E.M.F. in Lg has the phase of the *back E.M.F.* in the anode coil. To maintain oscillation, Eg must have the phase of the *applied voltage* (V) across the tank. To give this, the reaction coil must be connected the reverse way to the anode coil.

Effect of Resistance

If you have followed this reasoning closely, there should be no difficulty about the resistance *r* in Fig. 1.

The vector diagram is drawn in Fig. 4. Instead of lagging 90 deg. on V, the current IL lags by some angle ϕ, less than 90 deg.—resistance brings the current more into phase with the voltage, an angle of 90 deg. being true only of purely reactive circuits. The back E.M.F. vector E is shifted by an angle $\alpha = (90 \text{ deg.} - \phi)$ from exact phase-opposition to V, but remains fixed at 90 deg. with respect to IL.

A slight difficulty arises here. To maintain an oscillation Eg must be at 180 deg. to the back E.M.F. E. Also, we keep to the convention that Ia is in phase with Eg. But, for a purely resistive load, we assumed that V, also, is in phase with Ia and Eg, whilst Fig. 4 now shows Ia *leading* on V by an angle $\alpha = (90 \text{ deg.} - \phi)$ —where ϕ, be it noted, is the phase-angle of the L-arm of the tank circuit.

Frequency-shift

Can this possibly be correct?

No. At least not if the tank circuit is supposed to be exactly *resonant* at the generated frequency.

Now, usually when this point is treated in vector accounts of oscillators, conventions are used which ultimately show Eg and Ia out of phase. As it is difficult to see how there can be a *time-phase* difference between grid potential and anode current changes, internally in a valve, we keep to our simple convention that Eg and Ia are always in phase, but that, in Fig. 4, Ia sets up a voltage V across the tank load lagging by an angle α.

This makes conditions easily understandable. Fig. 4 is quite correct—neglecting any extra loading or capacitances due to the valve—if the tank circuit has a net *capacitive reactance* (and resistance). Ia is *leading* on the supply voltage V by a small angle, α, hence the tuned circuit is *not exactly resonant.* It is taking a small capacitive current. How can this state come about in an oscillator?

Surely the oscillation is generated at a frequency which makes the tank load look like a pure resistance?

In truth, no self-oscillation can take place in any oscillator at this exact frequency—not as long as there is any resistance present. *The generated frequency is always slightly "off" the exact resonant frequency of the anode load.* That is the only way the valve can supply A.C. power to make up the loss in the resistance *r*, Fig. 1. Exact 90 deg. phase-angles imply a "perfect" tank circuit which would take no true power.

In Fig. 4 the generated frequency is slightly *greater* than the value f given by the formula $\frac{1}{2}\pi\sqrt{LC}$. If a rejector combination is connected to a supply at a slightly higher frequency than the one it is tuned to, the net current taken will show a *leading, capacitive* component.

A *leading* angle is not necessarily true of all types of generators. Some types generate a frequency *below* the resonant f of the tank load, giving a net *inductive* reactance.

The important thing to understand is that a frequency-shift does occur to some extent in all oscillators, and that the larger the coupled load resistance r, the more the frequency will have to depart from the theoretical value in order to supply enough power into the extra load.

Frequency Stability

These facts should help to explain a good many things connected with generating stable frequencies.

If a generator is accurately calibrated to a frequency scale, there will be "shifts" from the calibrated values according to the degree of loading of the tuned circuit. Usually, the coupling to external circuits must be kept small, since stray capacitances, etc., would cause frequency changes other than the one now being considered.

But even where everything possible has been done to eliminate extraneous causes *the valve itself forms a "shunt" across its own anode load.* We cannot go into this point fully now. Briefly, the H.T.+ line is returned to cathode, say, through a large capacity by-pass condenser. Hence, the internal A.C. resistance ra is virtually connected in parallel across the tank circuit—even though the valve at the same time is acting as an amplifier. This is a point we have not considered before, because it was proposed to outline in later articles how it modifies some of the simpler vector relations, e.g., with purely reactive loads.

This "series-parallel" aspect of valve networks complicates things enormously when trying to give an outline of the more straightforward vectors. But with a tuned circuit, as in Fig. 4, the shunting effect of the valve—if we neglect capacitances—is equivalent to an *increase* in the resistance *r*.

Thus, ra—the valve A.C. resistance—constitutes a "load" on the tank, which will vary with different valves and with temperature, H.T., grid bias, and filament voltages. In addition, at high frequencies the internal capacitances of the valve may have a marked effect.

Changes in the valve constants account for most of the difficulties in designing oscillators of extreme frequency stability. Special circuits or couplings, or crystal stabilisation for one fixed frequency, can be used to reduce the variation to quite negligible amounts.

But we must leave this subject for future consideration. Volumes have been written on "frequency stability," and it bristles with all sorts of complications, such as the effect of the harmonics generated, etc. It is hoped this very elementary outline will help towards understanding some aspects of the problem.

FOOTNOTE: Since writing this article I have received correspondence to which a reply will be given next month. The shunting effect of ra for a purely inductive load is the main point at issue, and I have referred to the subject for the first time in the present article. But, until my correspondent can show otherwise, I see no good reason for departing from my convention that Eg and Ia are in phase.

Underneath the Dipole

Television Pick-ups and Reflections. By "THE SCANNER"

HOW much are you able to spend on your hobby? Not very much, I expect. The cost-of-living index figure may *not* be going up in leaps and bounds, but the man in the street finds that his pound note buys less than five shillings' worth of goods, judged at pre-war values. The daily headlines of the newspapers do little to relieve the gloom, while certain of the newspapers seem to go out of their way to belittle Britons' past achievements, present efforts or future ambitions. The future merely presents an outlook of a sea of frustrations and form-fillings, with the dark clouds of taxation rapidly overhauling and enveloping the pay-packet of effort! I begin my article this month in a rhetorical manner as a preamble to the announcement of that well-known fact, necessity is the mother of invention, and that this utility age has brought about the successful development of two inventions which may have considerable influence on the progress of television.

Two Lamps for the Price of One!

Television is expensive. Not only for you and me, but also for the B.B.C. The cost of television-production is high—enormously high—even without the inclusion of artistes' salaries. There is the large (but not large enough) staff of producers and technicians, with their assistants; the expensive apparatus, plant and premises; and there is the colossal amount of electric current required to turn the wheels and light the lamps. This is where two new British inventions find a place and make history. First, there is a remarkable new arc-light developed by the General Electric Company, which gives twice the amount of light for a given current, and then there is the "compact light source," a development of the high-pressure mercury discharge tube, carried out independently by both the B.T.H. and the G.E.C. firms. This lamp also saves a remarkable amount of current.

The Double Negative Arc

The normal large high-intensity arc-light used in film studios and also, on occasions, in the television studios consumes about 150 amperes at 110 volts. The voltage drop across the actual arc is about 65 volts, the other 45 volts being the potential "wasted" across the ballast resistance, which merely gives off heat which is not required. With the double negative arc-lamp, the voltage across the arc gap is reduced to about 48, and this lower value permits two such arc-lights to be run in series on a 110 volt supply, with practically no losses in resistances. The double negative lamp is the result of much painstaking research on the part of the G.E.C. engineers, and the angles taken up by the two negative carbons relative to the one specially cored positive carbon (the latter being rotated by a motor) are quite critical. But the ability to run two lamps in series at more or less the same current consumption as one lamp of the standard type does not end the advantages of this new lamp. Most of the extraneous noise, frying and sizzle emanates from the negative carbon when this is carrying a large current; divide this by two, as is done with the double negative lamp, and these noises are reduced to a neglible amount. This noise reduction refers only to carbon noises, of course, and not to generator ripple (which is smoothed with chokes or filter circuits) or to the noise of the motor which rotates the positive carbon (which is reduced by divers means!).

Television's Special Requirements

For the normal type of studio transmissions there is at present little demand for arc-lighting at the Alexandra Palace. But for "special effects" requiring hard lighting, sunlight effects, and for outside television relays, where a few really powerful lights are preferable to a multitude of smaller incandescent lights, arc-lights which can be run at a reasonably low current consumption will prove extremely useful. One of the chief snags of carbon lamps is, of course, that they need re-carboning and trimming from time to time, which can hardly be undertaken during the progress of a television play of an hour or so's duration. The lamp which requires no attention and gives off the smallest amount of heat is naturally one which will form the

(*continued on page* 123)

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Join the **ROYAL MARINES**

(*Continued from page* 120.)

main light source at television studios. At the moment, the standard film studio "inky"—incandescent lamp—is the principal type. But another new type of lamp, a British invention, is now being tested at the film studios and, in due course, will find its way to the Alexandra Palace. This lamp is the "compact light source," the latest version of those street-lights which make everyone look like a "keep death off the road" poster. This peculiar blue-green light is the radiation from the mercury vapour glow, which is extremely strong at the blue and violet end of the spectrum, but is entirely deficient in red rays. The inclusion of other elements with the mercury changes the colour of the glow perceptibly, and it has now been discovered that a light which is almost white can be obtained when cadmium is added.

A Revolutionary Light

In its latest form, the B.T.H. and G.E.C. Companies have both developed their own special types. The B.T.H. lamp comprises two electrodes in the legs of a quartz envelope, almost side by side, leading up to a light-radiating bulb. The G.E.C. version has its electrodes at each end of the bulb. This type of lamp takes about seven minutes to heat up and strike. To avoid the delay which would occur every time the lamp is switched off between "takes" in the studio, there is a special arrangement which enables current to be reduced to about 10 per cent. of full load during waiting periods, after which it can be switched fully on without a further warming-up period. Thereafter, the light glows steadily and quietly, and a 5 kW. lamp of this type gives as much light as a conventional two-carbon arc consuming about 7½ kW. The compact light source will run on A.C. or D.C., but for film studios and television 110 or 115 volts D.C. is most satisfactory. In films, the camera-shutter revolves at 24 revolutions a second, which beats with the 50-cycle A.C. on the light, giving a slow flicker effect, while in television "hum bars" mar the picture. But on D.C. the results are highly satisfactory, and the light is sufficiently white to give promising results with the colour systems, Technicolor, Kodachrome and, I believe, Dufaycolour.

Many readers, I know, are keen owners of 35-millimetre or 16-millimetre home cinematograph projectors, and they will be interested to know that the compact light source has also been adapted as a point-light for projection. I suppose that if the projection machine were kept steadily at 25 pictures a second instead of 24, an A.C. lamp might give reasonably good results; but it is probable that D.C. would have to be provided to eliminate all flicker. These lamps, I am glad to say, are entirely a British development, and in this particular field we are far ahead of America, or anywhere else for that matter. Alas! I suppose the Government will export them all in exchange for dried eggs and Betty Grable!

Impressions on the Wax

IN a recent review of a new biography of Tchaikovsky it was said that the composer was at his greatest in ballet-writing, where he was not hampered by a symphonic form inherited from the Viennese masters, a form only put aside by Sibelius. Tchaikovsky's symphonies have abundant good points, but once he gets into the free air of composing for the stage he allows himself complete indulgence, and the results are nearly always entirely happy. The waltz from the "Sleeping Beauty" ballet is an example of this side of Tchaikovsky's art at its best, and this month it has been recorded on *H.M.V. C*2892. Its smooth melodic line is admirably balanced by Chopin's energetic "Polonaise Militaire" which is on the reverse side. Both pieces receive a brilliant performance by the Boston Promenade Orchestra under Arthur Fiedler.

There will be many who will welcome an anthology of Ivor Novello songs recorded on *H.M.V.* C3521-2. They have been carefully selected to show a representative collection of the most attractive melodies composed by this gifted actor-producer. It is no easy matter to write music that is both light and of good quality, and Ivor Novello's achievements in this reveal a steady finger on the public pulse. *H.M.V.* C3521 leads off with the immortal "Keep the Home Fires Burning," a "last war" song that has endured, surviving the circumstances for which it was written. The four sides of the records are packed tight with a generous measure of subsequent favourites.

"The Magic Bow"

THE film, *The Magic Bow*, in which Stewart Granger plays the part of Niccolo Paganini, very naturally requires the principal star to play the violin. For this he had to undergo intensive practice in fingering and bowing to convey the illusion that he is actually executing the music provided by a sound track. Yehudi Menuhin flew from America specially to record this sound track, and he has expressed admiration for the way in which Granger has performed a very difficult feat. This month Albert Sandler gives us the "Romance," written for *The Magic Bow* by Phil Green and based on a theme by Paganini himself. As always, the Palm Court Orchestra, under Sandler's direction, has contributed a really delightful record with this piece and a melodious excerpt from Magyar Melody on *Columbia DB*2236.

George Formby makes his first appearance on Columbia records this month in songs from his latest film, *George In Civvy Street*, in which he plays the part of George Harper, a demobbed soldier returning to take over a country pub, the "Unicorn," founded by his father. Formby is thoroughly happy in his part and puts over his snappy songs with his characteristic humour. "You Don't Need a Licence for That" and "Mad March Hare" are both excellently recorded on *Columbia FB*3251.

Children's Corner

EVER since Ann Stephens appeared in the constellation of H.M.V. artistes, as a consequence of her delightful performance in *Alice In Wonderland* and *Alice Through the Looking-Glass*, her records have received an immense following. She appears again this month, in an excerpt from "Alice" and in three delicious songs from Kiddies' Delight, an album of pieces specially written for children.

The songs are "Tell Me, Hatter," from *Alice in Wonderland*; "The Frog Who Broke the Ice"; "Lazy Jack-in-the-Box"; and "The Toy Soldier and the Dainty Little Doll," from the album "Kiddies Delight," recorded on *H.M.V. BD*1150.

Dance Music

ALL the popular tunes of the moment have been recorded this month by a variety of well-known dance bands. Geraldo and his Orchestra have recorded "Sleepy Serenade" and "Till Then," on *Parlophone F*2186, and "Running Round in Circles Getting Nowhere," and "This Is Always," on *Parlophone F*2187.

Programme Pointers

This Month MAURICE REEVE Deals With January's Anniversaries

FIRST of my notes this month is to recommend to readers the "Henry Wood Memorial Fund" pocket diary for 1947, actually styled "The Musician's Diary."

Not only do all music-lovers know that the fund is being raised to build a concert-hall in replacement of the ever-to-be-lamented Queen's Hall, but we know, even better, our debt to the late founder of the Promenade Concerts and the manifold enjoyments he has given us in the broadcasting era.

At 7s., the diary is very good value, and contains a mine of interesting information. Get one if you are not already fixed up.

The Third Programme

I must be the only music-critic in the land who has not yet had his say concerning the Third Programme. The B.B.C. must now feel something like ancient France, whose States General consisted of the three "estates" of clergy, aristocracy and people. Which programme compares with which estate, I will not say. But certainly our own two chamber systems, in which the democratic intrusions to the Upper House and the aristocratic elements of the Lower seemed each to be the complement of the other, are gone.

It would seem too early yet finally to pronounce whether the segregating of so many good things, at the peak of listening hours and on a wavelength that many sets are unable to receive, is altogether wise. For my part, I think I shall eventually draw the conclusion that it is. At present, I give thanks for it if only because it has led to the virtual abolition of what I hate and despise most in all the world of noise—the signature-tune. And the jarring clashing—as I wrote last month—of totally unrelated and discordant items.

To listen-in to great music, drama or equally thought-provoking items without first having to tune-in and get even the fag-end of an event or number poles apart is like being able to eat a slice of plum cake that has not been cut with the knife that was used for peeling and chopping up those marvellous fried onions we had for lunch. Onions, yes; plum cake, yes also. But keep them well apart.

The thrill of hearing Wagner again—in the recent broadcast of "Tristan and Isolde" in its entirety—should whet our appetites for the New Year production of the complete "Ring" cycle. What enormous satisfaction such wonderful art affords after its almost total absence from our programmes for six years. How satisfied and comfortable such a meal makes us feel. Just like we shall feel when our 1939 menus are restored to us. One cannot live entirely without such fare and remain feeling nourished. Although not everybody's meat, Wagner is to me both nectar and ambrosia: Lucullus's own banquet, the alpha and omega of music.

My Musician's Diary tells me that it was one hundred and four years ago, on January 2nd, that the "Flying Dutchman" was first produced, in Dresden; that Henrietta Sontag, the original Sentra in it, died in 1854 on the third, and that Hans von Bulow, the famous pianist, who played such an enormous role in the master's life, produced many of his operas, and whose wife, Liszt's daughter, left him for Wagner, was born on the eighth, in 1830. Events of a long time ago, but how real and personal to those of us who know their art intimately.

A Suggestion

I commend to the notice of the B.B.C., as the subject for a drama, the life of this brilliant, patient and long-suffering musician, who endured everything so that a greater genius should not be denied in his imperishable work for music.

Another anniversary falling in January is the birth of one of the most famous of tenors—Jean de Reszke. A countryman of Paderewski, the two great Polish musicians were once dining in a fashionable New York restaurant. "Who is the greatest living musician?" Paderewski asked. The great tenor's reply must have flattered the illustrious pianist if even for a moment: "Pa-de-refsky." This is quite a classic amongst musical badinage or petites histoires.

Another clever one came from the meeting of two equally famous Polish pianists of their day, de Pachmann and Godowsky. "Who is the greatest living pianist," asked Godowsky; de Pachmann replied: "Godowsky is the second greatest."

The wind-swept, cheerless month of January must have had a strange call to parents to produce musicians of genius during its unwanted term of office. For, in addition to the celebration of those already mentioned as falling within its icy confines, and the birth of such other notabilities as Scriabine, Thalberg, Charbrier, Josef Hoffmann, Clementi, Lamond and Arthur Rubinstein, are the towering names of Mozart, Delius and Schubert.

Third-party Insurance

A witty writer recently referred to the new Third Programme as a form of third-party insurance, which it certainly is. For does it not insure the listener that he will have some, at any rate, of what he wants of a certain intellectual brand comparatively free from the nerve-shattering, ear-bursting, hair-splitting interruptions, introductions and contrasts of the other two? As I have remarked already, this is one of its greatest merits. Perhaps I may be allowed to continue in the same writer's metaphor and say that, like another class of the community which also takes out a third-party insurance, the listener takes all the risks also! But, so far, these have not been unduly onerous.

In conclusion, I am sorry to read the announcement of a winter season—two weeks—of Promenade Concerts. Surely this is trying to flog willing horses to death and exploit the present boom to beyond saturation point. When they were tried a few years before the war at the Queen's Hall the experiment was a total failure and was never repeated. The number of symphony concerts—amongst which the Proms must be counted—nowadays, in any given twelve months, must surely equal the ten-years' quota of, say, pre-1914. And those with programmes of any originality, as the first of the B.B.C.'s current season, are being very poorly attended. What a pity if pure greed kills the goose that lays the golden eggs.

OUR COVER SUBJECT

OUR cover illustration this month shows the nerve centre of the third programme. This is the recording-mixer room, and the photograph was taken during a dramatic broadcast. The producer, Joel O'Brien, sits at the controls with Mary Leftwich, programme engineer. Through the window may be seen the sound-proofed studio in which appear the cast of readers (left to right) Alison Leggatt, Paul Martin, Sheila Sim and Alec Mango.

News from the Clubs

THE STOURBRIDGE AND DISTRICT RADIO SOCIETY

Hon. Sec. : D. Rock (48PR), Flat 1, Block 1, Worcester Road, Summerfield, near Kidderminster.

AT a recent meeting of the above Society about 30 members were present. The main topic of the evening was a lecture by G. F. Peirson, Esq., A.M.I.E.E., Chief Engineer, Midland Electric Co.

Many interesting details of the problems of Power Generation and Distribution were given, aided by demonstrations in fault locating and repairs. Also, Mr. Peirson projected a film, the subject of which was Water Power, illustrating the utilising of water as generating power for electricity in Scotland.

The membership of the Society continues to grow, and is now in the region of 45 full members. Any person interested will be welcome at any of the meetings held on the first Tuesday of each month at 8.0 p.m. in King Edward's Grammar School Science Block), Stourbridge.

WIRRAL AMATEUR RADIO SOCIETY

Hon. Sec. : B. O'Brien, G2AMV, 26, Coombe Road, Irby, Heswall, Cheshire.

AT a recent meeting of the above named Society 38 members heard G3CK give a very interesting talk, the first in a series on transmitter design, entitled "The Oscillator Stage." The January meeting took the form of several short talks by members on various aspects of construction.

THE SURREY RADIO CONTACT CLUB

Hon. Sec. : L. C. Blanchard, 122, St. Andrews Road, Coulsdon.

AT a recent meeting Mr. Castles gave a talk on micro-wave technique, and an attendance of 45 was recorded. The speaker dealt with different types of magnetron, such as the earlier split anode variety, and also the present day cavity magnetron. Reference was made to positive grid oscillators such as the Barkhausen circuit of a few years ago, and these were compared with the present day disc-seal triodes which are specially built to fit the tuned circuit. Owing to the lack of time, wave guides and rhumbatrons could only be dealt with briefly.

THE HALIFAX EXPERIMENTAL RADIO SOCIETY

AT a recent meeting held at the Society's headquarters, the committee presented a set of draft rules for approval by members. These were debated at length and the final result should give satisfaction to all concerned. Morse classes have commenced.

A service for members has been inaugurated whereby members desiring any technical information and circuits for building equipment may be obtained.

Anyone interested in radio, elementary or advanced, will be welcome, for one of the aims of the Society is the advancement of amateur radio in the district. Meetings are held at Toc H, Clare Road, Halifax.

CANNOCK CHASE RADIO SOCIETY

Hon. Sec. : K. R. Boot (G2FZG), 75, Beech Tree Lane, Cannock, Staffs.

THIS club was reformed under the above title on October 8th with seven members. The club meeting room is at the rear of the "Black Horse" Inn, Mill Street, Cannock and meetings take place monthly upon the first Tuesday at 7.30 p.m. A number of lectures have been arranged for the future, also a Field Day to take place in the new year. Members have agreed to demonstrate their gear and "Dreamboat" Mitchell (G2AMG) started off with a sub-standard wavemeter at the last meeting.

All those interested in radio in the district are requested to contact the above address.

STOKE-ON-TRENT AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec. : Dan Poote (G3AQW), 13, Oldfield Avenue, Norton-le-Moors, Stoke-on-Trent, Staffs.

ALL meetings are well attended—even floods can't keep the boys away! More new members have joined, including 2HFI, and all are welcomed.

First meeting of the month, G3UD—alias Colonel Bandspread, brought along his 40-metre TX and RX to complete his lecture on "The Correct Procedure."

Second meeting: A general get-together debate on RXs—the usual T.R.F. v. Superhet battle-royal.

Third meeting: We are indebted to 3UD for his generous gift of an 1155 Rx for the club's use. A power pack was constructed and a lecture on "How to Modify the 1155 for Amateur Use," followed.

SLADE RADIO

Hon. Sec. L. A. Griffiths, Tresco, 34, Florence Road, Sutton Coldfield.

HAVING just held their A.G.M., Slade Radio are now starting on the second session since their "revival," and shortly hope to be able to announce that the meetings will be held fortnightly. They have commenced a series of D.F. tests, made especially easy to enable the beginners to get as much experience as possible before going in for a full scale test. To enable as many people to take part as wish, the tests have been made a pedestrian effort.

THE WEST MIDDLESEX AMATEUR RADIO CLUB

Hon. Sec. : Norman S. C. Priest, 7, Grange Road, Hayes End, Middlesex.

THE Club's future arrangements are as follow: Wed., Jan. 22.—Speaker: Mr. J. Teague. Subject: V.H.F. Oscillators. Wed., Feb. 12.—Speaker: Mr. A. C. Gott. Subject: Radar. Wed., Feb. 26.—Speaker: Mr. F. Charman, G6CJ. Subject: Aerial Propagation; demonstrated by an ingenious U.H.F. oscillator and aerial array.

All the above meetings will be held at the Labour Hall Rooms, Southall, Middlesex, at 7.0 p.m.

ILFORD AND DISTRICT RADIO SOCIETY

Hon. Sec. : H. T. Stott, 17, Sylvan Avenue, Mill Hill, London, N.W.7.

FURTHER recent successful meetings have been held in accordance with our fixtures list. Meetings of particular note were those on:

(a) November 14th, when Mr. De Gruchy, of Everett, Edgcumbe and Co., Ltd., gave an interesting and well-explained dissertation on "Measurements in the Radio Field," covering all types of instruments and apparatus for measuring which use moving-coil meters. Much time was also spent on the moving-coil instruments themselves, and it was interesting to hear the view that owing to the considerable frailty of movements operating at less than 1 mA. through both coil and shunt combined, a meter of this rating seemed likely to continue to be a useful maximum-sensitivity type. The lecturer covered points of measurement in circuits where current flow is so restricted that the extra current drawn by the measuring instrument upsets the balance, and indicated alternative ways of arriving at the truth at such points.

(b) On November 28th Mr. H. A. Hartley gave an interesting talk and demonstration on "New Developments in Speakers and Records." As is, of course, well known, improvement continues in these fields, even if not structurally and by great leaps and bounds, although considerable advances do appear to have been made. An excellent demonstration was made and the speaker's points well exemplified and borne out.

CLUBS REFORMING

WEYMOUTH AND DISTRICT S.W. CLUB

THE original proposer and founder is interested in reviving this club and invites all old and prospective members to get in touch with him and give their views. The name and address is: W. E. G. Bartlett, Midland Bank House, Whitland, Carmarthenshire, S. Wales.

EXETER SHORT WAVE RADIO SOCIETY

MR. E. G. WHEATCROFT, of 7, Mount Pleasant Road, Exeter, is endeavouring to gather local S.W. listeners and transmitters under one club, holding meetings at least once a week. The above is suggested as a provisional name for the club. Promises of lecturers have been received, and all interested should contact Mr. Wheatcroft at the above address.

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WAVE CHANGE SWITCHES, 4-pole 3-way 4/-, 4-pole 2-way 3/6, 3-pole 2-way 3/3.
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Open to Discussion

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

A.C. versus A.C.-D.C. Receivers

SIR,—I did not intend troubling you again on this subject, but in your December issue Mr. House, of Bradford, mentions my last letter, which you thought interesting enough to publish.

He is quite wrong in his idea that I am not so sure as I was that A.C. sets are better than comparable universal sets, and nothing has been said to affect my opinion in that respect ; in fact, I went so far as to name a factory set made in both A.C. and A.C.-D.C., but fitted into the same cabinets, and being able to tell one from the other after listening to them !

In "Modern Radio and Television," a three-volume work by C. A. Quarrington and published by Caxton's, it states that universal sets are "fundamentally inferior" (Vol. 2, page 2). If Mr. House can be dragged away from his A.C.-D.C. amplifier, which he again mentions, the original letter which started this correspondence was about commercial sets. By this I mean sets manufactured for ordinary listeners, who must outnumber by many thousands those who have amplifiers either A.C. or A.C.-D.C. either home-constructed or purchased through the trade, and I refuse to be drawn into a topic which can interest only a limited number of people.

To sum up, we can take it that the universal set was evolved through the necessity that while there are two types of current in the country, there would be a demand for a set which would work on both without any alteration. Such a set, to my mind, could not possibly be as good as one designed for A.C. mains only, and I prefer to think of universal sets as a necessary evil until we are in the fortunate position of having a standard A.C. supply all over the country. This, in turn, will greatly reduce the number and types of valves which have to be stocked at present, if and when available.—P. G. HARRISON (Newcastle-on-Tyne, 5).

SIR,—May I be allowed to reply to the December letter from Mr. G. W. House.

Here, Mr. House says—very complacently—that his universal receiver has a self-regulating heater device.

Now, with the majority of universal receivers self-regulating heater devices are the exception, rather than the rule. At least the A.C. receiver does enjoy some voltage variation, even if only between 200-250 volts. Also in some cases anode voltage must not exceed 180 volts ; with the A.C. receiver, anode voltage and heater current voltage are compensated for to meet variations of mains voltage regulations.

But Mr. G. W. House has apparently overlooked one important fact, and that is not so much as the merits of the individual receiver on one mains supply, as to its ability to maintain a reasonable freedom from hum over a wide range of mains supply. Some receivers have a bad name because of hum, and investigation has revealed the fact that the mains supply is a little rougher than usually known when the set is being manufactured.

In the A.C. receiver, due to phase opposition, hum or other disagreeable noises are cancelled out, or easily got rid of, if present. As H.F. in the mains is a not uncommon occurrence, the universal receiver, with its direct connection to the mains supply, may experience modulation hum more so than the A.C. receiver.

Furthermore, any type of voltage dropper means a waste of energy ; it is for this reason that the heaters in the universal receiver are wired in series. One may as well use an electric toasting rack as a mains dropper, and thus cut expenses. The transformer is a highly efficient component, the transference of energy being a maximum, its efficiency rated as high as 98 per cent.

In conclusion, while I agree that a universal receiver can be as good as the A.C. receiver—given a suitable design—it is pointed out that this is only achieved at extra cost.—F. C. PALMER (Truro).

[This correspondence is now closed.—ED.]

Bandspread S.W.3

SIR,—I have not seen any readers referring to the "Bandspread S.W.3" in the July issue of "P.W." 1946, or any logs obtained on this receiver.

I have built this set—my first one—and have obtained good results with it up to the present.

The aerial used is 50ft. inverted L, 30ft. high, E. to W.

Log on 14 Mc/s, 07.30 G.M.T. to 20.00 G.M.T., 21/11/46 : ZB1AB, VQ4ERR, ZS6GV, 20 Ws, 7 XAs, 11 OZs, 9 LAs, 12 D4s, and a few PAs, ONs, Fs ; on 23/11/46, 17.45 to 20.10 G.M.T. : VE1IV, EK1MD, VO2AD, VO2AF, VO6F, SHF, YR5R and more Ws.

On the B.C. band : Panama, HOXA, 19.86m., English programmes 17.00 to 21.30 G.M.T.

British Guiana : ZFY, 6,000 kc/s, heard closing at 00.45 with Ted Lewis's Good Night song.

Turkey : TAP, 31.7m., English programme Sunday, Monday, Thursday at 21.30 G.M.T.

Bulgaria : Radio Sofia, 32.02m. English news 20.30 to 20.40 G.M.T.

Belgian Congo : Leopoldville, 9,745 kc/s. News at 10.30 G.M.T.

Your journal has been a boon to me, and I've learnt all my "gen" from it, and I wish your staff the best of success.—A. E. LINCOLN (Grimsby).

Compact Domestic Amplifier—A Correction

SIR,—In connection with my article on a "Compact Domestic Amplifier," in the November issue of PRACTICAL WIRELESS, I should like to point out an omission in the "tone control" circuits shown in Fig. 6 (a) and (b) on page 489. I accidentally left out a D.C. blocking condenser which should be connected between the arrow marked "V2 Grid Circuit" and the grid circuit itself. The value of this condenser should be 0.1 to 0.5 mfd. Without this component the D.C. voltage dropped across R10 will be applied as negative bias to the grid of V2, causing the valve to be over-biased.—RALPH S. MOORE (Halifax).

Ex-Service Equipment

SIR,—I would like to bring up a point about which my fellow operators and myself (all keen amateurs in the radio world) feel very indignant. Each month as we scan our PRACTICAL WIRELESS our eyes go to the adverts. The reason ? Well, having only a limited knowledge of wireless theory—maybe just enough to get our licence—and wanting to "set up" straight away on demob., the primary need in life is a good trans-receiver. But all we see in the way of such apparatus is Walky-Talkies, which not only operate on the wrong band of frequencies but have the average range of a good pair of lungs. Now here is the sore point. On going to the American bookstalls we pick up a "Radio News," open the cover, and staring at us, practically full size, is an advert. for British ex-Army 19 sets. The whole station assembly is included—15 spare valves, remote control unit, etc.

To people associated with the 19 set, and realising that it has a range of 300 miles on the A set and five miles on the B set, both being incorporated in one chassis, a sum of 78 dollars for this trans-receiver is a "god-send."

But British subjects are not allowed to buy British sets, so we will have to go home and take up "fretwork" or buy a Walky-Talky 38 set.

The Army authorities surely can release some of the surplus good sets to foster wireless enthusiasm.—SIGM. P. BARNES (Paris).

Tx Contact Wanted

SIR,—I am desirous of corresponding with a few transmitting enthusiasts in Britain.

I am operating on c.w. in the 10- and 20- metre bands, using a 6V6 tritet driving an 807 at 40 watts. Aerial is a half-wave 40-metre "Zepp" 35 feet high. Receiver, a National NC-81-X, and a stand-by TRF.

I also possess a "local" transmitter—76 "Tes-tet" oscillator, crystal controlled, driving a 6V6 class C. Input, 4½ watts.—W. E. RIGG, VQ2WR (P.O. Box 121, Lvanshya, Northern Rhodesia).

German People's Receiver

SIR,—The article on "The German People's Receivers" published in the November issue of PRACTICAL WIRELESS by G. A. Kent was of particular interest to me a few days ago, as a D.K.E.38 came into my temporary possession for repair and investigation. It had been rejected by the service man as an uneconomic proposition.

It was in a broken-down condition and an attempt had been made to extemporise but had failed. The rectifying valve V72 was missing and had been replaced by a RGN504 Telefunken 4 volt D.R.P. valve. A mains transformer, 230v., supplied the 4 volt filament of this valve, and the circuit had been altered to accommodate the change, but the mains resistance remained as before to supply the anode and the remainder of the circuit. The result of the extra 26 volts on the filament circuit of the triode-tetrode VCL11 and the mains resistance caused the resistance to burn out.

The remainder of the components and circuit appeared to be in order on tests.

It was decided to return the set to its original circuit to check and substantiate Mr. Kent's article, and as a matter of interest.

Replacing the rectifier by a V30 Tungsram valve the mains resistance by a 0.3 amp. 2000Ω one, and removing the mains transformer, which was no longer required, it was found necessary to bypass the filament of the triode-tetrode valve with a resistance of sufficient ohms and wattage for the rectifier to be fed to give an output of 25-30 milliamps.

As the current requirements of the T.T. valve was not known, it became a matter of trial and error, and this was found under working conditions to be approximately 0.15 amp. Owing to the previous overloading the normal method of measurement was only a rough guide, and a portion of the original mains resistance was utilised as the bypass, gradually reducing the resistance until the rectifier was acting and delivering 30 milliamps.

Ultimately the circuit was completed and the receiver returned to its case in running order.

In the final test it was found that the selectivity was average but sensitivity subnormal for the power expended.

The condenser (tuning) arrangement, as explained by Mr. Kent, is certainly compact and ingenious, and the coil pack of solid construction but outdated by modern requirements. The layout is small and very compact, with only a few long leads, but the thin paxolin base is too thin and flexible.

The volume output was sufficient for the average room, provided one listened and not talked.

But, as Mr. Kent states, the receiver was evolved for a particular purpose and range, was easy of mass production, and the cost was cheap, to fit the pockets of the working peoples of Germany, so it fulfilled its objective.

But it does not compare at all favourably with the Utility models of the British radio firms, and there is nothing in it that is outstanding either in the circuit, components or performance.

I trust this short summary may be of use to any of the readers who may have the same problem to solve.

Thanking Mr. G. A. Kent for his article and circuits, which were a true and perfect guide, and also the "P. W." for its high standard of articles, I hope the day is not too far off when we shall again have our Advice Bureau column for the assistance of the none-too-technical and the increasing numbers of interested ex-Service readers.—W. A. G. NEALE (Gillingham Kent). (A Ham of 1905 vintage.)

A 2-valve Log

SIR,—I am 14 years of age and very interested in ham radio. My Rx is 0-V-1 battery set using a 25ft. long indoor aerial. I have received so far on this set over 400 amateur signals.

Here are a few which I received on 20 metres (all phone): XE1AC Mexico, PR6AG Brazil, VE3HC Canada, VO6H Labrador, ZB1AB Malta, W9CAC Iceland, OX1Z Greenland, W6OCA Japan, YR5C Rumania, XAEU Austria, SV1EC Greece, XAAP Greece, EAID Spain and dozens of Ws. Could any reader supply the Q.R.As. of W2LMH, and W2CZO? By the way, I have received Q.S.L. cards from PA0NA, HB9FE, D4ACE and D4AAO.—KENNETH M. BEASANT (Swindon).

Service Engineers

SIR,—As I carry out a considerable amount of radio service work on my own account in my spare time, I was interested to read "Thermion's" remarks on private "Service Engineers" in the January issue of PRACTICAL WIRELESS.

Whilst I am in full agreement with the statements about racketeers, I should like to draw your attention to the other side of the picture. On numerous occasions I have been requested to service sets which were sent to dealers for repair and when returned were either no better than before, or, although some improvement had been effected, were still not satisfactory. In most cases the faults are of a simple nature and the repairs previously carried out usually show an incredible amount of ignorance on the part of the repairer.

In view of my experience with repairs carried out by some dealers, I feel that Thermion's advice to deal only with recognised dealers will result in many cases with disappointment to the owner of the set.

I may add that I have two friends in a similar position to myself and they both wholeheartedly endorse the above remarks.—R. A. LOVELAND (Addlestone).

Stereo Television?

SIR,—I was very interested in the article by "Scanner" entitled "Underneath the Dipole," in the January, 1947 issue. There is, however, one outstanding omission in the article which your correspondent might possibly not be aware of and which makes stereo colour television a practical possibility, however remote. Stereo methods which depend for their success upon the use of a picture in one colour for one eye and in another colour for another eye, suffer from many limitations, one of which is severe physiological fatigue and another the impracticability of colour stereo television on such a basis. Surely, the modern way out is to use a polaroid screen in a vertical plane on one picture (which can be coloured or black and white) and in a horizontal plane on the other picture. The use of a pair of untinted polaroid spectacles in these planes for the two eyes respectively would then ensure the right eye seeing only the right picture—coloured or uncoloured—and the left eye seeing the left picture only. As polarised light causes no more physiological fatigue than normal light, this way out would appear to solve simultaneously several problems connected with stereo viewing of films or radio.—(DR.) R. GORDON BOOTH (St. Albans).

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PRACTICAL WIRELESS, February, 1947.

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