LOUDSPEAKER REPAIRS

Practical Wireless

9D EVERY MONTH

Editor F. J. CAMM

Vol. 18. No. 432. NEW SERIES. JUNE, 1942.

Practical Wireless

and PRACTICAL TELEVISION

EVERY MONTH

Vol. XVIII. No. 432. JUNE, 1942.

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COMMENTS OF THE MONTH BY THE EDITOR

New Broadcasting Rules

THE B.B.C. has announced that in future its broadcasts are to be subject to the emendation of all phrases which it thinks objectionable. This is a recrudescence of the principles which actuated the B.B.C. at the time when Lord Reith was Director-General—principles which were severely criticised at the time and led to the relaxation which it is now decided to withdraw. It was said of the B.B.C. that instead of existing to entertain it was endeavouring to educate, that it was subject to the dictates of the Church, that the Sunday programmes were too mournful and too religious, and that the B.B.C. was acting as a dictatorship, giving to the public what it thought the public ought to have, and not what the public wanted.

Now, the B.B.C. is a body which has somewhat greater responsibilities than the manager of a theatre, or a cinema. Films are graded so that parents may know the style of film and whether children are admitted. One has a fair idea of the nature of a play, and whether the script is likely to give offence, from its title and the actors appearing in it. To some extent we can gauge what programmes are likely to contain the matter which the B.B.C. now considers to be offensive, and thus to choose the listening time according to the views and tastes of those who are listening.

National Entertainment

THE B.B.C., however, has no duty to perform in deciding taste in entertainment. It must not be permitted to say what is or is not offensive if such views conflict with what is now an accepted fact. For example, the B.B.C. is to expunge from broadcast script such expressions as "damn," "heavens," and so on. Whether the B.B.C. believes it or not, they have become so much part of the national vocabulary that they cease to be offensive. How can a word be offensive? If the listener knows the implications of the word complained of it doesn't matter, and if he doesn't know the meaning of the word it still doesn't matter. The B.B.C. would not, of course, broadcast the expressive expletives of a cockney docker, but the mild oaths against which it has set its hand now cannot offend. It would seem that the B.B.C. is slipping back to the days when programmes became almost the playthings of evangelical revivalists. It would be interesting to know what has caused the B.B.C. to revert to its former system. Has it received complaints from thousands of listeners when a comedian utters the word "damn"? Is it taking too much notice of the Lord's Day Observance Act, and those who would like the public to spend Sunday in religious misery? The B.B.C. should remember that some of these bodies who think that honest entertainment is irreligious are able to exercise power and pull strings without reflecting the views of the public. An excellent case was made out a short while ago for the Sunday opening of theatres. It was pointed out that cinemas opened on Sunday and what was right for the cinema could not be wrong for the theatre. The move was supported by members of the public all over the country, and there was very little opposition. Notwithstanding this, when the matter came before Parliament certain religious bodies were able to veto it. There has been in recent years a healthy tendency to slip away from the hypocrisy of the Victorian and Edwardian eras. There seems now a tendency to slip back to them. There cannot be an articulate person in this country that has not uttered the word "damn," or conveyed surprise by ejaculating "heavens." The B.B.C. is not the arbiter on these matters. It must give clean entertainment, and there are occasions in dialogue when particular words must be used.

Crooning and Jazz

WE agree with the B.B.C. in its new policy of restricting those modern afflictions, crooning and jazz, and we hope that it will insist upon this and not remain unmindful of what happened a few years ago when it endeavoured to stop song plugging. It is our view that they did not succeed in doing this. Jazz music and songs which may be droned (which seems to be the modern interpretation of genuine crooning) have become highly capitalised and a profitable industry, whose wares are flaunted forth as music. Great efforts have been made to keep it alive, and to use aboriginal themes as a basis for songs. It is good to know that is to be curtailed. We hope that it will eventually vanish to the point where it satisfies the few, the noisy minority, who like it.

The B.B.C., as we have said, is not empowered to decide as to what is and what is not profanity, and if its present decision is any index it is not able so to judge. Famous authors, past and present, have made use of the words complained of and their work is regarded as literature. Shakespeare, the Prophets, Shelley, Scott, Dickens, Southey, to mention but a few, found the expressive words of use, and the Government has not seen fit to ban their publication. Until the Government does see fit to do so it is not a matter in which the B.B.C. should interfere.

It should not strain at gnats and swallow camels.

Editorial and Advertisement Offices: "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone: Temple Bar 4363. Telegrams: Newnes, Rand, London. Registered at the G.P.O. for transmission by Canadian Magazine Post.

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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.

ROUND THE WORLD OF WIRELESS

B.B.C.'s New Announcer

A NEW voice was recently heard reading the B.B.C. news. The reader was Mr. James Urquhart, who has been added to the panel of news readers.

Radio Sets for Rescue Dinghies

RADIO sets for making SOS calls from rescue dinghies are to be supplied to the R.A.F. The German airmen's self-inflating rubber dinghy is equipped with a small radio transmitting set.

B.B.C. Language Adviser

DR. GEORGE STUART GORDON, president of Magdalen College, Oxford, since 1928, died at Oxford recently, aged 61.

Although one of the leading authorities on the English language and literature and chairman of the B.B.C. Spoken English Committee, Dr. Gordon once said: "I am one of a large number of people peculiar to Oxford who would notice nothing unusual if the sun rose in the west."

Brighton Wireless Service

POLICE and fire services in the Brighton district are to have a joint wireless service. The scheme will cost about £7,000.

The wireless stations will be used for contacting outside authorities if there is a breakdown in the telephone service.

U.S. Radio Industry and Munitions

IT is reported that the U.S. War Production Board has given notice that by the end of June the entire American radio industry must turn over completely to the production of arms and equipment for the war. Manufacturers were told that if this change over is not made within the period specified, plants may be seized by the Government and, if necessary, shifted to other centres where they can be mobilised for war production.

An air crew of the R.A.F. using a cubicle representing an aircraft in which they carry out operational flights on the ground.

Air Mail Letters for Antipodes

THE Postmaster-General announced recently that, as a result of temporary interruption in the air service to Australia and New Zealand, air mail correspondence for those countries is for the present being routed via the United States of America and thence by sea, and may be subject to some delay. The normal air postage rate of 1s. 3d. per half ounce (postcards 7d.) still applies.

U.S.A.'s Huge Radio Output

ACCORDING to figures issued by the American Institute of Radio Engineers, nearly fourteen million broadcast receiving sets, valued at 438,500,000 dollars were produced during 1941 by American radio manufacturers. These figures show an increase of about two million sets as compared with production during the preceding twelve months.

Station WGY

THE General Electric medium-wave station WGY, situated at Schenectady, New York, has just recorded its twentieth anniversary, and it is interesting to note some of the outstanding developments in its history.

It was as early as 1923, one year after its opening, that the station used metal water-cooled modulator valves, and the condenser microphone. WGY claims to be the first station to make use of both of these advances. Two years later crystal control of the transmitter frequency was introduced.

Hospital Service

INDIVIDUAL or group appeals for hospitals generally still cannot be arranged, but it is hoped to include among Week's Good Causes a certain number of specialised hospitals working on a national basis both in London and the provinces. In the main, the selection will be confined to those hospitals which are not receiving Government grants for undertaking war work in connection with the Emergency Hospital Service. Applications should be addressed to the Secretary, Appeals Advisory Committee, Broadcasting House, London, W.1.

Radio Engineers and War Problems

THE Institute of Radio Engineers, holding a three-day convention in New York City recently, witnessed a demonstration of the latest threat to any hit-and-run wireless transmitter which, in the hands of enemy agents, attempts to send a message to its home base and get off the air before being caught. This latest adjunct to radio listening posts was described by Dr. Marcel Wallace of the Panoramic Radio Corporation, as an electronic eye which spreads a picture of the broadcasting spectrum before the operator and aids his ear in detecting and locating a spurious transmission.

To the radio engineers present at the meeting it represented one more instance of current engineering attack on possible enemy subterfuges involving communications.

New Radio Picture Link

ACCORDING to a recent report, the first picture sent by radio from Australia to the U.S. shows Mr. Forde, the Australian Army Minister, chatting with two American privates.

Fire Damage

A RECENT outbreak of fire completely gutted the Cwmcarn (Mon.) station of the Gwent Radio Relay Company, and all the equipment was destroyed.

Radio in Invasion Test

THE Metropolitan and City Police of the London area recently carried out a mock invasion test over a period of 36 hours. One of the objects of the operations, in which policemen represented Nazi parachutists, spies and fifth columnists, was to check the efficiency of the alternative system of communication using short-wave transmitters and receivers. The installations are set up at each chief police station, and it is not difficult to realise how valuable such a vital link would be in the event of the telephone and other forms of communications being broken due to enemy action.

Archaic Radio Practice

ACCORDING to the Radio Component Manufacturers' Federation some sections of the wireless industry still order components in terms of the gross. This practice involves unnecessary calculations and is archaic. It is hoped that in future orders will be in multiples of 100.

Broadcasts from China

A NEW broadcasting station at Chungking, China, is shortly expected to begin transmissions beamed on England. This was announced by Mr. F. Y. Chai, of the Chinese Embassy, when speaking at the Radio Industry Club luncheon recently. A schedule of the transmissions of news in English from the existing 35-kW station is given in "News in English from Abroad."

Swedish Listeners

IT is reported that at the end of 1941 Sweden had 1,550,000 licensed listeners, which, according to statistics, means that every fourth Swede has a licence. This indicates that Sweden is maintaining her position of first among European countries in receiver density.

Radio Saves Another Aircraft

THE organisation which plots the course of enemy aircraft on their way to raid this country recently helped a "lost" British aircraft to get back safely to base. A Coastal Command Hudson, which was out on a night patrol, had not been heard from for a long time. No reply was received to wireless messages sent to it. Then the country-wide "plotting" system was brought into operation, and an aircraft was located circling, apparently aimlessly, over Northern Ireland. It was the Hudson.

Later the aircraft was plotted over Scotland. It flew over Loch Lomond, then turned south. Aerodromes switched on their lights, searchlights swept the sky in the path of the Hudson, barrage balloons were close-hauled. Wireless messages were sent to the Hudson every few minutes, and at length a reply was received. The operator had got his set going again. "Follow the searchlights," he was told. The pilot was instructed to lose height over the South-West of Scotland. Searchlights near an aerodrome again flared into the sky, and shortly after came the message from the Hudson, "We are in the searchlights."

After that it was easy. The searchlights dipped in the direction of the aerodrome. The Hudson followed the long, silvery beams, and at length the pilot saw below him a lighted runway. He made a safe landing.

FM Car Radio

THE Radio Engineering Laboratories, of Long Island City, New York, have produced what is believed to be the first frequency-modulated receiver for installation in a car. The receiver, which has been built for the general manager of the Milwaukee FM station W55M, is fixed tuned by crystal control to the station's frequency. A quarter-wave telescopic aerial is carried, and the control unit includes a signal strength meter.

Just Like Blackpool

A BEAUFORT was approaching Brest on a job when the pilot and navigator saw a long line of riding lights stretching out into the sea for miles.

Everyone was keyed-up—the Germans might open fire at any moment. The pilot jumped when the wireless operator, a tough, stolid Yorkshire lad, called him up on the "inter-comm."

"Yes, yes, what is it?" the pilot asked quickly—the wireless op. must have seen a night fighter at least to speak to him at such a time.

"Have ye looked out o't window lately?" inquired the Yorkshire voice.

"Yes, yes—come on, what have you seen?" replied the pilot.

"Did ye notice all them lights—*joost like bloomin' Blackpool!*"

Trumpet Call to Poland

IN the greystone belfry of a little Scottish town, a Polish trumpeter sounds a famous herald call which is fraught with poignant memories for Poles everywhere.

The whole ceremony has been recorded for broadcasting, and the B.B.C. hope to use it frequently in the Polish service.

The trumpeter in the tower plays to Poles in the four corners of the earth, but his message is primarily for Poland, where hearts of oppressed people beat high at such a well-known refrain. For the "hejual" (herald) trumpet call has been sounded from the Mariacki (St. Mary) Tower in Cracow at twelve noon each day since the thirteenth century, when the Tower was a look-out for approaching Tartars, until the Germans overran Poland.

The fanfare has been sounded in Scotland every day since March 2nd, 1941, to carry on the tradition, and now every man, woman and child in this Scottish town knows the story behind it and its significance.

A group of A.T.S. girls learning Morse by means of the Creed apparatus during their course of training as wireless operators.

Loudspeaker Repairs

Replacing and Repairing Cones : Centring the Speech Coil : Magnet Alignment : Rewinding the Speech Coil : The Matching Transformer

THE present economy drive must be extended to wireless components, of which the loudspeaker is an important item. A permanent-magnet moving-coil speaker has in its construction a large percentage of valuable alloy magnet steel, which is scarce these days, so care should be taken that it is not wasted. Even an energised moving-coil speaker needs a good deal of high-grade iron alloy.

Cone Replacement

One of the most common defects in a speaker unit which has been lying idle in a junk box for some time is a damaged cone. If this has been badly torn there is very little that can be done short of fitting a new one, or one taken from another speaker. And that is not easy, since the cone itself carries the speech-coil former and winding, and therefore must be accurately centred. To remove the old cone it is generally necessary first to take off the felt segments round the front of the unit, and then to file off the heads of the rivets and drive out the rivets with a pin punch.

Since sudden jarring of the magnet will result in loss of magnetism, it is often desirable to remove the magnet before continuing with the main job. This is usually possible after removing the four or more bolts by means of which it is attached to the cone frame (see Fig. 1). Withdraw it carefully, and after removal gently slide a piece of soft iron over the face of the pole piece to act as a "keeper." When this has been done the magnet can be put aside out of harm's way. When the rivets have been removed, it will generally be found that there is a front metal ring which can be drawn off, leaving the edge of the diaphragm exposed.

Move the cone forward slightly and then unsolder the braided leads from the cone to the terminal plate; this is best done by unsoldering at the terminal-plate end. If the new diaphragm is identical with the old one it can be laid in position and attached by means of new aluminium or copper rivets. Alternatively, an unskilled person may prefer to use short 4 B.A. bolts with countersunk heads. Shallow countersinkings can be made in the holes in the front metal ring, and the nuts should be at the rear of the cone frame. Mention was made of 4 B.A. holes, which will suit most speakers, but the bolts used should be a good clearance fit in the existing holes to ensure correct alignment.

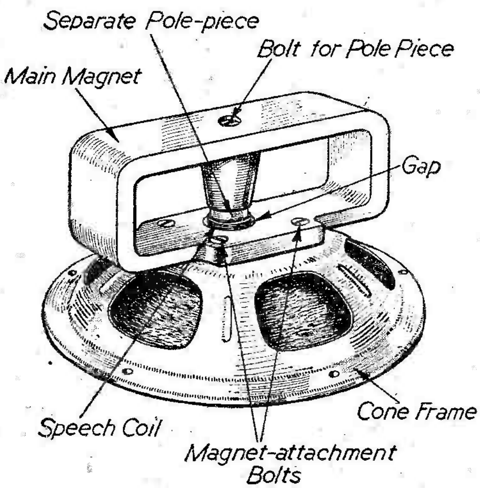


Fig. 1.—Some details of a representative permanent-magnet moving-coil speaker which are referred to in the text.

Reassembly

When the new cone has been fitted and the felt segments have been replaced with glue, the braided speech-coil leads can be soldered to the appropriate tags. If the speaker is a small one, however, it will probably be found easier to solder these before mounting the cone. After that, the magnet can be refitted after carefully sliding off the "keeper." This must be done with extreme care to avoid scratching the enamelled wire of the speech coil. The magnet bolts can then be fitted, making sure that the speech coil is reasonably centred in the magnet gap. Before replacing the centre bolt in the "spider" in the middle of the cone, means must be adopted for ensuring accurate centring.

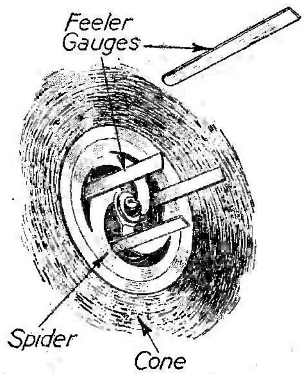


Fig. 2.—The method of centring a speaker cone by the use of three feeler gauges of equal thickness. The screw in the centre of the "spider" is tightened only when the feelers have been inserted between the inside of the speech coil and the pole-piece.

Centring the Cone

The best method of doing this is by using three small feeler gauges made from celluloid, ivorine or similar material. These should be about 2in. long by about ¼in. wide at the upper end, and slightly tapered toward the other end. At the narrow end the corners should be slightly rounded. These strips should be of such a thickness that when all are in position between the inside of the speech-coil former and the centre magnet pole the speech-coil is held fairly firmly. At the same time it must not be necessary to apply any force to insert the feelers; if they were a press fit the former would be distorted.

It will be clear from this that the feelers must be cut from material of just the right thickness. A figure cannot be given for this, since it must differ with different speakers. It is therefore necessary to experiment unless the reader is fortunate enough to have, or be able to obtain, a set of these which were at one time obtainable at about a shilling a set in a small wallet.

Should celluloid not be available, it is possible to use strips of hard card of the kind used for good visiting cards or postcards (pre-war, of course). Another alternative is to use softer card treated with a coat of thin shellac varnish or a cellulose adhesive. The time taken to find material of exactly the proper thickness will be well repaid.

Slip in the feelers, as shown in Fig. 2, and then insert and tighten the screw by means of which the spider is attached to the end of the magnet pole. If this has been done carefully, the speech-coil should be accurately centred in the gap, and the speaker should be ready for use again.

Cone Repairs

When the damage to the cone is not very severe, it may be possible to effect a satisfactory remedy by applying a very small amount of thin, liquid glue to the edges of the tear and pressing them together. There are some cellulose adhesives, sold in small tubes and obtainable from sixpenny stores, which are excellent for this purpose. Unless the process is unavoidable, it is not a good plan to repair a cone by sticking a strip of adhesive material over the tear. The reason is that this may cause the speaker to have a resonance. If a strip must be applied, make it as small as possible and use very thin paper, and apply a trace of adhesive to the edges of the tear before applying the patch. It has sometimes been found that rubber solution makes a satisfactory adhesive for a patch, and this has the advantage of being flexible when dry.

Pole-piece Alignment

If a speaker has been very badly handled or dropped it may be found that the speech coil cannot be centred in the manner described above (this applies whether fitting a new diaphragm or not). This would be evident, due to the "scratchy" reproduction or by a mechanical "scratch" when pressing and releasing the centre of the cone. Before taking further steps when this fault is suspected, make sure that the gap is clean, preferably by blowing very hard into the gap, from front and back, with a bicycle pump or vacuum cleaner.

Should the gap be clean, despite the faulty behaviour, it might be due to the pole-piece having moved. This is usually separate from the main magnet and is secured by means of a long bolt passed into it from the back of the magnet casting (see Fig. 1).

To effect a cure it will be necessary to remove the magnet from the cone frame, as described above, and then to slacken the bolt with a large screwdriver. The pole-piece will still be held fairly firmly, due to magnetic attraction and must be moved carefully until it is seen to be central with the hole in the front of the magnet. After centralising in this manner, tighten the bolt and reassemble the speaker, again centring the cone as previously explained.

Speech-coil Renewal

It is not unlikely that the speech-coil winding will have been badly scratched and possibly damaged should the pole-piece have been out of truth. Re-winding will then be called for. This is not an easy operation, although it is not particularly difficult for one with deft fingers. The work can usually be done without removing the cone from its frame.

First carefully count the number of turns and make a mental note of the method adopted for anchoring the ends of the winding. Then obtain a few feet of enamelled wire of similar gauge to that originally employed and wind on the same number of turns as before. In doing this, the wire should be kept just taut, but should not be stretched for fear of buckling the former; this can be avoided by fitting a wooden rod inside the speech-coil former. It will probably be considered wise to apply a coat of very thin shellac varnish to the new winding to prevent movement and vibration. Finally, the ends should be carefully soldered to the tags attached to the cone.

Re-winding the Field

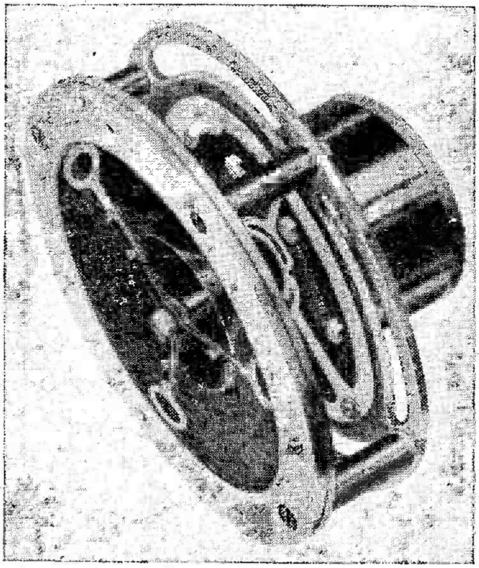
In the event of the field coil of an energised moving-coil speaker burning out, re-winding is not normally an easy task. This is because the winding will probably have been partly melted, so that its removal is awkward. Additionally, the insulating tape placed over it will be sticky. However, provided that care is exercised and if the gauge and covering of the wire is suitably noted (use a micrometer or wire gauge to find the diameter of the wire), re-winding can be done by putting on wire of the same kind as the original and simply filling the bobbin. If space permits, place a single layer of oiled silk or empire cloth after every few layers of the winding. An indication of whether or not there is sufficient space for this can be obtained by noting whether or not such insulation was used originally.

The re-winding may be simplified if a lathe is available, by removing the cone frame and mounting the "pot" in the lathe. Keep the winding as uniform as possible in order to get on the same number of turns as before and to prevent vibration of the new winding.

The Transformer

A faulty speech-coil transformer cannot easily be repaired except by one who has had experience of this kind of work and who has a lathe or other machine for rotating the spool while the wire is fed on. It will, of course, be desirable to remove the clamps and core stampings in order to mount the spool for re-winding.

When the transformer cannot be re-wound for any reason, and a replacement is not available, it is sometimes possible to make use of an old microphone transformer. In that case the primary would be used as secondary, and the secondary as the primary. Although the primary is of fairly low resistance it will probably not be low enough for the present purpose. If it is used it will normally be found that sound output from the



The Goodman infinite baffle type of speaker incorporating a unique centring system.

speaker is low due to the losses involved in the transformer "secondary." But if this winding can be removed and replaced by about one-third as many turns of heavier-gauge wire, a fairly satisfactory component may result. It is best to experiment with different numbers of turns in order to find that which is most suitable.

It should be understood that the original secondary winding, now used as primary, will probably be wound with very fine wire and will not be suitable for connection in the anode circuit of the output valve of a mains set—or possibly even of a battery set. In that case, choke-capacity output coupling may be desirable. If two speakers are in use, the transformer primary winding of the "good" one may be used as the output choke for feeding the other.

AN A.C. TWO-VALVER

THIS is a two-valver for all the usual short-wave channels, working entirely from its self-contained mains power pack—suitable for all A.C. supplies from 200 to 250 volts, and frequencies from 40 to 100 cycles.

It is a detector and pentode combination (see Fig. 1), the third valve being a full-wave rectifier for the mains supply of high tension. The detector valve comes under the heading of " high slope," which means that it has a very good amplification factor for a medium impedance. The factor is 40—and in practice this means a very sensitive valve.

Then the pentode output valve has an amplification factor of 100, which again helps to strengthen the weakest of input signals. Altogether, this two-valve combination, with its robust power from the mains, gives great amplification to the faintest whispers from the world at large.

There are two windings for each coil unit. These are entirely separate, making four connections in all. No. 1 goes to the grid of the valve, No. 2 to earth. That is for the tuning coil. No. 3 goes to the moving plates of the reaction condenser and No. 4 to the anode of the valve. That is the reaction winding, of course.

Now for the actual construction. You want three pieces of ebonite tubing, 3in. long and 1½in. diameter, this including the ribs. You will want twelve Clix valve pins with three nuts for each pin. For the complete set of coils about 6ft. of No. 20 gauge round tinned-copper wire and 8ft. of No. 20 gauge enamelled wire will be needed. The tinned-copper wire is needed for the smallest and middle-sized coils, the enamelled for the largest coils.

Many requests are now being received for the constructional details and blueprint—A.W. 453—of this efficient S.W. set. The blueprint is still available, but as the article is out of print we give below all the essential information.

The Power Supply

This incorporates a mains transformer having a normal output of 250-0-250 volts from its H.T. secondary winding, and 2-0-2 volts at 1 amp. and 2-0-2 volts at 2 amps from the two L.T. windings.

Smoothing is a very great point about a short-wave mains set. But it is not a difficult business, especially with modern components. Two electrolytic condensers are used for the capacity part of the smoothing. In conjunction with these is a specially low-resistance choke of high inductance. There are 12 mfd. of capacity with this choke—more than enough to ensure absolute silence.

Silence, until the oscillation point, anyway. Then there comes into the picture a thing called modulation—which can be cured with two .01 mfd. fixed condensers across the anodes of the mains rectifying valve. These have therefore been included in the circuit.

The smoothing in this set is so complete that you can hear absolutely no sign of hum unless the set is actually oscillating. As you will never be listening with the set in this condition, the slight hum that comes up then does not matter.

So much for the power supply. The set itself is designed to take advantage of home-made short-wave coils, which are made as follows. (See Fig. 2.)

A set of three coils is needed, the smallest coil tuning from about 12 up to 28.5 metres. Although this coil goes up to 25 metres it is not intended that you should tune in 25-metre signals on that coil.

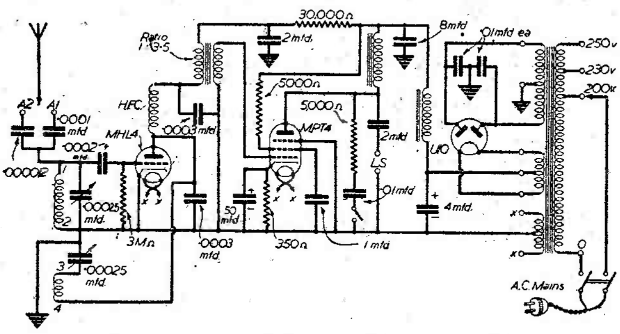


Fig. 1.—Component values and circuit details are given in this theoretical diagram of the set.

The second-sized coil does that. It tunes from 19 to 59 metres, and thus gives you the 25-metre signals with a high inductance-to-capacity ratio—signal strength will, therefore, be good.

The third-sized coil tunes from 55 to 175 metres, and is quite suitable for reception of 160-metre band signals.

All these ranges assume a .00025 mfd. tuning condenser with a reasonably low minimum capacity—and a similar value of condenser for reaction.

Order of Construction

The order of construction is simple. Drill first the ebonite former to take the pins, which should fit tightly. Then, with pliers and a vice, stretch some of the wire until it gives, when it will be ready for winding on the former.

Dealing with the smallest coil, start at the first pin and wind on as tightly as possible three turns, finishing off at pin two. Start again at pin three with three more turns, finishing off at what will be pin four.

The middle coil is wound in the same way, except that between pins one and two there are eight turns, and between three and four there are five turns.

Now we come to the largest of the short-wave coils, wound with the No. 20 gauge enamelled wire. There is no spacing between the turns, the coil being wound simple solenoid fashion. You need 23 turns between pins one and two, and 10 turns between three and four.

Don't forget when anchoring the ends of this wire that the enamel must be scraped off, otherwise there will be no pin contact.

The base for the coils is quite easily made from a strip of ebonite and two supports, as shown by the sketch. The sockets are spaced exactly the same distances as the pins in the coils, of course. You will notice that the reaction winding pins are closer together than the tuning-coil pins. This avoids the possibility of wrongly inserting the complete coil unit in the base.

The three coils tune easily over all the useful wavebands on short waves, with the wavelengths overlapping in such a way that you can always be sure of a high inductance-to-capacity ratio for the most used wavebands.

Serial Aerial Condensers

Many persist in using a longish aerial. For such readers, we have included a specially small input condenser so that, even with the longest aerial, the set will still be able to muster up a good oscillation. There are actually two series aerial condensers, the smaller being of only .000012 mfd. and the larger the usual .0001 mfd. With the average 45 to 60ft. aerial the larger condenser connection is advisable.

For detection, we have employed the usual leaky-grid system, but note that the grid-leak itself, which is of 3 megohms, goes direct to the chassis or earth.

We come now to the very important question of anode by-passing—an aspect of short-wave technique often sadly overlooked. If you will glance at the circuit, you will see that we have used the usual anode H.F. choke—actually it is a special short-wave one—but with it there are associated two by-pass condensers.

Both have the same value—.0003 mfd., these going to earth from each side of the choke. In this way, the high-frequency by-passing is complete—and no high-frequency will trickle through into the low-frequency section to introduce hand-capacity effects when you want to wear phones.

It is much more scientific to eliminate the high-frequency as soon as its job is over—rather than to let it wander about in the low-frequency side and then by-pass it at the phones.

The low-frequency coupling for the pentode output valve is perfectly standard. There is the usual de-coupling circuit in the primary winding, of course. This consists here of a 30,000 ohms resistor and a 2 mfd. fixed condenser. Rather essential, all this, as the set is working from the mains.

Choke-filter System

The pentode circuit, too, is perfectly standard. Perhaps it is worth noting that there is a 50 mfd. electrolytic across the automatic bias resistance—thus ensuring complete stability of operation. The 350 ohms resistor in the cathode lead provides the correct working bias for the specified valve—this being derived from the main high-tension supply in the usual way. In the anode circuit of the pentode there are one or two very important points to note. For one thing, you will see that a choke-filter system is included to isolate the phones or loudspeaker winding from the mains high-tension current. A choke takes the place of the phones or loudspeaker winding, and the A.C. speech currents pass to the desired winding through a 2 mfd. condenser that effectively prevents the passage of the direct current.

If you are going to use headphones, this filter is absolutely essential unless you want to risk a nasty shock. Even with the filter, you may possibly notice a slight tingling when you touch one of the leads—this being quite harmless, though—the A.C. currents representing the actual signal.

Secondly, across the loudspeaker terminals—or virtually so—is what we are pleased to refer to as a static suppressor. Actually, this is our old friend, the high-note cutter—a 5,000-ohm resistor in series with a .01 mfd. fixed condenser. In series with these two components is a little on-off switch, so that the effect of the high-note cutter can be brought in as required by conditions.

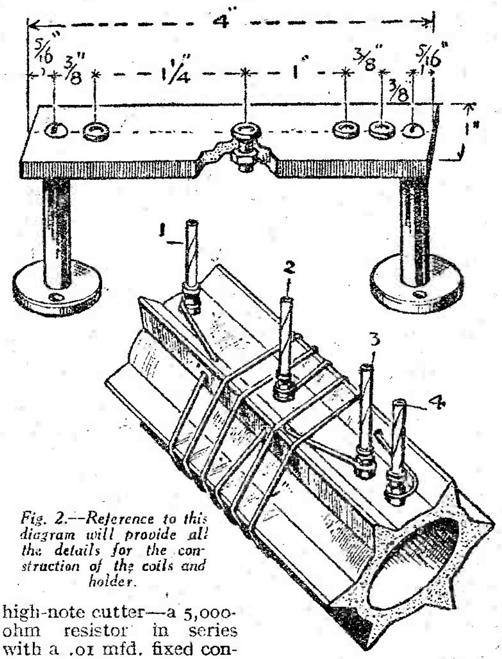


Fig. 2.—Reference to this diagram will provide all the details for the construction of the coils and holder.

When static is bad, you will want to cut down the background as much as possible—and this you can do by switching in the high-note cutter. Most of the noise is at high frequencies and an appreciable easing of the torments of static—especially on phones—can be noticed when the device is in circuit.

Under good conditions you will want to make the most of the pentode incisive quality—and then is the time to switch out the high-note cutter enabling the pentode to reproduce speech with clarity, and music with great brilliance.

There is really nothing more to say about the circuit, except that it is a sound piece of engineering that will give no trouble when interpreted as a metal-chassis set.

All-metal Chassis

Which brings us to one or two points about existing conditions and shortage of material. Sheet metal, in particular aluminium, should not now be used for chassis construction. It is needed for vital war work; therefore the constructor is advised to make do with an old discarded metal chassis, or one of the many so often offered by advertisers in PRACTICAL WIRELESS. One must not be too particular these days about the final finish of a set; the main consideration is efficiency rather than appearance.

LIST OF COMPONENTS

- One aluminium chassis, 12in. by 9in. by 3in.
- One H.F. choke, type short-wave.
- One L.F. choke, type 25H at 60mA.
- One L.F. choke, type 25H at 40 mA.
- One set of home-made coils, as described.
- One fixed condenser, .000012 mfd., type CM2 (Bulgin).
- One fixed condenser, .0001 mfd. type tubular (Dubilier).
- One fixed condenser, .0002 mfd. type tubular (Dubilier).
- Two fixed condensers, .0003 mfd. type tubular (Dubilier).
- Three fixed condensers, .01 mfd. type tubular (Dubilier).
- Two fixed condensers, 2 mfd. type BB (Dubilier or T.C.C.).
- One fixed condenser, 1 mfd. type BB (Dubilier or T.C.C.).
- One fixed condenser, 4 mfd. type electrolytic, 500 volt (Dubilier or T.C.C.).
- One fixed condenser, 8 mfd. type electrolytic, 500 volt (Dubilier or T.C.C.).
- One fixed condenser, 50 mfd. type electrolytic, 50 volt (Dubilier).
- One variable condenser, .00025 mfd. short-wave (J.B.).
- One variable condenser, .00025 mfd. Popular Log (J.B.).
- One full-vision dual-ratio slow-motion dial, type Arcuate (J.B.).
- One 4-pin chassis-mounting valveholder (Clix).
- One 5-pin chassis-mounting valveholder (Clix).
- One 7-pin chassis-mounting valveholder (Clix).
- One strip, marked L.S.+ and L.S.— (Clix).
- One strip marked A1, A2 and E (Clix).
- Four plugs, marked Aerial, Earth, L.S +, L.S.— (Clix), type 16.
- One fixed resistor, 350 ohm (Erie).
- Two fixed resistors, 5,000 ohm (Erie).
- One fixed resistor, 30,000 ohm (Erie).
- One fixed resistor, 3 megohm (Erie).
- Connecting wire and sleeving.
- Four dozen ¼in. 6B.A. bolts and nuts.
- 14yds. twin flexible lead.
- One double-pole on-off switch, type S104 (Bulgin).
- One single-pole on-off switch, type S102 (Bulgin).
- One L.F. transformer, 1-3.5 ratio, type Niclet (Varley).
- One mains transformer with windings 250-0-250 volts, 60 mA; 2-0-2 volts, 1 ampere; 2-0-2 volts, 2 amperes.
- One permanent magnet loudspeaker (W.B.).
- One MHL4 met. valve (Osram).
- One MPT4 valve (Osram).
- One U10 valve (Osram).

D.C. Mains Apparatus

Some Facts About D.C. Supplies Not Always Considered, Together With Details of H.T. Eliminators and L.T. Chargers

ALTHOUGH it is generally acknowledged that constructors who have A.C. electricity supplies at their disposal are more fortunate than those who have D.C., the actual position is not so one-sided as this statement tends to indicate.

Both forms of supply have their advantages and disadvantages; with certain circuits and apparatus, A.C. does become a necessity, but this does not imply, that—so far as the radio enthusiast is concerned—the utility value of D.C. is so low as to render it of little use.

During the early days of mains-operated receivers, 75 per cent. of them were designed for A.C., and the remaining 25 per cent. for D.C. supplies. The "universal" or A.C./D.C. set as we know it to-day was not then in production in this country. These figures did not, however, represent the ratio of A.C. to D.C. supplies, but rather were they indicative of the policy adopted by the set manufacturers, and the number of people who, having D.C. mains, and, possibly, a poor opinion of the performance of the restricted choice of D.C. sets, retained in use their battery-operated sets. Since those days a great number of D.C. districts have been switched over to A.C., yet in spite of the extensive change-over programme which was in full swing prior to the start of the war, there are a surprising number of commercial electricity undertakings still generating direct current.

The majority of constructors on D.C. appear to have developed a kind of radio inferiority complex; they adopt the attitude of "Well—what can one do on a D.C. supply?" They infer that it is impossible to make a set or amplifier capable of doing all that an A.C. model would. The fact that they have to hand a source of direct current between 200 and 250 volts, without any thought or trouble of providing rectifying equipment, does not seem to enter into their view of the position.

Variation of Voltage

The chief difference between A.C. and D.C. supplies, when considering them in the light of radio construction, is that the former can have its voltage increased or decreased by means of a simple transformer. With D.C. such variation of the initial voltage is not so simple; a decrease can be obtained by the inclusion of resistance in the circuit, but, to secure an increase, it is necessary to use more complicated and costly apparatus than for A.C., this usually taking the form of rotary convertors or vibratory rectifiers, and, so far as the average constructor is concerned, the former is generally out of his reach owing to cost.

Examining the problem of restricted voltage from D.C. supplies, the point so often put forward by those having to use them, one should not overlook the fact that quite a large proportion of A.C. sets utilise a rectifier having an output of 250 volts (unsmoothed) at 60 mA.s. Such sets are capable of satisfying most domestic requirements, therefore there seems to be little in the restricted voltage argument. Again, one must take into account the great progress made in the design of the "universal" types of set; the majority of these—and the types available range from three-valve straight to multi-valve superhet circuits—are fully capable of putting up a very good show, as regards both quality and range.

Utilising the Supply

During normal times it is not a difficult matter to construct an efficient A.C./D.C. set from one of the blueprint designs published in PRACTICAL WIRELESS. If the set is to be used solely on D.C. mains, the rectifier portion can be omitted, provided that the filament circuit is corrected and the positive side of the D.C. supply taken direct to the rectifier side of the smoothing circuit. At the present time, however, there is a greater demand from constructors for H.T. eliminator and L.T. charging equipment for operation off D.C. supplies, than for sets, the obvious reason being the lack of H.T. batteries, the possession of a good battery receiver and the difficulty of obtaining new components for set building.

An H.T. eliminator is not a difficult piece of apparatus to make, and all the components can be obtained from the majority of dealers in surplus radio material who advertise in PRACTICAL WIRELESS. The simplicity of the fundamental circuit can be appreciated by reference to the theoretical diagram shown by Fig. 1, which is that of a circuit suitable for the average three or four valve set having a total anode current consumption of, say, 20 mA.s, and *not* having in the output stage a Class B or Q.P.P. valve. Assuming that the voltage of the supply is 200 volts, the value of the resistors as shown on the diagram will be satisfactory for a normal receiver. If other supply voltages have to be used, or if the anode current consumption of the set is below or greater than 20 mA.s, the resistor values will have to be adjusted to suit the prevailing conditions. This is not a difficult matter if the simple formula $R=\frac{E}{I}\times 1{,}000$ is remembered and applied. R equals

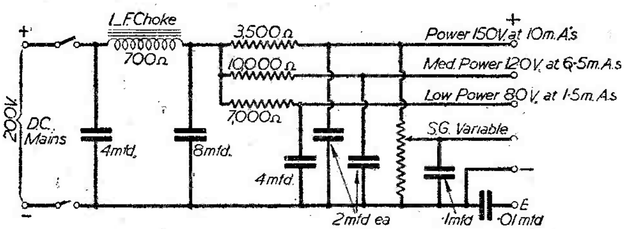


Fig. 1.—An H.T. eliminator for D.C. mains. The valves shown are suitable when the unit is to be used with a 3 or 4 valve receiver off 200-220 volts D.C. supplies.

the value of the resistor, E the value of the *voltage to be dropped*, and I the current—in milliamps—flowing in the part of the circuit under consideration. For an example, assume that the smoothing choke has a resistance value of 700 ohms and that the current *is* 20 mA.s, then we must first determine the voltage which will be *dropped* across the choke. Re-arranging the above formula we get $E=\frac{I\times R}{1{,}000}$; substituting actual values: $E=\frac{20\times 700}{1{,}000}=14$ volts.

Thus, instead of having 200 volts after the smoothing circuit, the value would be $200-14$, which equals 186 volts.

If, therefore, the power or pentode valve in the output stage only needs 150 volts at 10 mA.s, the resistor required to drop 186—150 volts equals $\frac{186-150}{10}\times 1{,}000=\frac{36{,}000}{10}=3{,}600$ ohms, say, 3,500 ohms.

The value selected for the potentiometer, which provides a variable control for the screening-grid voltage of an H.F. S.G. or pentode valve, will be suitable for practically all supply conditions. If a potentiometer is not to hand, two fixed resistors connected in series could be used, the junction between them being the point from which the screen voltage is taken. The values would be 50,000 ohms for the top component and 40,000 ohms for the lower.

Points to be Observed

It must be remembered that one side of the supply mains is earthed. To prevent the possibility of short-circuits, it is, therefore, absolutely essential for the earth connection on the receiver—which is usually common with the H.T. negative side of the circuit—to be taken to earth *through* a reliable fixed condenser and *not direct to earth*. It is for this reason that an earth terminal point is shown on the diagram of the eliminator circuit. The lead from the earth should be taken *off* the set and connected to the E point on the eliminator.

It is also advisable to include a small variable or fixed condenser in series with the aerial lead-in, this being to prevent a short-circuit via the aerial coil if the aerial should break adrift and touch the ground, and to prevent the possibility of *shocks* to anyone who might touch the aerial during adjusting or cleaning operations.

For the smoothing condensers, those of the paper dielectric type are perhaps the best, as these are unaffected by incorrect connections as regards polarity. Electrolytic condensers are smaller and could be used, but with these harm will be caused to them if, by mischance, the mains plug is inserted the wrong way round and the polarity reversed.

L.T. Charger

The circuit shown by Fig. 2 is that which can be used when it is desired to charge L.T. accumulators from *D.C.* mains.

The charging current is regulated or determined by the wattage of the lamp and this should be selected to suit the type of accumulator under charge. On a 200-volt supply, a 100-watt lamp would pass, approximately, 0.5 amp., a 60-watter would pass 0.3 amp. If a greater charging current is required, the lamps can be connected in series-parallel, as shown by the broken lines, two lamps approximately doubling the current passed by one, and so on. For the average radio accumulator, it is usually sufficient to trickle-charge, or, in other words, apply a low charging current of, say, 0.25 amp. for a period slightly longer than that during which the set is in use. If carbon filament lamps can be obtained, they provide better regulation and are recommended in preference to the modern types. It will be found that they—the carbon filament lamps—are not rated by wattage but by candle-power, and as an approximate guide an 8 candle-power lamp will pass .1 amp., a 16 c.p. .2 amp. and a 32 c.p. .5 amp., these figures being for a 210-220-volt supply.

Safety Precautions

A double-pole switch should always be used for controlling the mains circuit. The charging equipment should be located in a room or shed having a dry wooden floor, to prevent the possibility of shock to the operator if he should touch one side of the accumulator—when it is on charge—and complete a circuit to earth via his body. On no account should any connections be made or broken *without first switching off the mains*. With the D.C. operated apparatus described, it is essential for the positive and negative lines of the supply to be

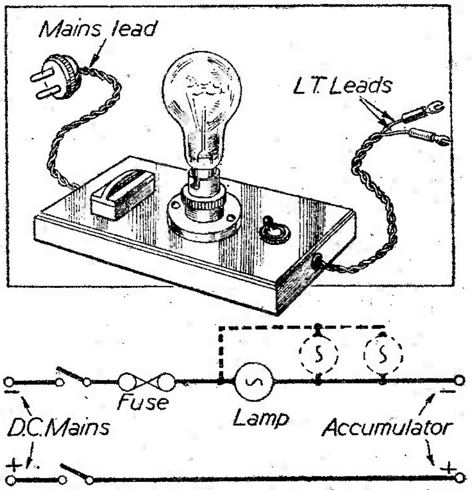


Fig. 2.—A standard L.T. charging circuit and layout suitable for use with D.C. mains. The double-pole on-off switch is essential.

determined and marked, and once this has been done, care must be taken to see that the connections are always made to the correct poles, i.e., positive and negative.

To find which is the positive line, the following procedure can be followed. Into a glass or earthenware vessel, a large jamjar or basin will do, pour a solution of common salt and water. From the mains plug take two wires, and connect in series with one of them a lamp having the same voltage rating as the mains. Now insert the free bare ends of the wires in the salt solution, keeping them some little distance apart. From one of the ends a cloud of minute bubbles will be produced, and this will indicate that that wire is the negative pole of the supply. Tracing this wire back to the mains plug, the latter should then be marked accordingly.

Books Received

RADIO RECEIVER CIRCUITS HANDBOOK. By E. M. Squire. Published by Sir Isaac Pitman and Sons, Ltd. 104 pages. Price 5s. net.

WRITTEN for the practical radio man, this book presents a summary of the general theory of the most important and commonly used circuits in modern radio receivers. Notes are given on the best methods of operating the circuits described, and on the faults likely to develop if the wrong operating conditions, or components, are employed.

THERMIONIC VALVE CIRCUITS. By E. Williams, A.M.I.E.E. Published by Sir Isaac Pitman and Sons, Ltd. 174 pages. Price 12s. 6d. net.

THIS book, which deals with the theory of the operation and design of thermionic valve circuits, is based on a lecture course in Electrical Engineering given by the author in the University of Durham. The book, which assumes a knowledge of alternating current theory and mathematics, should prove particularly suitable for students at universities, technical colleges, and electrical engineers trained in the days before the development of the thermionic valve.

RADIO HANDBOOK SUPPLEMENT. By the Incorporated Radio Society of Great Britain. 141 pages. Price 2s.

THIS book has been produced to bridge the gap between the current edition of "The Amateur Radio Handbook" and a future third edition, which cannot be prepared in the present circumstances. It consists of nine chapters covering Fundamentals, Radio Mathematics, Circuit Mathematics, The Cathode Ray Oscillograph, Direction Finding, etc., A Service Operator's Vade Mecum, Emergency Operation of Radio Equipment, and Data and Formula.

WIRELESS, AND HOW IT WORKS. Edited by Arthur Elton. Published by Longmans, Green and Co. 56 pages. Price 1s. net.

THIS useful handbook, which is intended as a first book for the services, explains the why and wherefor of radio in a simple and interesting manner. No detailed descriptions of sets or mathematical formulæ are included, and the text is illustrated by diagrams.

Manual Volume Controls

Practical Details of the Various Systems of Volume Control, with Some Notes Regarding the Choice of the Most Suitable Arrangement for Different Requirements

VOLUME control by manual means is often considered to be such a simple matter that little thought is given to the possibility of one system being more suitable than another for certain circuits. It is possible to vary the volume in almost any part of a receiver circuit by means of a potentiometer, suitably wired. Thus, the potentiometer could be used to vary the input from the aerial to the first tuning circuit, the degree of amplification provided by the H.F. amplifier, the input to the L.F. amplifier, or the input to the loudspeaker.

L.F. Input

Each of these control points offers certain advantages, and it is often a good plan to apply a control at two of the points mentioned. Now that automatic volume control is extensively used for varying the gain of the H.F. or I.F. amplifier, and sometimes of the frequency-changer of a superhet, the only other control need be in the L.F. portion of the set. The arrangement shown in Fig. 1 is widely used and is very satisfactory. In this case a potentiometer of about .25 megohm is wired across the secondary winding of the first L.F. transformer, the slider being connected to the grid of the first L.F. valve. By this means the whole or any fraction of the total audio-frequency voltage developed across the secondary winding may be applied to the following valve.

When the L.F. amplifier has a very high gain, this form of volume control may remove any slight tendency towards L.F. oscillation. This is partly due to the "loading" effect of the potentiometer resistance on the transformer secondary, and partly because of the permissible reduction in input to the amplifier. One minor objection is that variation of volume by this means may have a tendency to affect the tone of reproduction, because of the varying resistance in the grid circuit as the potentiometer slider is moved. That tendency can be reduced by connecting a fixed condenser of about .005 mfd. between the slider and the upper end of the potentiometer.

Variable Shunt Resistor

An alternative method of control is shown in broken lines in Fig. 1. Here it will be seen that a variable resistor is wired in parallel with the primary winding of the L.F. transformer. It would appear that this arrangement would be very unsatisfactory, due to the alteration in effective anode load resistance on the valve preceding the transformer—usually the detector. This is not necessarily so in practice, and the control often gives a slight tone-correction effect; in the ordinary way reproduction has a tendency to become somewhat "thin" as the volume is backed off.

Fig. 2 shows a system which corresponds to that indicated by full lines in Fig. 1. This applies to a resistance-capacity-coupled stage, however. A potentiometer replaces the usual grid leak, and the voltage applied across this by the preceding valve is "tapped off" as required. An additional resistor of 10,000 ohms is also shown in Fig. 2, this being a grid-stopper resistor for preventing the leakage of H.F. voltages into the L.F. amplifier. This resistor is optional in the circuits of both Figs. 1 and 2, but would normally be included in a short-wave receiver as a matter of course.

The form of control shown in Fig. 2 is that most often employed in a superhet with a diode second detector. In that case the potentiometer simply replaces the normal load resistor. Its value would usually be .5 megohm, but the valve makers' instructions should be followed, using the same value as that stipulated for the load resistor. An indirectly-heated L.F. valve is shown in Fig. 2, but the connections would be the same when using a battery valve, with the exception that the lower end of the volume-control potentiometer would be connected to G.B.–, as in Fig. 1, instead of to the earth line.

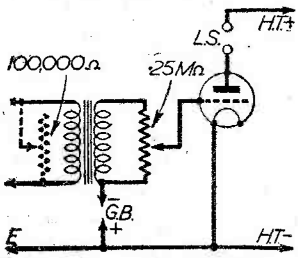


Fig. 1.—Two methods of L.F. volume control. That shown in full lines is often better than that indicated by broken lines.

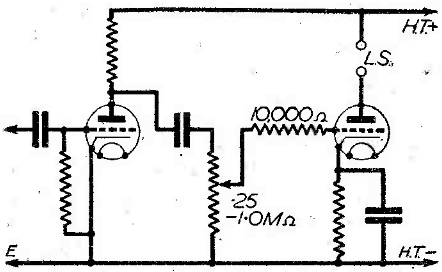


Fig. 2.—A form of volume control similar to that shown in Fig. 1, but for an R.C.C. stage. A grid stopper resistor is also shown.

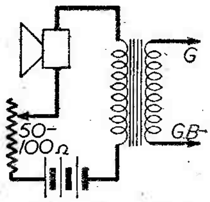


Fig. 3.—A method of L.F. volume control which can sometimes be used conveniently with a microphone.

Microphone Volume Control

When using a microphone or pick-up the method of volume control shown in full lines in Fig. 1 could well be used; the pick-up would actually take the place of the L.F. transformer indicated, since a transformer is not normally used in conjunction with a pick-up. Another method of volume control with a carbon microphone is that illustrated in Fig. 3.

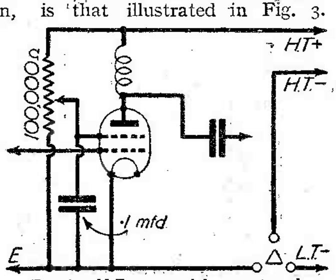


Fig. 4.—H.F. control by varying the voltage on the screening grid of an S.G. valve.

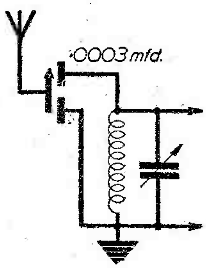


Fig. 5.—Input H.F. volume control by means of a differential condenser.

Here it will be seen that the output from the microphone is varied by including a variable resistor between the microphone battery and the microphone itself. This serves to vary the energising current. The approximate value of the variable resistor indicated is suitable for the average carbon microphone, which has a resistance in the region of 50 ohms. If the resistance varied appreciably from this figure, the value of the resistor should be modified proportionately.

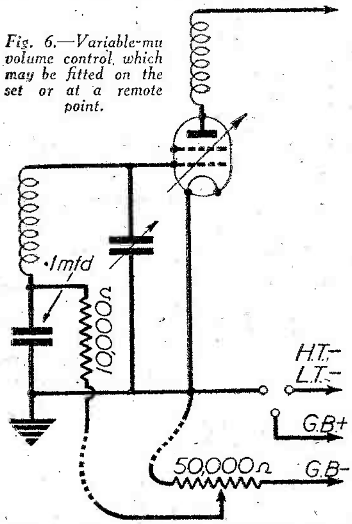


Fig. 6.—Variable-mu volume control, which may be fitted on the set or at a remote point.

One small practical advantage of this arrangement is that it is often easier to obtain a "quiet" variable resistor rated at, say, 100 ohms than it is to buy one of a quarter-megohm or so. The volume-control resistors used in the circuits in Figs. 1 and 2 should be of high-grade construction if they are to be silent in action.

S.G. Control

An old and fairly satisfactory method of controlling volume in the H.F. amplifier is by varying the voltage applied to the screening grid of the first tetrode or pentode. The appropriate connections are shown in Fig. 4. Observe that when this arrangement is used it is necessary to have a three-point on-off switch so that the H.T.– circuit is broken when the set is switched off. If this circuit were not broken the H.T. battery would be constantly, if slowly, discharging through the potentiometer. There are various technical objections to this form of H.F. volume control, but none of them is very serious when the set is not of the "high-quality" type. One useful point is that reduction in the potentiometer setting sharpens the tuning.

Aerial Input Variation

The volume-control system illustrated in Fig. 5 is in many respects preferable to that just described. It has no effect on reproduction, and adjustment does not affect the accurate tuning of the set. But unless the differential condenser is provided with an extension spindle there is a danger of hand-capacity effects being troublesome. It will be seen that input to the set is increased as the moving vanes of the condenser are turned into closer mesh with that set of fixed vanes which is connected to the upper end of the tuning coil. As the capacity between these two sets of vanes is reduced the capacity between the moving vanes and the other set of fixed vanes is increased. As a result, the total capacity between aerial and earth is maintained constant for any particular setting of the tuning condenser.

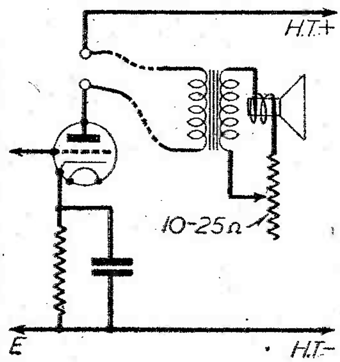


Fig. 7.—Remote volume control for a M.C. speaker.

Remote Variable-mu Control

There is little doubt that the best form of H.F. volume control is by the use of variable-mu valves. A circuit for this is given in Fig. 6, where it is also indicated that the volume-control potentiometer may be situated remotely from the set. This is because it is in a low-potential part of the circuit, and also because the current to be carried is quite negligible. Should the potentiometer be mounted within the set, and when the control is effective on only a single valve, it would not be necessary to include the 10,000-ohm decoupling resistor shown. This may be desirable with the remote control, however. When it is used, it should be placed close to the coil terminal.

Graded Potentiometer

The three leads to the volume control can be of ordinary insulated flex, and may be twisted together, since any capacity between them cannot affect the operation. As with the potentiometers used in the circuits of Figs. 1, 2 and 4, the potentiometer here should be a good one, and preferably of the "carbon-track" type unless a really good wire-wound one is available. In all cases it is an advantage to employ a "graded" potentiometer; that is, one with which the variation in resistance over any given arc of slider movement is progressively smaller towards one end. That end should be connected to the "maximum-volume" end. When the normal type of control is employed there is a tendency for the useful arc of the slider to be crowded towards the "maximum" end of the resistor. In other words, a slight movement of the control knob away from the "maximum" position has a far greater effect than has a similar movement at the other end of the range of movement.

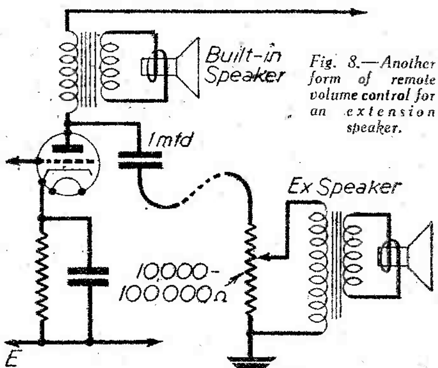


Fig. 8.—Another form of remote volume control for an extension speaker.

Control With Extension Speakers

When using an extension loud-speaker, it is often desirable to have a volume control near the speaker, and suitable methods are shown in Figs. 7 and 8.

In using the method illustrated in Fig. 7 it is necessary to break the flexible connection between the secondary winding of the transformer fitted on the speaker and speech coil, and to insert a variable resistor. Since the resistance of the speech coil is low it is necessary to use only a low value of variable resistor.

The method of remote control shown in Fig. 8 is useful when the extension speaker is fed through a choke-capacity output arrangement. Here the potentiometer is in the primary circuit of the speaker transformer. The value of the potentiometer should, to a certain non-critical extent, be governed by the optimum load of the output valve. If it is between one-and-a-half times to twice the value of the optimum load it should give satisfactory control.

Practical Hints

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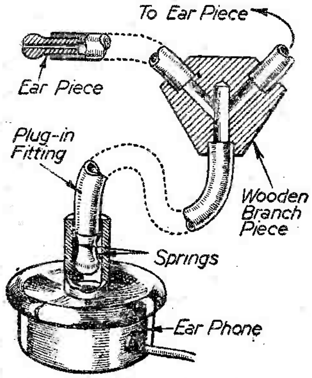
SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page iii of cover.

Novel Earphones

THE accompanying sketch shows how I constructed simple light earphones for use with a pocket receiver. Connection to the earphone is made by a plug and socket device

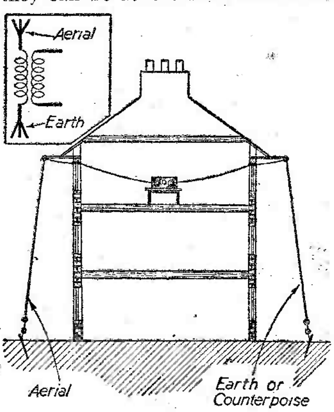


A simple plug-in attachment for earphones.

which is glued to the centre of the earphone cap. Three small springs, about ⅛in. long, parts of an old watch spring, are glued in notches cut inside the socket piece. The connecting plug is made from a piece of ⅛in. dowel rod. Connected to this plug by a 2in. length of ⅛in. rubber tubing is the wooden branch piece, made from hardwood, ½in. thick, and bored as shown in the sketch. Glued into the sloping holes in this branch piece are the ends of two 18in. lengths of ⅛in. rubber tubing, and in the other ends of the tubing small wooden plugs are fixed, shaped to fit one's own ear.—R. G. CROWTHER (Birmingham).

Short-wave Reception

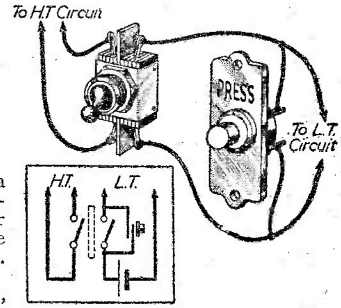
THERE must be many who, like myself, are forced to do their short-wave listening on the top floor of the house. This means that the ordinary down-lead no longer applies, and that the lead-in must be taken from the top of the aerial. It also implies a long earth lead. I recommend those who are situated like myself to try the aerial system shown in the sketch. It will be seen that there are two "aerials," though one of them is really a counterpoise earth. These should be at opposite sides of the house if this can be managed, otherwise they can be at the same side of the house but sloping away from each other. Two insulators at the bottom and a short support at the top are all that are required in the way of fixtures. One of the aerials is connected to the top end of the aerial coil and the other one to the bottom. Try also the effect of joining the bottom of the aerial coil to the bottom of the grid coil. Being a vertical aerial, this arrangement picks up equally well from all directions, and some good results can be obtained with it.—WM. NIMMONS (Belfast).



A novel method of arranging a short-wave aerial.

H.T. and L.T. Switching

NOW that H.T. eliminators are coming into their own again, owing to the battery and mains-valve shortage, no doubt many amateurs will be using these units in conjunction with a two-way, double-pole switch, for switching on the H.T. and L.T. together.

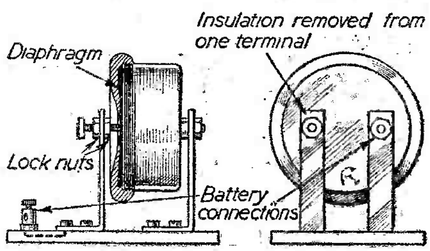


An efficient arrangement of H.T. and L.T. switching.

As is well known, this dual switching, whilst convenient, in time affects the efficiency of the valves, and possibly the decoupling condensers owing to peak voltages. Failing the actual incorporation of a commercial delay switch, I have found the following idea gets over the trouble quite simply, and it will be found quite convenient. This is the inclusion of an ordinary bell-type push-switch, mounted quite close to the mains type switch, and wired in parallel with the L.T. portion of the latter. This bell-push is pressed first, and then the mains switch snapped on. This lights the valve filaments a fraction of a second before the H.T. comes on. When switching off there is, of course, no need to press the bell-push. I have found it is quite easy to operate this combination with one hand.—R. L. GRAPER (Chelmsford).

An Improvised Buzzer

THE accompanying sketches show how I converted an earphone into an improvised buzzer. The earphone is of the type with two terminals at the back, though it can be done with other types. The earpiece is removed, and adjustments made so that the diaphragm makes good contact with the metal case. The insulating washer on one of the terminals is removed, and the nut screwed back again, thus connecting the case to one of the coil ends. The adjuster for the contact will be understood from the sketch. The earphone is mounted on two metal brackets, one battery lead going to the other earphone terminal, the other to the contact. The buzzer when adjusted correctly emits a high-pitched note suitable for morse.—D. BROOKS (Woking).



Two views of a simple buzzer made with an old earphone.

Radio Examination Papers—7

Another Collection of "Test Yourself" Questions, with Suitable Replies
Prepared by The Experimenters

SPECIMEN QUESTIONS.

1.—*Explain briefly how voltage amplification is provided by means of a triode valve.*
2.—*What is the difference in meaning between the terms "induction" and "inductance"?*
3.—*If it were found that the output from one gramophone pick-up was appreciably lower than that from another, and of inferior quality, on the same receiver, what faults would you suspect?*
4.—*Draw a diagram of a rejector circuit used as a wave-trap, and briefly explain its function.*
5.—*The amplification factor of a tetrode or pentode is considerably higher than that of a triode. Why?*
6.—*What is the "Q" of a coil? Calculate the "Q" of a coil having an inductance of 200 microhenries and a resistance of 10 ohms at 600 kilocycles.*

1.—Voltage Amplification

SINCE a comparatively small change of input voltage on the grid produces the same change in anode current as a much larger variation in anode voltage the effect of voltage amplification is produced. Thus, if a change of 2 volts on the grid has the same effect as a change of 20 volts on the anode, the amplification factor would be 10. Actually, this is not strictly correct, since the amplification factor is determined at one point on the valve characteristic and is worked out for a *very small* change in anode and grid voltage. This is not of importance for our present purpose, because we are not necessarily concerned with particular figures.

Using the approximation given above it could be said that when a voltage variation of 2 were applied to the grid of the valve shown in Fig. 1 a variation of 20 would appear across the anode load resistor shown. And since the grid of the next valve is connected to the anode of the valve V.1.—through a grid condenser—and the filament of the next valve is connected to the "H.T.+" end of the resistor, through the H.T. supply, 20 volts variation would be applied to the grid of the next valve.

The voltage variation developed across the anode load resistor is due to the change of current through the resistor. And we know from Ohm's Law that the voltage across the resistor is proportional to the product of the resistance in ohms and the current in amps.

2.—Induction and Inductance

Induction refers to the current, or voltage induced into one circuit from another. The term is generally employed when two coils are placed adjacent to each other so that the magnetic field created around one of them is cut by the turns of the other.

Thus, in the case of a reaction and grid coil wound side by side on the same former the magnetic fields created around both coils by the H.F. currents flowing through them "interlock." If the coils are so connected that they are in the correct sense—that is, so that the fields tend to assist each other—voltages from the reaction coil are induced into the grid coil in such a manner that they assist in the production of a stronger field around the grid coil.

In the case of an aerial coil coupled to a grid coil, voltages from the aerial coil are induced into the grid coil. Similarly, with an L.F. transformer, alternating voltages in the primary winding are induced into the secondary winding. Because of this, the transformer could be described as an induction coil.

Inductance is a term applied to a single coil or winding. This has the property that if an increasing current is passed through it the magnetic field built up around it also tends to "grow." This field cuts across the turns of the coil in such a way that an opposing voltage is induced into the coil. The effect of this is to slow down the tendency for the magnetic field to grow. When the current through the coil tends to fall the magnetic field similarly tends to be reduced. In that event the induced voltage is added to the initial (falling) voltage and therefore tends to prevent the fall in voltage.

3.—Pick-up Faults

Assuming that the two pick-ups are of similar type and should give similar outputs, the fault described in the question would probably be due to sluggishness in the movement of the iron armature which carries the needle. If the armature were partially jammed it would not move freely and therefore output would be cut down. Similarly, there would be less tendency for the needle point to follow accurately the groove in the record, and distortion would occur. The armature is normally positioned a short distance from the magnet poles and is centred by means of two soft rubber buffers. If the rubber were perished, movement of the armature would be restricted. Alternatively, the armature may be allowed almost to touch the pole pieces with the results that it could not move over a sufficiently great distance and that it would touch the magnets at one end of each backward-and-forward oscillation. This would cause distortion and "rattling," and also a reduction in output.

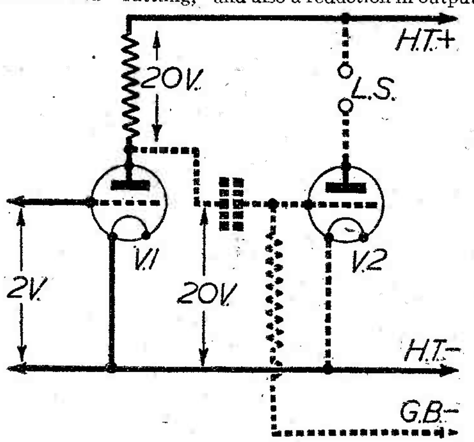


Fig. 1.—This simplified diagram shows how voltage amplification is provided by the triode marked V.1; the amplified signal voltage is passed on to the grid-filament circuit of V.2.

Weakened magnets could also result in reduced output, whilst if the pick-ups were fitted with built-in volume controls the partial short-circuit of the volume-control resistance element in one would result in a reduced input to the amplifier.

4.—Rejector Circuit

A rejector circuit is shown in Fig. 2, where it can be seen to consist of a coil and tuning condenser in parallel, the two being wired in series with the aerial lead. This tuned circuit in series with the aerial acts as a wave-trap, because it can be made to "reject" a transmission on a certain frequency.

This is explained by the fact that a parallel-tuned circuit offers an infinite impedance at its resonant frequency (the frequency to which it is tuned). Thus, suppose it were desired to prevent interference from a transmission on 1,000 kc/s it would be necessary to tune the rejector circuit to this frequency. It would then prevent the passage into the receiver of transmissions on that frequency. Provided that the circuit were highly efficient, however, it would have little effect on other frequencies; even those fairly close to 1,000 kc/s. In other words, the rejector circuit should have a "peaky" response curve.

Although the question does not call for it, it may be well to consider also an acceptor circuit, which can also be used as a wave-trap. This also is shown in Fig. 2, and can be seen to consist of a series-tuned circuit placed in parallel with the input circuit.

A series-tuned circuit offers negligible impedance to signals at its resonant frequency, but has a high impedance at other frequencies. Thus, if tuned to the frequency of the unwanted transmission it by-passes it to earth, and so prevents it from affecting the input circuit.

In both cases the receiver is tuned as accurately as possible to the unwanted transmission, and then the wave-trap is tuned until that transmission becomes inaudible or as weak as it can be made. Desired transmissions can then be tuned-in in the normal manner, free from interference.

5.—Screen-grid Amplification Factor

In a screen-grid or pentode valve the screening-grid is placed between the control grid and the anode, and is maintained at a fairly high positive potential. Being closer to the control grid than is the anode it has a greater effect on the cathode-anode electron flow than has the anode.

And since the screening-grid is maintained at a constant potential, greater changes in anode voltage are required to produce similar changes in anode current than would be the case if the screening-grid were not used—as in a triode. Anode impedance is equal to the ratio of a small change in anode voltage to a small change in anode current. It will be seen, therefore, that the anode impedance of a screen-grid valve is very high.

Now the amplification factor is equal to the product of the mutual conductance and the anode impedance. Since the anode impedance of a tetrode or pentode is high, it follows that the amplification factor also must be high.

It should be mentioned that the amplification factor depends, to a large extent, upon the screen voltage, but is higher than that of a triode when this voltage is anywhere within the working range as stated by the makers.

6.—The "Q" of a Coil

The "Q" factor is an indication of the efficiency or "goodness" of a coil. It is the ratio between the reactance and resistance of the coil, the resistance being that at H.F., and including all losses, and not the D.C. resistance, which is relatively unimportant. Since reactance increases with frequency (it is equal to $2\pi f$ times the inductance, where π is the usual 3.14 and f is the frequency in c/s) it would appear that the "Q" factor must vary with frequency. This is not necessarily so in practice, however, because the H.F. resistance also increases with frequency.

Expressing the above statement in the form of a simple formula we have: $Q=\frac{2\pi fL}{R}$. Taking the figures given in the question, we can work out the answer as follows:

$$Q=\frac{2\times 3.14\times 600{,}000\times 200\times 10^{-6}}{10}$$

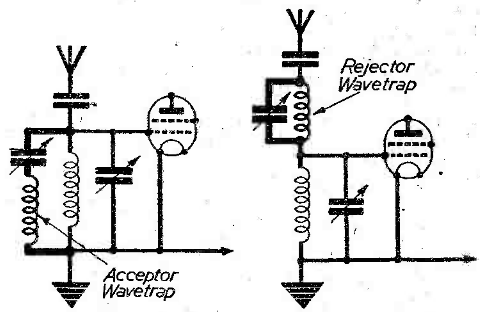


Fig. 2.—An acceptor circuit wave-trap is shown on the left, and a rejector circuit wave-trap on the right. In both cases the wave-trap is shown in heavy lines.

The reason for multiplying 200 (microhenries) by 10 to the minus 6 is that the inductance must be expressed in henries.

Simplifying the above we get:

$$Q=\frac{2\times 3.14\times 6\times 20}{10} \text{ or } 24\times 3.14$$

which is 75.36.

A highly efficient coil may have a Q factor in the region of 120, while a figure between about 60 and 90 would be considered as very satisfactory. Such a coil would be expected to tune sharply and to provide good voltage magnification.

Special Broadcast Programmes

B.B.C. Programme to Malta

BRITISH troops in Malta will soon be hearing their own friends and relations on the air. The producer of the B.B.C. programme to Malta wants anyone who has a friend or relation serving on the island and who can sing or play any instrument, to get in touch with him. Every application will be carefully dealt with, and auditions will be held weekly, at which the judges will be a soldier, a sailor and an airman (non-commissioned).

Three successful applicants will appear in the broadcast the same evening, accompanied by Nat Allen and his B.B.C. Back Room Boys, who provide the music for the Malta programme. It is compered by Ronnie Shiner, whose name is a byword in Malta.

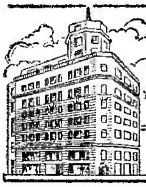
Would-be radio artists in this new "Home Made Music" feature are asked to send a postcard giving their own name and address, the name and address of their relation or friend serving in Malta, and details of their musical accomplishments to: "The Producer, 'Malta Forces Programme,' B.B.C., London."

Airs of the Nations

AMONG the most interesting of the war programmes of the B.B.C. are the National Airs, broadcast every Sunday.

Philip Bate, the man behind the programmes, has carried out a great deal of fascinating research, discovering, for example, that in much music written by Polish or Czech musicians, the basic influence is often French or Teutonic.

The presence in England of the Polish and Czech Army Choirs and of the Dutch Military Band has made it possible to collect the authentic folk music of these countries, and to get first-hand, authoritative views on their music, while the assistance of the various Embassies and Legations has been invaluable and generous.



ON YOUR WAVELENGTH

By THERMION

The Cryners

AS a voice in the wilderness I have been crying alone, or almost alone, on the subject of crooners, and jazz bands and tin-pan alley music, and crying is the operative word, for from crooning these queer creatures, who seem to earn fantastic sums for exhibiting their lack of voice, have turned to cryning. I have coined the word and I hope that the editors of the Oxford Dictionary will take note of the date on which it is used, and include it in the next edition. A cryner is one who cannot even croon, and so is many shades worse even than a crooner. A cryner will choke and sob and chant and be lachrymose, whereas a crooner will merely boop-a-doop, la-di-da, and hi-di-ho. Crooners and cryners are morons, that is to say, their intelligence has not developed beyond that of a child of eleven years. The apogee of their efforts is the nadir of nonsense.

When jazz was first thrust upon the world in the first years of the B.B.C. most of us predicted for it a short life, but we were wrong. It has been attacked by almost every journalist and journal, but the forces behind jazz have been too strong. The B.B.C. gauges the popularity of an item from the number of laudatory letters it receives concerning it. I have none the less for many years suspected that there is a claque behind crooning and jazz. Every time I have written adverse criticisms of it I have had a large number of letters of the inspired sort. The B.B.C. reached that conclusion some years ago when it stopped the reprehensible practice of song plugging. It issued instructions to dance band leaders that they were not to plug songs. A musician was often paid by a music publisher to push a particular song, and at the time he was being paid by the B.B.C. to broadcast. Therefore, for three or four weeks—practically the life of the song—you had to suffer a rendering (apt word!) of this song. You were told that it was popular, that it was being played by request, that it was the latest song hit, and so on. There was no justification for any of these descriptions. A song isn't popular because a musician says it is. It has taken the B.B.C. a long time to reach the conclusions I reached years ago. It is now going to curtail the amount of jazz and the amount of crooning, but it goes from one extreme to the other. It has issued new orders and one of them is that drink must not be mentioned. How far this order is intended to be interpreted I do not know. Will Sandy Macpherson be permitted to give a pôt-pourri of the famous drinking songs, such as that good old English tune, "There is a Tavern in the Town," the drinking song from Old Heidelberg, or any of the other songs concerning drink which have become part of the national musical history?

Old English Curses!

PROFANITY, execrations, and vituperations are also to be rigidly exorcised from the programmes. "Damns" and "hells" and similar oaths are taboo. Perhaps our etheric entertainers will revert to the old English curses of "By my halidame, I will up and smite thee hip and thigh," or "'Odswounds," or "Odds-bodikins." This order is going a little too far, for even "My God!" or "Heavens" are to be rigorously eschewed. I do not think that anyone in these enlightened times is annoyed when they hear such expressions, nor do I think that references to drink are likely to upset the public morale. "In vino veritas"—in wine the truth—is very apropos, unless, of course, the B.B.C. prefer to rely on the other tag that when the wine is in the wit is out; for it is wit that they want. I agree that rudeness is not wit, but sentences rigidly purged of everything will fail to be funny. Like George Robey, most of us, I think, believe in a little honest vulgarity. Bernard Shaw, in his play "Pygmalion," makes use of the expressive adjective. Will the B.B.C. alter the line to "Not blue pencil likely"?

I understand also that sophisticated songs are to be reduced in number, and to be subject to certain editorial evisceration. I agree with their decision to stop pirate versions of classical music. The "Eighteenth Century Drawing Room," which has been very popular, is based upon Mozart's Sonata No. 16, which was written in 1788.

Stentorian Response to Mansfield Warships Week

THE Whiteley Electrical Radio Co., Ltd., manufacturers of the well-known W.B. Stentorian speakers, have given another example of the whole-hearted manner in which the radio trade is "making its money fight."

Led by the example of the managing director, Mr. A. H. Whiteley, who not only contributed one shilling to every savings certificate but doubled the fine total achieved, the Works exceeded their target of £2,000 by another £2,338 14s. od. By Mr. Whiteley's generous action the week's savings for the firm were brought up to the commendable total of £8,677 8s. od.

Friendly inter-departmental rivalry was stimulated by the works manager, Mr. G. W. Coney, who presented a handsome silver cup to the department which reached the highest figure. The challenge was taken up by the twenty-odd departments with zest, and results were computed according to the number of employees and wage bill of each department. Winners were the Drawing and Costing Office, with Accounts and Sales second, and Research third.

It was this type of enthusiastic co-operation which helped to make Mansfield's Warship Week an outstanding success, in which the target of £400,000 for the town was considerably exceeded.

HUSH! HUSH!

[The Minister of Information, answering a question in the House of Commons, said he thought the B.B.C. gave too much news, and he would like to see it cut down.]

Exalted one, are these your views,
That we poor muts should get less news,
Content to pay the cost;
And worry not our hearts or minds
Of what is won or lost?

How often have we not been told,
This is our war. Both young and old
Must make heroic show.
It cannot help us in this fight
If news we may not know.

No wonder Rumour rears its head,
And on its evil course is sped,
When Truth must wear a muzzle
The folly of such plan must be
An everlasting puzzle.

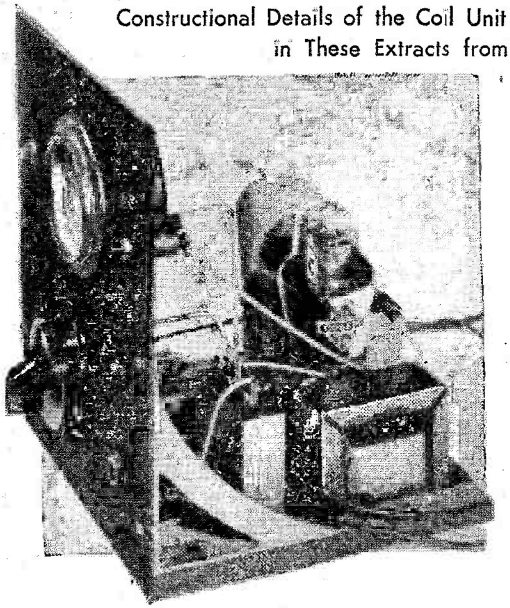
What do you take us for, good sir?
A race which cannot ill news bear,
Still wearing swaddling clothes?
The Briton, will you never learn,
Fights best when truth he knows

So with the B.B.C. no pacts
To give us less and less of facts,
For fear we make a push
Demanding that your title, sir,
Be—MINISTER OF HUSH!

"TORCH."

Notes from an Amateur's Log-book

Constructional Details of the Coil Unit and the Two-valve Amplifier are Given in These Extracts from the Notes by 2CHW



This illustration justifies the author's claim of a neat panel layout and a compact assembly.

THE restriction of supplies should not be considered as a detrimental factor, but rather as a blessing in disguise, *if*—as it should do—it makes us more dependent on our own constructional capabilities. Here is a case in point.

The coil unit used in the Rx has recently been the subject of considerable interest on the part of many readers who wish to secure a similar component. Unfortunately, this is not now possible owing to it being an American product; to assist those who are making the set the main constructional details are given below, and it is hoped that they will provide sufficient information to enable a reasonable equivalent to be made. It is possible that many experienced constructors will see alternative methods of design and assembly, in which case they can modify the description to suit their individual ideas and the material and facilities available.

Surprise has been registered at the coil unit in question being used; many think that it would have been better if I had specified the normal type of plug-in short-wave coils, which are more easily obtainable. Such views are fully understood but, in defence, I must add that the Rx was one I had in use and was not produced for the specific purpose of publishing its design. I have always fancied the large diameter coils (this is purely a personal fad) and as the unit is about one of the best of its type and, as I was not concerned with the saving of space, it was only natural that I should make use of it.

A general view of one of the coils is shown by Fig. 1. There are three coils to the set, but as all follow the same constructional lines it will be sufficient to describe one in detail.

It will be seen that the skeleton type of coil former is used. This consists of two thin but rigid end pieces which form, with the base, the main members of the assembly. Into these end pieces fit six longitudinal ribs, these being spaced equidistant round the circle, thus forming a hexagonal framework around which the grid-coil is wound. The ribs have the shape shown by the inset in Fig. 1, their outer edges being serrated to provide fixed spacing of the individual turns. In addition to the slot and tongue method of locating the ribs in the end pieces, small metal brackets—one on each end of each rib—are used to provide positive fixing between ribs and end pieces, thus locking the assembly and making it very rigid and strong, in spite of the thin material used. The small brackets are visible in Fig. 1.

The former is mounted on a narrow base of insulating material, by using two more small metal brackets. The base also carries four connecting plugs or pins, these being spaced to suit the holder, which will be described later.

Whilst the above method of assembly is most satisfactory, it is not one which would be ideal for the average enthusiast, therefore certain modifications are suggested to simplify matters.

Making the End Pieces

For these one requires some flat pieces of fibre, paxolin or ebonite having a thickness of 1/16in. approximately. If any selection is possible I would recommend fibre or paxolin, as these are stronger and less likely to crack than thin ebonite. To many, the materials mentioned will not be available; therefore in such cases I would suggest thin 3-ply hard dry wood having a thickness of, say, ⅛in. The ribs should be cut from the same stuff as used for the end pieces, and for the cutting out of all parts it would be best to use a fine fretsaw blade.

A suggested design to simplify the making and assembly of the parts is shown in Fig. 2, where it will be seen that the tongue and slot method and the small fixing brackets have been eliminated. The general idea is self-explanatory, though it must be understood that the length of the ribs is governed by the wave-range of the coil, i.e., the number of turns forming the winding.

In the original coils the reaction coil is located inside the grid winding, as shown in Fig. 1. The formation of this coil and its fixing in position are likely to prove rather awkward, so I would

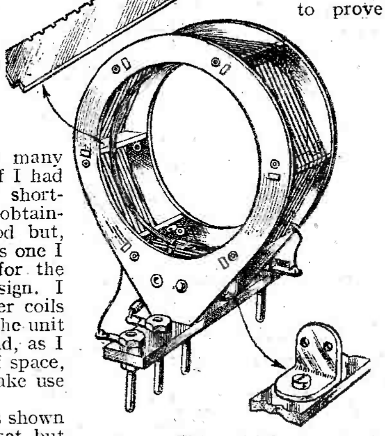


Fig. 1.—The type of plug-in coil used in the original unit. Note reaction windings inside grid coil.

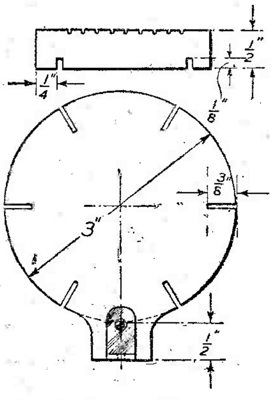


Fig. 2.—A suggested form of construction which will simplify matters.

suggest that a little extra length is allowed for the ribs so that it—the reaction coil—could be wound on one side of and slightly remote from the grid coil.

Suitable pins for the base could be made from some of the early types of connecting plugs or screwed-end valve pins, or it would not be a difficult matter to adapt some of the modern plugs and sockets for the coil bases and the holder.

The Coil Holder

The outstanding feature of this part is the swinging aerial coupling coil, which is shown in the diagram of the holder in Fig. 3. The holder itself should be made from a strip of thicker material, ⅛in. or 3/16in. would be suitable for the materials already mentioned. It is supported above the baseboard, at a height sufficient to clear the sockets, by means of simple distance pieces made from short lengths of tubing or small wooden blocks. The suggested method for making and fixing the swinging coil is indicated clearly in the diagram. The one winding is used with all the coils, the coupling being varied by the swinging movement, which, incidentally, enables a very fine adjustment to be obtained.

Winding Data

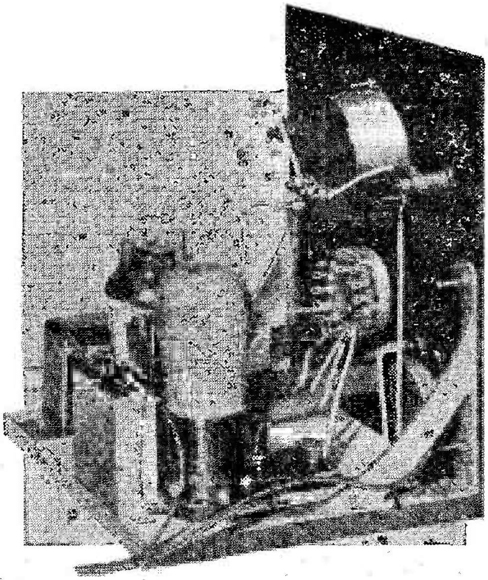
The three coils cover a wave-range of 15 to 130 metres when used in conjunction with a tuning condenser of 150 m.mfds. The smallest winding, which consists of 3 turns of 20 S.W.G. enamelled wire for the grid coil, and 3 turns of 32 S.W.G. D.S.C. or enamelled covered wire, covers the 15 to 34 metre band. The coil for the 30 to 65 metre section has 8 turns for the grid coil and 5 for the reaction, the same gauge wires being used as before. The largest coil requires 19 turns for the grid and 7 turns for the reaction, these also being wound with the same sizes of wire as above.

When carrying out the winding operations, the enamelled wire should be slightly stretched before using, and every care taken to see that each turn is kept really taut and spaced from its neighbour by an amount equal, at least, to the thickness of the wire. This only applies to the grid coils, as the reaction windings are put on with their turns touching. If, as suggested above, these windings are wound on top of the ribs, they should be separated from the grid windings by ⅜in.

Suitable lengths for the ribs are: 1¼ins. for the smallest coil, 1¾ins. for the next and 2¼ins. for the largest, these dimensions allowing for the additional space required for the reaction winding.

The Aerial Coupling-coil

The suggested construction of this coil, shown in Fig. 3, should simplify matters, and as there is only one of them to make, it would be advisable to spend a little extra time on preparing the parts so that the finished job is neat and yet robust. It is essential to see that the hinge has a smooth movement without being too loose. There must be sufficient grip in the assembly to ensure that the coil remains in the position to which it is moved, otherwise it will be impossible to get any fixed degree of coupling for any particular coil.



The location of the panel components is shown here. Note the tone selector switch and condensers.

The Two-valve Amplifier

At last I have been able to finish this part of the installation, which now makes the following line-up for the Rx: H.F. amplifier, detector and two L.F. stages, each of the three sections being constructed as separate units. This unit idea has much to recommend it; the whole rig is flexible, alterations can be made to the first and third sections without putting the detector out of action. Or, on the other hand, either the H.F. or L.F. portions can be cut out at will without stopping listening activities.

The theoretical circuit of the amplifier was given in the May issue, so now that the unit is completed it is possible to give the layout and wiring plan, plus a reproduction of a photograph of the finished article.

Here are the chief constructional details. For the panel the spare piece of black-crackle finished metal was used, and in keeping with that employed for the H.F. unit, its dimensions are 7 x 8ins. The baseboard is 5-ply wood 7 x 6ins.; this is on the small side compared with the other two, but it was a question of using what I could get.

On the panel are mounted, starting from bottom-left, the 0.5 megohm potentiometer, a double circuit and a single circuit jack. Above these three components is fixed the rotary switch, which enables one of the four fixed condensers in the resistance-capacity coupling to be selected at will. Proceeding up the panel, and in a vertical line with the switch, we come to the dual-range

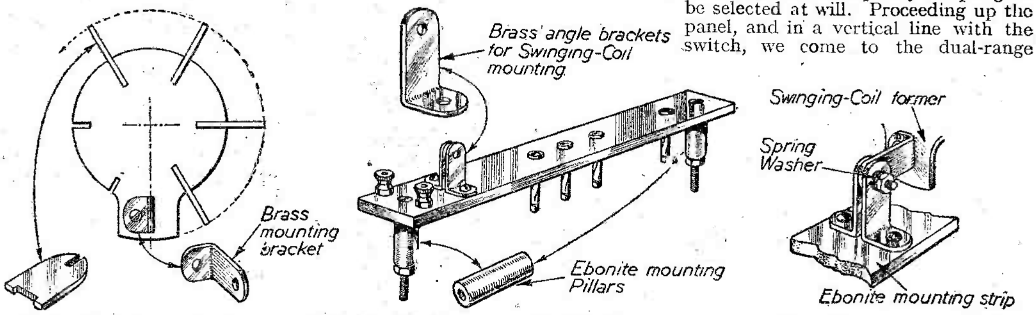
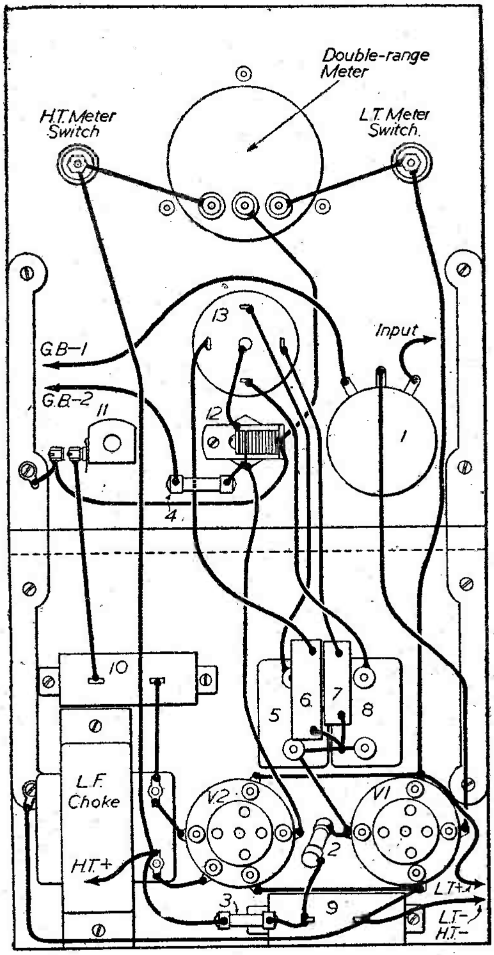


Fig. 3.—(Left) General details of the swinging-coil, for which 9 turns of 24 S.W.G. wire are required. (Right) Shows how the coilholder and the swinging-coil movement is made.

voltmeter, either of the two ranges being brought into circuit by means of the two push-button switches which are fixed one on each side of the meter. As previously explained, this meter is a luxury fitting and, though not essential, it is certainly handy.

The disposition of the components on the baseboard is clearly indicated by the plan drawing, so now for a word about them. The four R.C. coupling condensers have values of .001 mfd., .005 mfd., .01 mfd. and .05 mfd. and whilst these give a reasonable range of frequency response variation they are not super-critical. Other values can be substituted according to stock on hand,



Layout and wiring plan of amplifier. Components are: 1. 0.5 meg. potentiometer; 2. 50,000 ohm resistor; 3. 15,000 ohm ditto; 4. 1 meg. grid-leak; 5, 6, 7, 8. 0.001 mfd., 0.005 mfd., 0.01 mfd. and 0.05 mfd. fixed condensers; 9 and 10. 2 mfd. condensers; 11. Single-circuit jack; 12, Double-circuit ditto; 13. Suitable rotary switch. L.F. choke 25-30 henries.

but it is advisable to provide a fairly large difference in capacity between the various steps. If possible use condensers having a *mica* dielectric; it will be seen on the plan that I was able to use two of the early type of T.C.C. components.

The first stage is decoupled by means of the 15,000 ohm resistor and the 2 mfd. condenser, and I am glad to be able to say that this proved sufficient, due, no doubt, to the trouble taken with the eliminator circuit.

When the 'phones are plugged into the double-circuit jack, the output is taken from the anode of the first valve, via the R.C. coupling, thus leaving the 'phones dead so far as D.C. current is concerned. The coupling condenser selector switch will be in circuit, so it will be possible to adjust tonal response to suit taste. When the 'phones are in this position, it should be noted that the input to the output pentode is broken, due to the switching action of the jack. This will not effect the pentode, ***provided*** its grid-leak is connected to the *grid side* of the jack, thus allowing the grid to be maintained at its correct operating potential. Failure to observe this point, will mean that when the input is broken, the grid will be left "in the air" and excessive anode current will flow.

Another item to watch is the type of selector switch employed; in my case I have used a Bulgin 3-pole 6-point switch, as this was the nearest I could get to my requirements, but a simple rotary 4-point single pole is all that the circuit calls for. The point to be stressed is that the spindle must be dead, otherwise the coupling condensers will be short-circuited to earth via the metal panel.

When the 'phones are in the second jack, both valves are in use, but, as before, they are protected from D.C. by means of the output filter circuit, formed in this stage by the L.F. choke and the 2 mfd. condenser. If a fairly powerful signal is being received when the 'phones are in the first jack, the volume control should always be turned down before plugging the 'phones into the second jack, and then turned up as required. This avoids an unpleasant load on the ear drums.

Meter Movement

In view of the fact that I have been able to complete the amplifier, it has not been possible for me to carry on with the making of the meter movement mentioned in my last notes. However, I am hoping that I shall be able to continue with it during the next week or so, so that such details as I may have to offer about the work will be in time for the next issue.

PRIZE PROBLEMS

Problem No. 432

HARRIS constructed a three valver having the following valve sequence, one S.G. H.F. stage, triode detector and pentode output. It was for battery operation and for the H.F. coupling he used the "tuned grid" system. The H.T. supply he obtained from an eliminator. During his initial tests, he was unfortunate enough to let the top-cap connection to the S.G. anode fall against the metallising on the valve, after which he was unable to obtain any signals. He thought he had blown the filaments, but on testing them he found that that was not so. If he connected the aerial to the H.F. coupling condenser, he obtained quite good signals, but selectivity was poor. What was the cause of the trouble?

Three books will be awarded for the first three correct solutions opened. Entries should be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 432 in the top left-hand corner, and must be posted to reach this office not later than the first post on Monday, May 18th, 1942.

Solution to Problem No. 431

Robins, knowing Ohm's Law, should have been able to re-arrange the formula in the following manner. $W = I \times E$, but $I = \frac{E}{R}$ and $E = I \times R$, therefore W also equals $\frac{E}{R} \times \frac{E}{R} \times R = \frac{E^2}{R}$. Knowing the values of W and R, he could have written $5 = \frac{E^2}{2,000}$ and $E^2 = 5 \times 2,000$, therefore, $E = \sqrt{10,000}$, which equals 100 volts.

For the current, $I = \frac{E}{R} = \frac{100}{2,000} = \frac{1}{20} = .05$ amps or 50 mA's.

The following three readers successfully solved Problem No. 430, and books have accordingly been forwarded to them. B. Hutchinson, 133, Industry Street, Sheffield, 6; G. Bowden, Russell Hill School, Purley, Surrey; A. Burn, 12, St. Winifred's Avenue, Harrogate, Yorks.

A PAGE of OPPORTUNITIES

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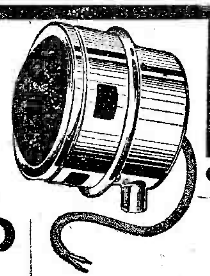

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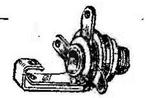

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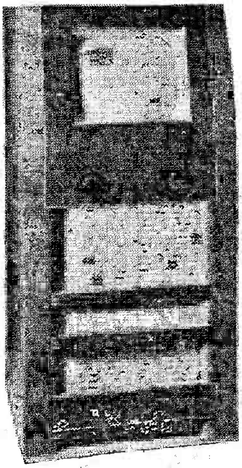

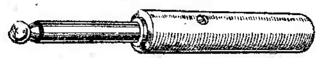

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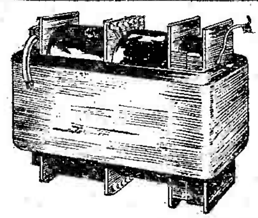

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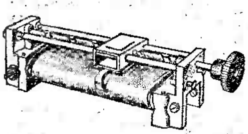

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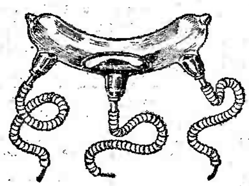

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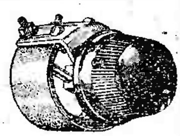

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Aids to Selectivity

Using Variable-mu H.F. Valves and an Extra Stage of H.F. Amplification

(Concluded from page 247, May issue.)

Use the Correct Valves

IN many cases vast improvements in the selectivity of a receiver may be accomplished by the simple expedient of replacing existing valves with those of modern or more up-to-date design. For instance, a receiver may possess only a detector stage, followed by one or more L.F. stages. Obviously such an arrangement, even if band-pass tuning is incorporated, is not one that can be desired from the point of view of selectivity combined with signal strength. When, in addition, a valve of the type designed several years ago is used, the improvement when fitting an up-to-date valve must be heard to be believed. At the time referred to a detector valve, or one of the so-called "General Purpose type," probably had an impedance of 20,000 ohms or more and an amplification factor of 7 to 10. To-day a valve for this stage may have an impedance as low as 11,000 ohms combined with an amplification factor of 20 or more. This means that not only is its efficiency very much greater, but due to the higher amplification, louder signals will be obtained and in addition selectivity will be improved owing to the lower impedance. The reason for this is rather involved, and it is not proposed to take up valuable space by delving into the question of valve - damping, anode current and kindred matters. Suffice it to say, that an improvement will be immediately noticeable if a valve having the above characteristics is substituted for one of the old design. It must also be remembered that if the valve has been in constant use for two years or so the emission may be failing, and the purchase of a new type of valve will thus be well merited by the general improvement of the receiver.

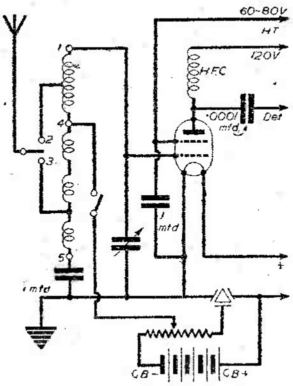


Fig. 14.—The circuit of an H.F. stage using a variable-mu valve. An H.F. pentode can be substituted for the S.G. valve if desired.

Variable-mu Valves

Where the receiver employs one or more H.F. stages, and these are of the ordinary S.G. type, the substitution of variable-mu or even variable-mu pentodes will prove invaluable. To convert a receiver for use with variable-mu valves it will be necessary to incorporate some arrangement for applying the bias to the valves, and where the circuit is of the single coil type, then all that is necessary is to disconnect the lower end of the coil from the earth line and to take this to the arm of a potentiometer connected across a grid bias battery. The latter may have a voltage of 9 to 16, depending upon the type of variable-mu valve which is purchased. These are known respectively as "short" or "long base" valves. There is not a great deal of difference, except that the short base provides approximately the same degree of volume control with a 9-volt battery as is obtained with the larger battery on the long base valve. If it is not desired to alter the coil, owing to fear of upsetting ganging, the bias may be applied to the grid of the valve direct, a grid leak and condenser being joined in the grid lead. The wire at present joining the grid to the tuning coil and condenser is removed, and a fixed condenser joined in its place. The grid leak is then joined between the grid and the arm of the potentiometer. The latter may have any value from 20,000 to 50,000 ohms and it is worth while when purchasing this component to ask for one of the graded type. The control then gives a more gradual effect, and it is necessary to connect it in the correct sense. The makers usually enclose an instruction sheet with these components so that there is little risk of joining it the wrong way round. The improvement in selectivity will be found to be easily controlled in the following way. With the volume control potentiometer at maximum the receiver will function exactly in the same way as with the present valves. As the control is reduced so is selectivity improved, and although this results also in loss of signal strength, the reaction condenser should then be adjusted to bring back the original strength, with a great improvement in selectivity. The characteristics of these valves, as in the first case mentioned, are also of such a nature that their mere substitution will greatly improve a receiver.

Advantages of an Additional Tuned Circuit

It is well known that where only one single tuned circuit is in use, selectivity must be very poor. If, however, the output from such a circuit is passed to a second tuned circuit, the selectivity will be improved, and thus the use of two or more tuned circuits is an aid to improved selectivity. Unfortunately, however, the transference of the signal from one circuit to the next results in a slight loss, and therefore we cannot add such circuits indiscriminately to a receiver, owing to the fact that we should lose too much of our original signal. It seems quite logical to state, therefore, that we may add a second tuned circuit to improve selectivity, provided we also add some form of amplification to make up for the loss, and as the valve is such an ideal form of amplifier, the simplest method of carrying out such a conversion is to build up a complete H.F. amplifiying stage. A unit of this nature will work wonders with the majority of receiving installations, and the work involved is of the very simplest nature.

The apparatus required may be obtained from many of our advertisers, and the entire parts may be assembled and wired in an hour or so. The theoretical circuit of a suitable amplifier is given in Fig. 14 on this page, but the actual shape of the base, panel, etc., has not been given, as many readers will prefer to make up this unit to match an existing receiver. It may, for instance, be built as a small compact unit having a panel and base of the same dimensions as the existing receiver, and it may then be stood alongside the present set to make up a complete receiver for permanent use. Alternatively, the unit may be roughly constructed to be employed only when distant reception is desired. Where the complete existing apparatus is home-made it may be found worth while to build the unit as an integral part of the present receiver and then to enclose the combination in a cabinet.

Construction

Fig. 15 shows the parts laid out on a base and wired up, and this arrangement should be adhered to if it is at all possible. The coil is of the dual-range type, and is screened to avoid direct pick up. The valve is of the latest variable-mu type, and the condeneer will enable the full range of the present broadcasting wave-band to be explored. It will be noticed that there is no H.T. negative lead supplied for the unit, and this will be automatically obtained when the unit is joined up to the present receiver. A separate 9-volt grid bias battery is required, and although it is possible to use this also for the L.F. portion of the present receiver, it is worth the additional expense to use a separate battery in order to prevent risks of instability. The switch must be of the three-point type in order to disconnect the grid-bias battery at the same time as the L.T. supply. If this is not done the bias battery will be continually discharging through the potentiometer. It will be seen that this unit is designed to provide not only higher selectivity, but range combined with complete stability, by-pass condensers having been included at certain points for the latter purpose.

Having decided upon the method of assembly to be used in your particular case, mount the parts in approximately the positions shown, and wire up from the wiring diagram. It will be seen that a four-way battery cord is wired to certain parts of the apparatus, and that the ends of this cord are taken to H.T. and L.T. supplies. The two H.T. leads should be furnished with ordinary wander plugs and these should be inserted into the H.T. battery at the voltages shown on the theoretical circuit. They may require slight modification when the apparatus is in use, but this will easily be ascertained when the unit is tested out. The two L.T. leads should preferably be joined direct to the terminals on the existing receiver which bear similar markings.

Using the Unit

To use the unit, remove the aerial lead from your present receiver and attach it to the terminal on this unit marked Aerial. The flexible lead marked Output should then be joined to the original aerial terminal, and the battery leads joined up, when the complete apparatus is ready for use. Rotate the arm of the potentiometer to a position approximately half-way round and switch on both receiver and the unit. Now rotate the tuning control of both pieces of apparatus and you will soon find the combination of settings which will enable you to obtain the local, probably at very much greater strength than you have heard it before. The potentiometer will be found to give a wonderfully smooth control of volume, reducing the local to a whisper when required. Obviously, if the tuning coil in your present set is of the same type as that chosen for the unit, the tuning points on both condensers will match up, but if different coils are employed, the tuning points will not agree. It will not take many minutes, however, to find the relation between the two pieces of apparatus, and tuning will not be found by any means difficult. As the coil is screened, there is no need to screen the entire unit, as it will not be possible for interaction to take place between the coils in the two pieces of apparatus. It must, of course, be remembered, that when switching off after use, both the unit and the receiver switches must be operated. This operation of both sets of switches must also be remembered when changing from medium to long waves, the appropriate wave-change switches both being operated to effect the change-over.

Swamp Areas

Those living in swamp areas require special advice, and in many cases it will be necessary to deal with individual cases in special ways. As a general rule it may be stated that within a few miles of a powerful B.B.C. station much of the selectivity trouble is due to direct pick-up of the actual wiring of the receiver. Where this is proved to be the case the entire receiver will have to be screened. To ascertain whether this direct pick-up or shock excitation is responsible, remove the aerial and see if the local can still be heard. It may be necessary to retune slightly, but it may be definitely stated that if the local can be heard with both aerial and earth disconnected from the receiver, then the wiring is responsible. In some cases the earth lead will be found responsible, in which case it should be screened. Removal of the earth wire and/or the aerial wire will enable you to ascertain which is responsible in the particular case, and although the aerial is required for distant reception, it will be found that an improvement can be effected by using the special screened lead obtainable.

If the receiver is home-made, then it will probably be found a simple matter to make up a metal box to accommodate the receiver, with the control knobs projecting from one side. Obviously, no portions of the receiver or controls should be permitted to come into contact with the metal in view of possible short-circuits. If metal working is considered too difficult, a wooden case may be made (or the existing cabinet adapted) by using a lining of metal foil. In the case of the foil lining, it is essential that each side should be bonded, either by soldered leads, or by otherwise attaching some metallic link between adjacent sides. No matter whether a metal box or the special metal lining is employed, the entire assembly must be earthed, and this will be most conveniently carried out by joining the case to the earth terminal of the receiver.

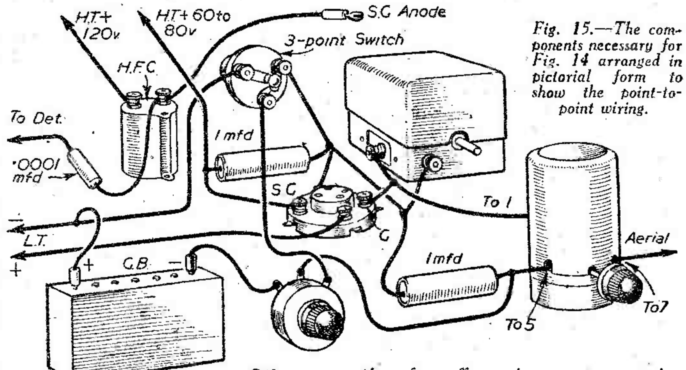


Fig. 15.—The components necessary for Fig. 14 arranged in pictorial form to show the point-to-point wiring.

Other suggestions for sufferers in swamp areas include such devices as varying the length of the aerial; altering its direction; using a vertical wire or metal post instead of the orthodox horizontal wire, etc.

Considerable improvement in selectivity can usually be obtained by paying particular attention to the type of aerial most suited to the local conditions, the set and the operator's requirements. In a swamp area, it is of little use erecting a high and efficient aerial system, especially if the receiver is of the "straight" type employing three or more valves. The signal pick-up would be so great that elimination of an unwanted local transmission would almost be an impossibility. Even with a superhet, which normally has a good degree of selectivity, one would be inviting trouble, therefore the only satisfactory solution is to experiment with various types of aerial and—an item which is so often overlooked—their line of direction.

A vertical arrangement has much in its favour, especially for town dwellers who are unable to carry out many experiments through lack of space. With a receiver having average characteristics, a vertical aerial having a length of, say, 10 to 15ft., erected at a reasonable height, quite satisfactory results should be obtained, and a reduction in interference from man-made static will, no doubt, be experienced. A screened down-lead will help to improve matters in that direction.

If an indoor or external aerial of the inverted-L type is in use, tests should be made with the horizontal portion reduced in length and, where space permits, pointing in a different direction.

A Transverse Cu

Many Readers Have Requested Cons
Are Reprinting This Article Dealing V

The parts required to make the efficient microphone described in this article.

WITH the development of the moving-coil, crystal and ribbon microphones, the once very popular transverse current type has been forced, so to speak, into the background, and many constructors have obtained the impression that it is therefore no longer suitable for serious work. While it cannot be denied that the modern types have more satisfactory characteristics as regards frequency response, when the matter is taken to fine limits, it would be incorrect to state that a good make of transverse current microphone cannot put up a very satisfactory performance *when* it is properly used in conjunction with a good amplifier and by an operator who has, at least, a fundamental knowledge of acoustics.

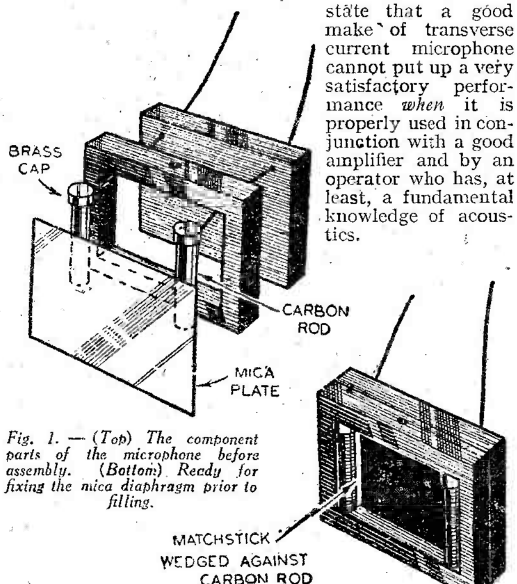


Fig. 1. — (Top) The component parts of the microphone before assembly. (Bottom) Ready for fixing the mica diaphragm prior to filling.

In common with many other pieces of apparatus, the transverse current microphone has been subjected to more than its fair share of abuse in the hands of inexperienced users and, unfortunately, the name has been applied to very inferior types of microphones whose design and construction could not allow them to even approach the performance usually associated with a model produced by a firm of repute.

It is not surprising, therefore, that the popularity of this type of microphone has waned, and it is all the more regrettable when one appreciates that it *does* offer many advantages over some of the more modern types, especially in so far as the average amateur is concerned.

In the first place, it is invariably more sensitive; secondly, it requires fewer stages in the associated amplifier, and allows less complicated and costly apparatus to be used; and, thirdly, it is not so super-critical regarding its feeder lines or input control circuits.

From the point of view of home construction, it is about the only type which lends itself to this sphere of radio activity, unless, of course, one is blessed with a fairly well equipped workshop, a good stock of patience, and the ability to undertake precision work. As regards cost, the transverse current type is usually much cheaper than the others mentioned.

Important Points

It must not be assumed from the above remarks that little or no care is required with the constructional work. As a matter of fact, it is very important for every consideration to be given to this, if an efficient job is to result.

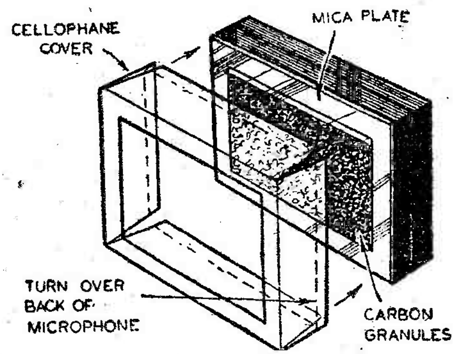


Fig. 2.—Showing how the protective cover of cellophane is cut and lapped over the unit after the granules are in position.

For example, the carbon rods must be handled with care, and although they have to be rubbed down to make them a perfect fit in the body of the microphone, they must be kept free from the slightest trace of grease, such as that which can be deposited by the fingers. It is always advisable, after giving them the final cleaning, to hold them in paper, or a piece of rag, and so prevent them from being touched by bare fingers.

Their connecting contacts must be positive, and free from any acid flux and possible intermittent connections. The body of the microphone must be perfectly airtight when it is completed, and rigid and solid enough to be free from any tendency to vibrate or be susceptible to vibrations in its immediate vicinity.

The thickness of, and the material selected for, the diaphragm are very important items, as they can directly affect the frequency response and sensitivity of the completed microphone. The carbon granules must

ırrent Microphone

ıructional Details for a Microphone, So We ·ith an Efficient Unit. By "Radio Engineer"

be of suitable high grade, and on no account should they be handled by the naked hand or left exposed to the atmosphere. Moisture and dust must be avoided at all costs.

The surface to which the diaphragm is to be fixed must be perfectly flat so that an airtight joint can be formed without creating stresses or strains which would tend to produce distortion of the diaphragm.

Constructional Details

The overall dimensions of the actual microphone in question are 1.9in. by 1.4in. by .5in. This size was decided upon as it has been proved from past experience that it is not necessary to make a huge, ungainly piece of apparatus to obtain sensitivity or quality, and, secondly, as it was intended to fit the completed microphone into the casing shown in the illustrations.

The body of the original model was constructed from ¼in. sheet ebonite, one piece being cut out 1.9in. by 1.4in. to form the back, and another piece of the same size for the front to hold the carbon rods and granules. In the front piece, an aperture 1.4in. by 1in. was cut and then the two pieces of ebonite stuck together by means of suitable adhesive.

A word of warning is necessary at this point; it is not

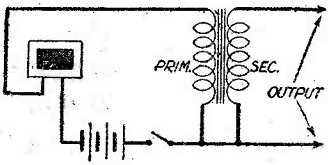


Fig. 4.—The connections for the microphone, battery and transformer.

easy to find an adhesive which will form a perfect joint between two pieces of ebonite; therefore, it is advisable to rough the contacting surfaces by scribing diagonal lines with a pointed bradawl, so that the adhesive can get a firm grip. When the two pieces are ready for joining they should be put under pressure and left for as long as possible. A good shellac varnish was found to be a very satisfactory adhesive. As it is rather a tedious job trying to fix small diameter carbon rods by means of bolts, it was decided to try to eliminate this snag by using rods to which a soldered connection could easily be made. As this necessitated fixing small metal caps to the rods to enable the soldered connection to be made, the writer utilised the small rods used in dry cells.

Carbon Rods

Two cells which go to form an ordinary three-volt torch battery were broken open and the rods removed, and as the cells were practically new, little or no deterioration of the surfaces could be noted, so after one or two tests they were embodied in the microphone.

They were cut slightly over 1in. in length, measuring from the metal capped end, and gently rubbed down until they were a firm push fit into the aperture of the body. Frequent tests should be made during this reducing process, as if a shade too much is taken off they will become a loose fit, and unsuitable for the purpose. When they reach the required length, the brass caps must be cleaned with fine emery cloth, and a short length of thin insulated wire soldered carefully to each. In the two corners where the metal caps will rest, a 1-32nd in. hole is drilled right through the back plate to enable the

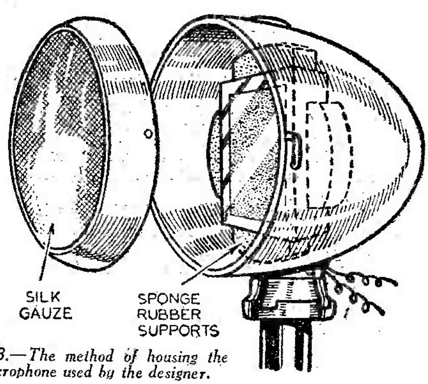


Fig. 3.—The method of housing the microphone used by the designer.

connecting wires to pass through, and while using the drill, another hole of 1-16th in. diameter can be drilled in the centre of the top of the aperture, i.e., the front plate, as this will be required for filling with the carbon granules.

After giving the carbon rods a final cleaning with very fine sandpaper or emery cloth, they can be fixed in position, but before passing the wires through their respective holes, put a drop of adhesive in each hole to form a seal when the rods are in position. It is also advisable to repeat this process on the outside, as no air must be allowed to enter. Two clean matchsticks are then cut to the same length as the rods and fixed, with a spot of adhesive, up against the inner edges of the rods, as indicated in Fig. 1. When you are satisfied that everything is firm and dry, the diaphragm can be fixed in position. Once again, owing to the hard and smooth surfaces to be joined it is essential to rough them in the manner previously described, and for the adhesive I would strongly advise good shellac varnish. The diaphragm is cut from a piece of mica free from flaws and approximately .002in. thick. If a press or vice is handy the microphone body with diaphragm in position should be clamped in it, under even pressure, and left for at least 24 hours. When removed, any unevenness of the edges can be removed with a sharp safety-razor blade, taking care that the cutting stroke is always toward the body of the microphone and not away from it.

Filling with Granules

The next operation is the filling of the space between the two rods with the carbon granules, and this is best done by forming a fine-pointed paper funnel which can just rest in the filling hole previously drilled. The carbon granules should be poured into the funnel very slowly, to prevent them packing in the filling hole, although a gentle vibration will usually ensure a steady flow. When the body is approximately half full it should be lightly tapped on the back to enable the granules to settle down, and the filling process then repeated until the space is filled to within 1-16in. from the top. Repeat the tapping process, and add more granules if necessary, but make sure that a space is left, otherwise the sensitivity of the microphone

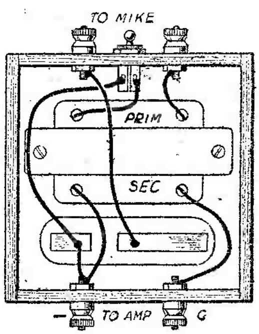


Fig. 5.—The transformer and battery can be housed in a neat case as shown here.

will be reduced. The filling hole can now be plugged and sealed by a very short length of match-stick, which has been rubbed down to make a tight fit, and after cutting it off flush with the outside, seal it with a spot of adhesive.

To complete the job the protective cover should be cut from a piece of cellophane such as that which used to cover packets of cigarettes. The cellophane does *not cover* the diaphragm. It is cut to form a cover over the edges of the mica and microphone body, and reasonable care should be taken to see that it is firmly stuck down at all points. (Fig. 2.)

The next step is to house the unit, and this is an item which will be governed by individual ideas and requirements. The writer of this article made use of the lamp-casing of a side-lamp obtained from an old motor-car, the arrangement being shown in Fig. 3. It will be seen that the finished article presents a neat and professional appearance, especially when it is mounted on a suitable table-stand.

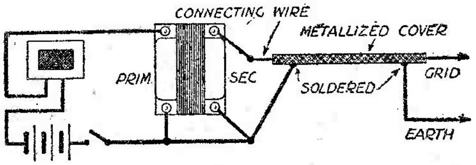


Fig. 6.—The method adopted when a screened connecting cable is used to provide a common negative earth return by means of the metallised covering.

Although the original model was constructed with ebonite, it is possible that some little difficulty might be experienced in obtaining satisfactory adhesion between the various parts. This difficulty can be overcome by cutting the two sections which form the body of the microphone from hard wood, or even well-seasoned plywood of the same thickness as the specified ebonite. If this method is adopted, it is essential to see that all edges are well finished and that the material is absolutely free from any trace of moisture. All other details would, of course, be the same as those given for the model described.

Testing

Before the microphone can be tested, it is necessary to secure a suitable transformer and have ready some form of low-frequency amplifier.

The transformer is required to provide the coupling between the microphone and the amplifier, and it is connected in the manner shown in Fig. 4. It should have a ratio of between 30 : 1 and 75 : 1, and if quality of reproduction is a consideration, as it should be with this class of apparatus, it will pay to buy a reliable component specifically designed for such work and not attempt to use some makeshift arrangement.

It will be noted that the primary of the transformer is connected in series with the microphone, i.e., the two carbon rods and a small dry battery. A 9-volt grid bias battery is suitable, but for the sake of compactness I would suggest an ordinary 4½-volt pocket lamp battery.

If the microphone is likely to be used frequently, it is advisable to include a switch between the battery and one side of the primary, so that the circuit can be broken at will and thus avoid an unnecessary current drain from the battery. It is a very good idea to house the transformer and battery in a small case to which has been fitted four terminals and a switch. The case should be constructed from metal sheet for preference, although a wooden case will be found quite satisfactory for average amateur requirements. A suggested assembly is shown in Fig. 5, two of the terminals being for the microphone, and two for the output to the amplifier.

After connecting the microphone to the appropriate terminals, completing the battery circuit, and connecting the output to the input side of the amplifier, snap the fingers just in front of the diaphragm and *don't* resort to the rather dangerous habit of *jabbing* the diaphragm with a finger to see if the "mike" is working. If the amplifier is in order, the sound should be reproduced via the speaker, in which case tests can be made with speech or music.

When speaking, don't speak *into* the mike unless you are at least two or three feet away. It is far better, when the mouth is close to the microphone, to speak *across it*, otherwise very objectionable blasting may be produced.

Microphone Howl

If the microphone is in the same room as the loudspeaker it is highly probable that a piercing howl will be set up as soon as the volume is increased. This is due to a form of feed-back between the loudspeaker and the microphone, and the only way to overcome the trouble is to adjust the position of the microphone with relation to the speaker until the former is out of the effective sound field of the latter. In most simple installations, the speaker should be in *front* and pointing *away from* the microphone, although a great deal depends on the acoustic properties of the room or hall in which the apparatus is being used.

It is permissible for the leads from the transformer to the microphone to be several yards in length, but the connections to the *input* of the amplifier should be kept as *short* as possible, and preferably made with screened wire, the screening being connected to earth. As one side of the input is invariably connected to the common negative earth line of the amplifier, the connections can be made with a single screened wire if the method shown in Fig. 6 is adopted.

There is one exception to short input leads, and that is in the case of A.C. operated amplifiers, when it will be found necessary to keep the microphone transformer three or four feet away from the mains transformer. This procedure is necessary, unless the mike transformer is housed in a metal box, to avoid the possibility of hum being introduced into the input circuit by radiation from any parts of the circuit carrying raw A.C.

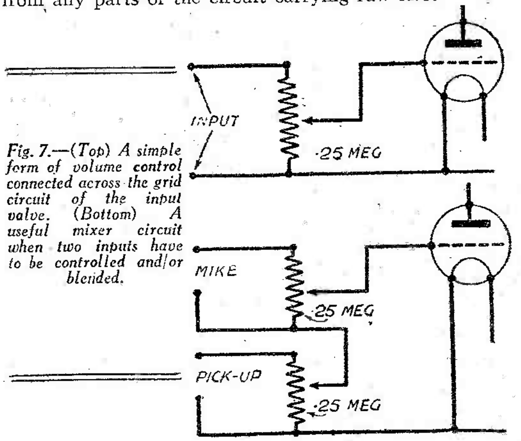


Fig. 7.—(Top) A simple form of volume control connected across the grid circuit of the input valve. (Bottom) A useful mixer circuit when two inputs have to be controlled and/or blended.

Volume Control and Amplifiers

As it is practically impossible to keep the sound, whether speech or music, to be reproduced within fairly narrow limits, it is essential to provide some form of volume control to enable the input to the amplifier, and likewise the overall amplification, to be regulated.

This is most easily done by fitting a potentiometer either across the secondary of the microphone transformer or, better still, across the grid circuit of the input valve, as shown in the top diagram of Fig. 7.

As it is desired, in so many instances when a microphone is used with an amplifier, to make use of a pick-up as well, the method shown in the lower diagram of Fig. 7 should be adopted as it allows the input from a microphone and a pick-up to be controlled at will and mixed according to the operator's requirements. It is well worth embodying this arrangement in the amplifier, as it adds considerably to the effects which can be produced.

It is practically impossible to say what type of amplifier or how many valves are necessary to give good reproduction, as so much depends on the volume required, the size of the room or hall, acoustic properties and the number of people to be addressed or the area to be covered by the amplified sound.

The figures given below must only be taken as a guide and, if possible, tests should be made to determine the amplification required for any given installation.

For domestic use, where sufficient output for a normal room is required, quite good results can be obtained from a battery-operated amplifier having an output of, say, 1½ to 2 watts. This will necessitate at least three valves and push-pull or Class B should be used in the output stage. A mains receiver or amplifier having an output of 3 watts can be used for speech or music in a small hall when the audience is *quiet*, but if dancing is to take place then a minimum of 5 watts will be essential.

If one is interested in using the microphone for, say, crooning or relaying music in a small dance hall, then I would strongly advise a mains-operated amplifier of the portable type, having an output in the neighbourhood of 8 watts.

A Word of Warning

When using a microphone for entertainment purposes *don't skimp* the selection of your apparatus to such an extent that everything is working at its maximum output. It is very advisable, and equally essential in the interests of quality, always to have a reserve of power.

Economise on Power

Power Required and Wasted are Matters Dealt With, Also the Preliminary Steps Towards Economy

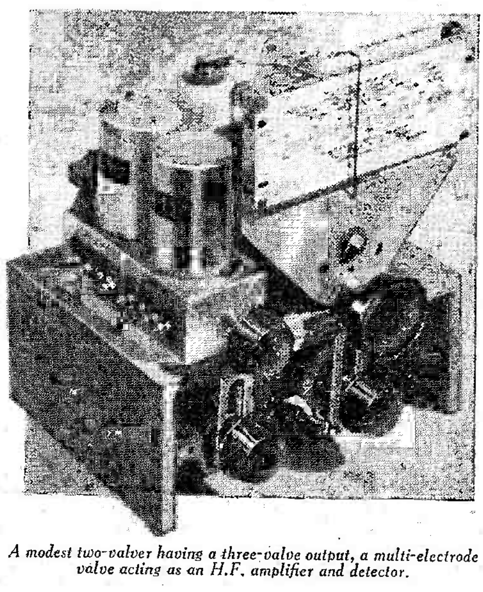
By L. O. SPARKS

A RADIO receiver can be compared with a motor-car with respect to power output required and the maximum which can be developed. In both cases, the power reserve is often greatly in excess of that likely to be required, and the average running costs are higher—bearing in mind the power necessary for general service—than if a smaller set or car were used. Under normal conditions, the extra running costs might not represent a factor which has to be studied; to-day, however, users of battery-operated equipment have to give the matter their consideration, not necessarily from the point of view of expense, but because of the more serious side of the problem, the reduction of available supplies.

The interest one can show in the reception of the majority of foreign transmissions is now almost a negligible quantity; likewise the need to use multi-valve receivers becomes redundant. Except in those areas where reception is definitely poor, battery-operated receivers could be restricted to the use of three valves, without sacrificing any entertainment value under present conditions, and, in many districts, two valves in a well-designed circuit would provide all that many listeners require. There is little sense in using, say, a four- or five-valve receiver, with the volume control well turned down, and frequently having difficulty in obtaining a replacement H.T. battery, or having to do without the set for several days owing to lack of supplies, when fewer valves would serve one's purpose. There is also the matter of valve renewals to be considered, so it is up to every listener to take such measures as may be applicable to his individual installation.

The First Step

What strength of loudspeaker output is required for normal domestic purposes? This is a question to which no two listeners will give the same answer, therefore it is only possible to make deductions by considering the rated output of the types of valve and speakers most widely used. A great deal depends on the acoustic properties of the room and the sensitivity of the listeners' ears. Speaking in a general sense, sets are more often than not operated at a volume level *far* in excess of that required for comfortable listening. This fact is one which can be most annoying to neighbours, and, in the main, is due to habit and lack of thought. It is surprising how one can get used to a certain volume of sound so that, eventually, it is not thought to be over loud. On the other hand, a simple experiment extended over a few days will prove that the same listener can hear and enjoy everything produced via the speaker when the actual output is reduced to 1/5th (*one fifth*) of the original power output. This is assuming that the person has normal hearing. To those not familiar with the use of decibels or the measuring of outputs, by which I mean the actual wattage, the above may seem rather phenomenal, but it is a fact that considerable experimental work has been carried out in connection with such acoustic or, more accurately, electro-acoustic considerations. The decibel, which is purely a comparative unit, and which is used to express voltage and current ratios and power ratios, as related to some predetermined standard, is also often used to indicate the comparative loudness of sounds. For example, if when considering power it is stated that an increase or gain of 5 decibels had been obtained, that would represent a change of 3.162 times when expressed as a ratio of powers. From the experiments already carried out, it has been found that a *reduction* of 8 decibels is necessary to produce what the average listener would say is about "half as loud" as the original signal or output. Now 8 db. actually represents a power ratio of 6.3, which means that the power output can be reduced from 6.3 watts to 1 watt to produce the effect on the listener of "half as loud." Other results obtained show that 3 db. change is so small that the majority of listeners could not tell that



A modest two-valver having a three-valve output, a multi-electrode valve acting as an H.F. amplifier and detector.

the output had been varied. If a table of decibels and power ratios is examined, it will be seen that 3 db. represent a change of double or half the power, according to whether it is a gain or loss. In other words, the power output of a set or amplifier can be *doubled* or *halved* and the average person will not be able to tell the difference. These figures make one begin to wonder just how much power is necessary, or how much power is being wasted.

What Power is Required

A small battery-operated power valve has an output in the region of 150 milliwatts; a super-power or a pentode rises to 500 to 650 milliwatts. Their mains-operated counterparts, taking average types most widely used, would have ratings around 2 watts (2,000 milliwatts) to, say, 3.5 watts (3,500 milliwatts). Any one of these valves, provided it is being operated under correct conditions and used in conjunction with a modern type of moving-coil speaker, is capable of providing sufficient sound for the average domestic apartment. Why, then, is it necessary to use the higher power valves if 150 milliwatts is sufficient? There are several answers to this question, and the first one would, undoubtedly, be provided by the super-quality enthusiast who would state emphatically that 5 watts, 10 watts, or 15 watts are vital to enable the peak passages of a transmission to be handled without distortion. Even if this point is allowed—to those who are able to live in detached houses remote from neighbours—one is really concerned, in a general listening sense, to the normal volume required, and the setting of the volume control during the majority of programme listening. It is appreciated by true quality enthusiasts that unless a specially balanced volume-control circuit is used, the effect produced on the ear when the control is turned towards its minimum is that the treble and bass are cut to a much *greater* extent than a comparatively narrow band of frequencies in the middle of the scale. This annoying effect can be recognised with many receivers, and, quite possibly, it is one of the reasons why the volume is turned up to a level far in excess of that required for hearing.

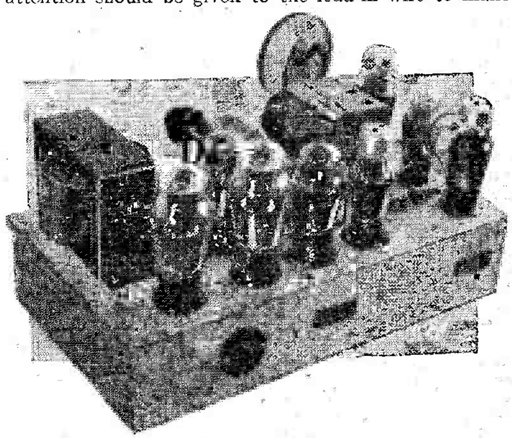
Smaller Output Valves?

From the above, one is led to ask: "Is it not better to use a valve in the output stage having a smaller output which would allow the volume control to be in its maximum position, and thus eliminate the clipping of the extreme edges of the frequency response?" Provided the circuit preceding the output stage is designed to suit local conditions, i.e., field strength of the nearest powerful transmitter, and the valve selected for the output stage, the question is quite in order and, in the writer's opinion, worthy of serious consideration from the majority of listeners, especially during *present conditions*. Most battery-set users will agree that they get a tonal response from their receivers which satisfies their ears, and many will say that they wish for nothing better. These statements do not reflect on the listeners ears or his appreciation of musical sounds; rather does it indicate the progress in receiver, component, speaker and valve design, and that a small output can be sufficient. Even with a modest three-valver, the volume control has often to be turned down, showing that a certain reserve is available and that, say, 200 milliwatts is not always required.

Reducing Losses

Before starting on any drastic economy modifications, it is advisable to commence operations by giving the whole installation a good overhaul and eliminating all possible sources of loss. A sensible starting point would be the aerial and earth system; too many listeners ignore the all-important aerial and even a greater number appear to forget altogether about the necessity of providing a good earth connection. The fact that many modern high-efficiency sets will give results when connected to two or three feet of wire and without any earth lead, does not alter the designer's original intention that reasonable aerial and earth connections must be used *if* the best results are to be obtained. No set can do justice to its makers if it is used under conditions contrary to their specification, and, so far as the constructor is concerned, it would be wise for him to remember that a good aerial is *often better* than an *extra* valve.

If an indoor aerial is in use, try replacing it with a simple outdoor type. Even if space only permits a short one to be erected, results will be better and, what is even more important, it is highly probable that interference from man-made static will be reduced. Height is the main factor, this being closely followed by the advice to keep the aerial wire well away from earthed objects such as walls, trees and overhead wires. Good insulation at points of suspension is very desirable and attention should be given to the lead-in wire to make



An 8-valve A.C. radiogram, capable of giving fine results, but—is such a powerful set necessary for normal domestic use?

sure that its covering is sound and weatherproof. Various types of external aerials have been described in a recent issue, which also gave important pointers about earth connections, so there is no need to elaborate on these items here.

Where such aerials are already in use, improved results will be obtained by giving the system a careful overhaul, cleaning the insulators—especially in industrial areas and after the winter weather—looking for fractures and other defects in the wire. External lightning-switches should be cleaned and contacts examined for looseness and corrosion. The termination of the earthing wire should be inspected, and, if possible, examine the earthing plate or tube if such is used. These have been known to corrode to a few flakes of rust-like substance before now.

If the set is battery operated, and it is these we are concerned with in this article, the next items to examine are all contacts made to the batteries. A dirty or poor contact represents a loss, therefore make them clean and positive in action. Accumulators are the worst offenders in this matter, due to the corrosion which often sets in around the terminals and connecting tags. If such is present it must be removed and the metal parts thoroughly cleaned, this being undertaken with hot water and a small metal scraper. Before doing this, it is necessary to see that the vent plug of the accumulator is securely in position to prevent any leakage of the acid. When *all traces* of the corrosion have been removed, it is permissible to smear a very thin coating of petroleum jelly or Vaseline on the exposed metal parts.

To complete the L.T. supply examination, it would be advisable to have the electrolyte examined by the charging station and, if much sediment is present in the cell, have it swilled out and the container refilled with fresh electrolyte. A good charging station will be able to advise you on this matter.

(To be continued.)

BRITISH LONG DISTANCE LISTENERS' CLUB

Groups

IT is hoped that members in certain districts will receive, before long, notification of other members residing in their area. The object of this will be to allow contacts to be made, so that the possibility of forming a Group can be discussed by those interested. During these preliminary moves a great deal will depend on the members themselves as to the success or otherwise of the project. Co-operation and enthusiasm are essential if Groups are to be formed, and in view of the general praise the idea has already received, we feel confident that members will get together once they are able to contact each other.

We do not advise any time to be wasted, during the first two or three meetings, over the selection or appointment of officials, etc. Those details can be attended to after members have got to know each other, and after we have been informed of the business discussed and the suggestions put forward and passed on our recommendation for the formation of a Group. It will, of course, be necessary for one member—authorised by those present —to notify us of all that takes place so that we can attend to the matter at this end.

We know of several instances where three or four friends living in the same district are all members of the Club; in such cases, we would welcome a letter from one of them, that is if all are agreeable, giving us the names, etc., of the others, as they could easily form the nucleus of a Group and we would then put other members in the same area in touch with them. Well, so much for that side of the Club's activities, now let us see what other members have been doing, by reading the following extracts from their letters:

From a member in the R.A.F.—Cpl. E. J. Roberts says in his letter:

"Have just received an official verification card from station KC4USA, Baird Antarctic Expedition, South Pole, confirming a report I sent them on their 20-metre fone signal.

"I logged them way back in 1940 and now, after nearly two years, I have received a QSL.

"I should be very pleased to hear from any other readers who have verified this station.

"Wishing your paper continued success."

Bury, Lancs.—We wonder how many members heard the dramatic broadcast referred to in a letter from J. E. Hodgkins:

"A few lines to tell you of something I heard on Friday, March 6th, which may interest other members.

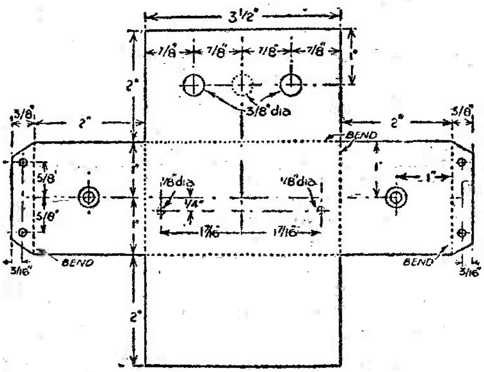


Fig. 3.—Cutting, drilling and bending dimensions for the cases.

"On the 1 p.m. B.B.C. Home News an enemy report that Batavia had been captured was quoted. At 12.40 G.M.T. I picked up the carrier wave of station PMA at Batavia on 15.48 metres. There was no speech or music until 12.50, when the announcer said, 'Hello, hello, this is Batavia. Due to technical difficulties we are obliged to close down. If the damage is repaired before 13.15 G.M.T. we shall resume transmission, if not, we shall be on the air to-morrow.' Then at 13.15 G.M.T. came this, 'Hello, hello, this is Batavia calling, we are now closing down with our National Anthem, good-bye to you all, God bless you, and good luck from the N.E.I.' No National Anthem was played and the station switched off. I think this was the last broadcast from PMA.

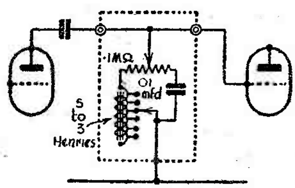
"I am fully in agreement with the Group scheme."

Kelso members please contact.—G. A. Lockie, of "Ashlee," Forrest Field, Kelso, Roxburghshire, asks for contacts and adds:

"I wonder if you could put my name down in the list on 'Contacts Required,' in PRACTICAL WIRELESS (age 16).

"Reception of station HCJB, Quito, was very good in February. The programmes started at 12.0 midnight with a relay from WBOS of news in English. This was followed at 12.15 a.m. with a programme called

Fig. 1.—Circuit of Unit No. 1, which combines high and low-note control.



'Equadorian Echoes,' in which the Andian Serenaders sang some hymns.

"Stations WRUL and WRUW broadcast to Australia at 9.15 (G.M.T.) on Mondays, Wednesdays and Fridays. Reception is usually very good here."

Willington Quay, Northumberland.—Members in or near this district can make contact with A. Scarth, of 49, Stanley Street, who is particularly interested in SW work.

Kettering, Northants.—N. C. Liddington, of 44, Bayes Street, makes the following remarks:

"I am writing to inform you that I would be very pleased if a B.L.D.L.C. group was formed in my district. I would also add that I would like to correspond with some other members."

Wigan members please note.—Where are all the radio enthusiasts in this area? Member 7,190, 42, Shaw Street, seems to be a "lone-wolf."

"I am prepared to support a B.L.D.L.C. Group in my town if there are enough members, but I have not yet come in touch with anyone in Wigan who is a member of the B.L.D.L.C."

Huyton, Liverpool.—Contacts are wanted by Bob Hughes, of 6, Sergrim Road, whose letter is given below:

"Many thanks for membership card which is now framed along with my QSL cards; by the way, are the badges ready? I have now altered the position of my den and aerial, which is now a 10ft. inverted-L type and quite efficient. I have also been polishing up my morse. I wholeheartedly support your idea of B.L.D.L.C. Groups, and I would like to be put in touch with some members around my QRA (Huyton and Roby).

"Your series of articles by 2CHW are welcomed."

Yes, badges are now in stock. (Hon. Sec.)

Tone Control

THE majority of circuits can have their tonal response improved by the addition of efficient tone-control arrangements. By this we do not mean those which emphasise the low notes at the expense of the higher frequencies, as they merely produce false or artificial response and invariably kill the brilliancy of the reproduction. It is amazing the number of listeners who confuse brilliancy with shrill or high-pitched response; the two are not comparable and every enthusiast should make a point of studying reproduction carefully so that he will be able to recognise the true value of the various musical frequencies and appreciate their respective relationship.

The two control units described below represent practical methods of obtaining a reasonable balance and correcting any tonal defects which might exist in a receiver or amplifier and compensating for faulty acoustic properties of a room or hall in which the installation is in use. The specified components are assembled in small metal cases, little larger than a standard L.F. transformer, thus allowing the units to be mounted on any existing chassis in the most convenient position close to the L.F. stages.

The theoretical circuits of both units are seen in Figs. 1 and 2, the former giving complete control of low and high frequencies with a single panel control, whilst the second gives separate control to both treble and bass. In either case the only modification to an existing receiver which is called for is the breaking of the lead to the grid, the two ends of the wire then being joined to the two terminals at the sides of the units. If the space available permits, the units should be mounted as close

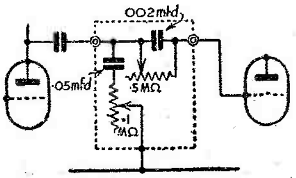


Fig. 2.—This is Unit No. 2's circuit, where separate controls are provided for high and low notes.

to the valve as possible, and then the control or controls should be operated through an extension spindle brought out to the panel. If, however, there is insufficient room near the valveholder, or it is desired to avoid the use of extension spindles, the leads to the units will necessarily be increased in length. To avoid any risk of instability which might be introduced by such leads it is a good plan to screen them.

Constructional Details

THE original units were built up in aluminium cases, but copper or even tinned iron sheet may be used. Remember that copper and aluminium are normally employed for H.F. screening and iron for L.F. screening. As the choke in Unit 1 is of the L.F. type and there may be a risk of interaction between it and another unscreened L.F. component of a similar nature, an iron screen would undoubtedly be preferable in this case. For ease of working, and for the other unit, ordinary soft metal may, however, be employed and will remove any risk of H.F. currents being picked up on the L.F. side.

The metal should be marked out as shown in Fig. 3, noting carefully that in one unit two holes are required in front, and in the other only a single hole, but two additional holes are then needed for the choke fixing bolts. For the terminals, as these have to be insulated, it is probably preferable to use the special bushed type of component, and the drilling dimensions are for these particular items. Smaller terminals, with insulating washers, could be utilised, provided that extreme care is taken to avoid short-circuits to the metal case. When the metal has been cut out it should be deeply scored along the dotted lines, noting carefully that the two holding-down lugs are bent in the opposite direction to all other bends, and thus should be scored on the opposite side

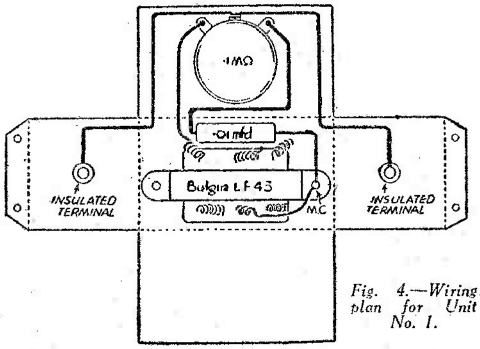


Fig. 4.—Wiring plan for Unit No. 1.

of the metal. Drill all holes before bending, and then carefully fold up the metal to form the rectangular case. No arrangements have been made to seal the edges of the cases in the experimental models, but if copper or iron is employed the edges may be carefully soldered. In the event of aluminium being employed, greater rigidity and complete screening may be obtained by providing lugs on the side pieces so that they may be turned over and bolted to the front and rear. If, however, stout metal is employed it will be found possible to bend it up and make quite a rigid job without going to this extra trouble.

Wiring

THE wiring details of the units are shown in Figs. 4 and 5, and in both units it will be found possible to mount the controls and choke before commencing wiring, the condensers being merely wired into position at the points indicated. Use stout wire and there is then no need to use any insulated sleeving, as the wires are so short that there will be no risk of their moving and causing a short-circuit. With regard to the component values it should be noted that each listener has to adjust his receiver to his own requirements. Accordingly, the values shown on the circuits on these pages may not be suitable for every listener. They provide, however, a wide range of tone variation and have been found to give the desired control on a number of receivers with which they have been tried. It should be noted, however, that the unit in Fig. 1 gives control of both bass and treble on the one control, maximum bass cut-off being given when the knob is turned one way, and as it is turned in the other direction it gradually reduces the bass cut-off and introduces top cut-off. Thus, in a central position the effects are more or less balanced out.

The most suitable tapping of the choke will also depend upon the remaining component values, and in our case we used the tapping giving one henry.

The other unit has a separate adjustment for each purpose, control of the lower frequencies being carried out on one knob and control of the higher frequencies on the other.

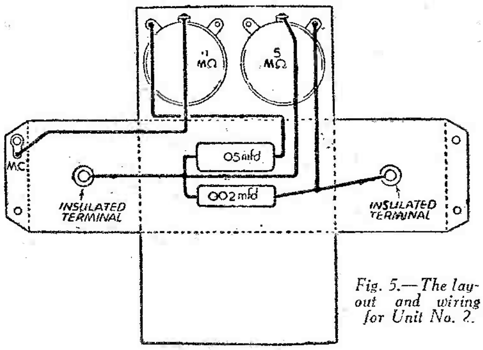


Fig. 5.—The layout and wiring for Unit No. 2.

L.F. Amplification Facts

There is a Limit to L.F. Amplification, and This Article Explains Certain Items Which Must be Considered

MANY constructors appear to have the opinion that the amplification of a signal is simply a question of adding valves to an existing circuit. They seem to think that the process can be carried on indefinitely, and that any odd type of valve will do in the intermediate and/or output stages, while many more are under the impression that if a valve is classed as an output valve, it can handle whatever power you care to inflict on it.

Every would-be designer, and every constructor at all interested in radio, should tackle the question of getting out his own circuits, and must realise that a valve can handle only a certain amount of work and, if you start giving it more than it is designed to cope with, it will make every attempt to get on with the work; *but something will suffer.* The quality of the output will be the first thing and, secondly, it will start to crack up under the strain.

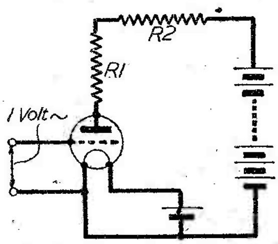


Fig. 1.—The resistance R1 represents the valve resistance and R2 the external load.

If a little consideration, plus even a smattering of elementary knowledge of the operation of a thermionic valve, is applied to the circuit under design, it will soon be appreciated that for any given operating conditions or particular type of valve a certain maximum input and output only can be handled, without running the risk of overloading and introducing the consequent distortion and strain on the valve or valves.

Stage Gain

Every valve has what is known as an amplification factor, and this factor plays a very important part in the amplification which will be obtained.

Take the simple circuit shown in Fig. 1, which is used purely to make this statement more clear. Assume the valve to have an amplification factor of 20. If a signal having a value of 1 volt is applied to its grid, it would be natural to think that it would be amplified twenty times, and that 20 volts would be available at the anode for passing on to the next stage. Such an arrangement, if possible, would be ideal, but, unfortunately, there are other things which have to be considered.

Impedance

Every valve has a certain internal resistance known technically as its *impedance.* This impedance, the same as the resistance in any ordinary circuit, imposes a certain amount of work on the valve, and results in a voltage loss.

Referring to the diagram, the resistance R1 represents the impedance of the valve, while R2 is used to denote the anode load resistance of the external circuit. It can be considered for our purpose as the anode resistance of a resistance-capacity coupling, ignoring any additional external resistance.

The signal voltage which will be available at the anode for passing on to the next stage is directly proportional to the ratio of the external resistance, i.e., R2 to the total resistance of the circuit, i.e., including the valve resistance. Suppose, for example, that R1 and R2 are equal, or in other words that R2 is half of the total resistance. Bearing in mind the above, if 1 volt is now applied to the grid the resultant voltage due to the amplification of the valve will be split up between R1 and R2 to the extent of 10 volts only being available across R2. With this arrangement, therefore, it would appear that the efficiency is very low, but in practice it is possible to increase the effective amplification by increasing the value of the anode load resistance, although it is not usually possible to get more than, say, 60 to 75 per cent. of the total magnification of the valve.

The actual voltage amplification can be found from the formula: $\text{V.amp.} = \frac{\mu R_2}{(R_1+R_2)}$ when μ is the amplification factor of the valve. Many might ask why not increase the anode resistance to such a value that would give even higher magnification. This can be easily answered by asking them to remember that a D.C. voltage has to be applied to the anode of the valve, from the usual source of high tension, through the anode resistance, and according to the current flowing so will a voltage drop be produced across R2 which would tend to starve the valve if the resistance was too high in value.

The actual voltage drop can be calculated from the simple formula:

$$\text{voltage dropped} = \frac{\text{current flowing} \times R_2}{1{,}000}$$

Choke and Transformer

This defect can be overcome by using a suitable L.F. choke in the anode circuit of the valve. This will have a comparatively low direct current resistance, but by virtue of the reactance offered by the inductance to the alternating current which forms the signal, it will produce a similar effect, as far as allowing the signal voltage to be developed across it, as the anode resistance.

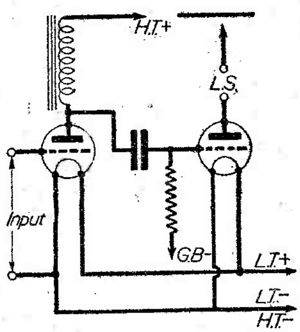


Fig. 2.—By using L.F. choke coupling excessive voltage drop in the anode circuit is avoided.

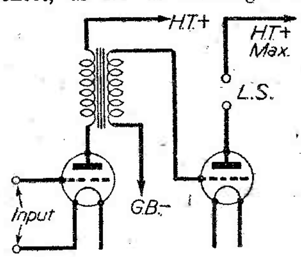


Fig. 3.—A normal transformer coupling which offers low D.C. resistance to the H.T.

With the L.F. transformer, however, one must take into consideration the additional amplification produced by the ratio of the primary winding to the secondary, and as this is usually of a step-up order, a greater overall amplification will be obtained than with a resistance-capacity coupling.

It would appear from this that the transformer method is the most efficient, but it suffers from a defect when the quality of reproduction is taken to a fine point.

The impedance offered to an alternating current by an inductance varies with frequency and, therefore, causes uneven amplification over the complete musical scale.

P.A. System in America

How Sound Systems for Amplified Music and Inter-communication are Helping in America's War Effort

AMERICA at war is taking advantage of every scientific aid, including sound systems for amplified music, selective and mass inter-communication, to speed up the country's efforts.

One of the newest uses of sound in the United States is the "ear-conditioning" of civilians and civil defence groups to the terrific noise of the air raids. Recordings of actual bombings complete with air-raid sirens, anti-aircraft barrages, and thunderous concussion of exploding bombs are amplified to sound levels near the actual ones. After the most peaceful-minded householder has sat through five or ten minutes of this ear-splitting excitement he is usually seized with a new understanding of the terrors of an air attack, and is ready to play an active part in organising his own community to protect itself against any such attack.

Morale Building with Recordings

Recordings are being used to build morale among industrial workers, and to speed up war material production. And now amplified melodies are even accelerating the building of battleships in the same way that whole brass bands were enlisted to stimulate shipbuilding during the first World War. It is therefore no surprise to radio men to learn that the 35,000-ton battleship *Alabama*, under construction at a U.S. navy yard, is being built to music. The programme comprises six concerts daily, from records played through an amplifying system—four during the shifts and two at lunch-time.

The music is described as "sweet" and "swing," "classic and corny," and its effect upon the workers is found to be stimulating, and to promote increased spirit and effort.

In fact, the record-breaking total of 100 major sound amplifying and reproducing systems were installed during a recent 30-day period, including a number of unusual installations. These sound jobs reveal the constantly widening field for "sound" in business and industry, during the present critical period.

Sound on Railroads

For example, twelve 100-watt loudspeakers are doing yeoman duty in the Roanoke classifying yards of the Norfolk and Western railroad, handling war-time traffic—constituting one of the most powerful systems of its type in the world. Since the installation operations in the shipping yards have been carried on with a note of efficiency. Orders are now communicated verbally over large areas, doing away with the need for time-consuming signalling by lights and flags.

Another unique sound installation has been completed at the Des Moin Ordnance Plant by the Technical Service Corporation of Des Moines. This system includes a master control station in the administration building, where microphone, radio and phonograph facilities have been provided. Remote microphones are provided as well at the telephone switchboard, for paging, at several other points in the plant. Four groups of loudspeakers are employed powered by amplifiers installed on the pole which supports the horns. Signals from the control station are transmitted to the remote amplifiers over telephone cables.

Munition Factories

A powerful sound system designed for permanent use in the new U.S. munition depot at New Brighton, Minn., was installed ahead of time so that it could also be used by the building contractor for expediting and paging. The apparatus consists of a central control cabinet with microphone and phonograph facilities feeding 64 power amplifiers which, in turn, drive 32 100-watt loudspeakers. The system is so arranged that any of the 10 groups of speakers covering various parts of the plant can be used individually for paging in selected areas, or the whole system may be used for plant-wide coverage.

Another sound system has been installed in a big brewery at Albany, N.Y. A number of powerful re-entrant loudspeakers are placed at intervals throughout the loading platforms. To acknowledge the call the person being paged goes to the nearest of a number of communicator stations located throughout the plant.

Making Ships With Music

The Oregon Shipbuilding Corporation has installed an extensive industrial sound system which provided recorded music programmes for the plant in addition to

The observation tower at a new munition plant at Indiana. Note the loudspeaker at the top.

paging and announcing facilities. Nine large speaker-trumpets are driven by 150 watts of power. The system is also used to provide music during the lunch and supper hours for the workers.

During the same month sound systems were installed in 21 schools and colleges, 12 industrial plants, eight churches, seven U.S. Government projects, 11 hotels, hospitals and institutions, and in such miscellaneous locations as a race track, several funeral homes, auditoriums, department stores, lodges, restaurants, a roller rink, a bowling alley and a night club. In addition, one city in Kansas purchased a mobile sound system, so that the police cars cruising around town can issue stentorian traffic commands to infractors of local rules of the road.

Safety Messages

When modern sound installations are made in industrial plants, the purpose is above all to stimulate morale and to promote general good feeling between workers and management, by the introduction of pleasing music during working hours.

Even though the noise conditions in such plants may reach such high intensities as 65 to 100 decibels, it has been found possible to use individual loudspeakers at each machine so that the music being played is heard clearly above the factory roar.

The loudspeaker system can also be used for local plant broadcasts of safety instructions, and for possible air-raid warnings.

The musical programmes are started five minutes before the time work is to begin and thus have the effect of getting employees in and ready to start work promptly.

Sound Relieves Fatigue

Industrial tests have shown that in factory work there is a peak of fatigue occurring about 11 a.m. To offset this, music is begun at 10.55 a.m. and continued 24 minutes until 11.19 a.m.

Then at the noon hour, news is given while the employees eat lunch in the cafeteria or alongside their machines. At 12.30 a "request programme" of musical selections follows.

Other fatigue peaks occur at 2.30 and about 4 p.m. and these are again periods for quarter-hour musical selections. At closing time, music is again heard.

The noon-hour "request" musical programmes which follow the noon news periods, are made up of selections chosen by the employees themselves, and thus they feel that they have a hand in arranging the noon music. Wedding marches and "happy-birthday" greetings are often included on appropriate occasions.

The usual practice for the supply of the necessary musical recordings is to furnish an initial plant "library" of 500 records, and then to furnish 100 new records a month, on an exchange basis. This accomplishes the elimination of old records, and continuously keeps the local industrial-music collection both up-to-date and in good operating condition.

In some of the workrooms where the new industrial music has been installed, high noise levels prevail but the new music system successfully meets the difficulty, particularly with the aid of small local speakers installed at each machine in rooms where the noise is great. In general, women like the music to be distinctly audible, so they can follow the melodies. Men at work, on the other hand, prefer music only as a "background" and so for male workers the music levels need be relatively low, and the sound sources can be large centralised speakers.

In contrast with workrooms of high noise intensity are certain departments in textile plants, such as the burling or mending rooms, where the hand-workers are surrounded by mountains of cloth material which maintain a depressing pall of silence all day long. In these hitherto "silent-as-the-tomb" departments, the coming of amplified music has been a great relief to the workers, tremendously stimulating their interest in their work and their sense of well-being.

The effect of such music in industry has been to increase production from 6 to 11 per cent. But the great benefit to be accomplished is the stimulation of employee morale, reduction of fatigue, and the building of a splendid spirit of friendly co-operation between workers and management.—RADIO RETAILING.

Comment, Chat and Criticism

War-time Concert Parties

How Entertainment is Provided for the Forces in Outlying Districts.

By Our Music Critic, Maurice Reeve

ONE of the many radical changes which this war has produced compared with the last is in the entertainment of the Forces. All are agreed that entertainment of one sort and another is essential if a healthy, contented and "V" spirit is to be maintained amongst all ranks alike. Also that it should be "issued out" with a reasonable regularity.

If I was asked to name the three most essential requirements of a Serviceman I should plump for (*a*) good quarters, (*b*) good food, and (*c*) good amusements (one could, and perhaps should, combine food as part of quarters and substitute "regular leave" for good food).

The difficulties in providing entertainment are enormous, as the conditions of the Army, at any rate, are as different from what they were in 1914-18 as one can well imagine. In those far-off and half-forgotten days troops were, for the most part, trained with the one object of sending them across the seas to one of the many theatres of war. They were concentrated in huge camps—sometimes containing a division—and it was the camp and not the troops which was static. Consequently it was not difficult to provide men with theatres and cinemas, recreational huts and billiard rooms, etc., although any one individual may not have used them himself for more than a week or two. The situation was almost comparable to a commercial traveller who requires the amenities of life as he journeys up and down the country.

Isolated Detachments

But in this war things are vastly different. Many men have been stationed in the same place for more than twelve months. And, the greatest difficulty of all to overcome, they are in small detachments, sometimes of under fifty. This applies to the place where I happen to be writing this article. Although we are actually under 40 miles from our London terminus we are over 12 miles from the nearest cinema! Furthermore, the last bus back home leaves that salubrious haven of peace and rest at 4.15 (16.15 hours in Army parlance) with a special "late" bus on Saturdays at 8.20! Few may believe that possible outside the Scottish Highlands or Dartmoor, but I can assure them it is correct.

As we are a small detachment of under fifty, no authority will provide us with any permanent form of amusement or recreation, and we are solely dependent on dart-boards, cards, a football or boxing gloves, provided out of regimental funds. So when the notice goes up "Concert to-night at 8," or "Cinema to-night at 7," the welcome it gets can well be imagined.

These are the conditions that prevail so widely to-day, though not exclusively. Last year I attended a course at a command depot in the West of England, and in one week saw two excellent shows at the Garrison Theatre for an admission of one shilling. The theatre held over a thousand, the stage was well appointed, and the shows excellently presented. But, as I said just now, I was a bird of passage, and the following week someone else was occupying my seat and I was a hundred miles away.

Travelling Shows

E.N.S.A. provide some very good little shows which travel around among such detachments as I am now in, but their visits are few and far between (through no fault of their own). They are very hard-working and conscientious people, and it is no light job to travel many miles between shows, cooped up in a small car which is like a gipsy's caravan, their self-contained home frequently losing its way when threading across the wilds of nowhere where troops have their stations, arriving late and hungry and then having to present their show, put on their best smiles, raise laughs, and do their bit with scarcely a wash beforehand and seldom a dressing-room other than "round the corner."

One of these parties visited us a few weeks back. We had arranged to give each of our three detachments a performance, but in journeying out from where they had spent the night they lost their way (armies have done that before now!) and didn't arrive at Company headquarters till 2.30, very hungry and tired. Their first performance was timed for 3 but, in spite of a gulped lunch they couldn't make the village hall till 3.30. The audience was naturally a little impatient.

Tea was refused in order to get to outpost No. 2 with as little delay as possible—eight miles. This show ran from about 6 to 7.30, then over to No. 3, which commenced at 9. Then came the journey back of almost 30 miles to their hotel. When it is borne in mind that their "properties"—piano, costumes, etc.—have to be packed in their little car as carefully each time as if they were going abroad, I think you will agree with me that this little party put in a very good day's work.

This party consisted of five people—tenor, comic, soubrette, soprano, and pianist. And they gave us a first-class show with a wide variety of turns. Their car is a very neat little affair with a seat for each artist (one of them is the driver), wardrobes for costumes, and fixtures on to which the "Mine" piano is clamped.

Popular Programmes

What type of programmes do the troops most enjoy? Firstly, I should say the collection of choruses, the sing-song in which they all join in and give expression to their thoughts and vent to their pent-up feelings. But the choruses must be a well-chosen collection, well led, and not allowed to flag. Nothing must be included that is not very well known. It doesn't matter how many times they are asked to share in the singing of "If you were the only girl in the world"; they love it more each time. But the most beautiful tune will fall as flat as a pancake if unknown to them.

An attractive soprano is always worth her weight in gold, whilst a short sketch by the soubrette and the comedian, in which a romantic adventure is more or less left to the imagination, gains great applause. The comedian with his wise-cracks and suggestive "asides" and "innuendos"; and a slick tap dancer—preferably male—are indispensable.

Transport Difficulties

The provisioning of these entertainments, and to a lesser degree the travelling cinema, on anything approaching an adequate scale (say one show a week), is a very difficult problem. Even if transport and petrol allowed troops to be collected into various centres where sufficient accommodation for both audience and actors could be provided, tactical requirements would put a heavy hand on such a scheme as it would be manifestly improvident to take men away from their posts for several hours at a time. And with such people as A.A. and searchlight detachments—to name only two out of many—it would be foolish to even raise the subject. The travelling show is obviously the ideal solution, and few things would be more appreciated by the fellows—and girls—than the provisioning of more and yet more of these stout-hearted companies of talented and hard-working men and women.

Old-time Sets

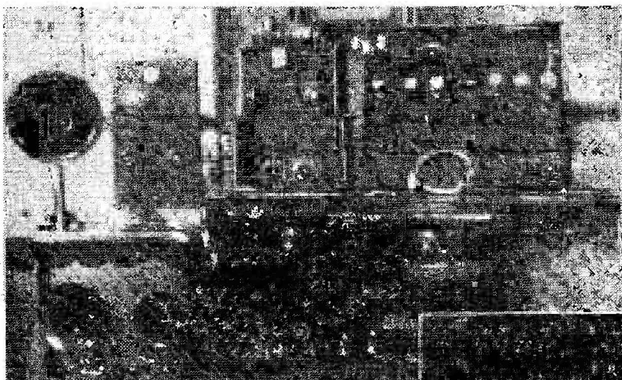
Interesting Particulars of the Activities of Some of Our Readers in the Early Days of Radio

IN our May issue Thermion issued an invitation to readers to send in photographs of receivers they had made in the early days of radio when bright-emitter valves were used, and crystal detectors were also the vogue. In response to this invitation we have received many photographs from readers and we now publish a selection of these, together with some brief descriptions which will, no doubt, bring back some welcome memories to other readers.

The photograph reproduced below is from F. Preston, who will be remembered as a regular contributor to PRACTICAL WIRELESS. He writes as follows:

"The outfit is not too old, but it's one of which I was fairly proud in 1924.

"The big set on the right was an eight-valve 'straight,' provided with plugs and sockets so that any valve could be cut out in turn. In other words, the outfit could be operated as a single-valver, or it could have up to four H.F. stages and up to three L.F. stages. Plug-in coils were used, while two of the H.F. stages had semi-aperiodic tuning; these had coils wound with resistance wire and tappings were brought out to rotary contact switches. Coils for the other H.F. stages were mounted in rotatable holders so that the coupling between them could be pre-set. A swinging coil was fitted for aerial coupling. There were separate tuning condensers for the aerial circuit and for the two fully-tuned H.F. stages. As was the fashion at the time, a separate variable resistor was included in the filament circuit of each valve, and the controls may be seen along the bottom of the sloping panel. To the right of the big set is a small box housing a buzzer-type wavemeter, also with plug-in coils.

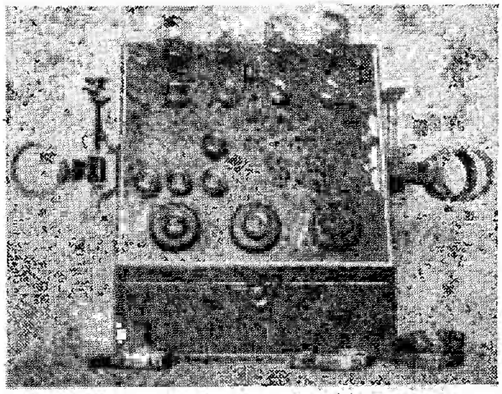


A corner of F. Preston's wireless den showing his eight-valve "straight" receiver as used in 1924.

"Of the two smaller sets on the left the upper one was a three-valve all-wave outfit, also with plug-in coils. The circuit was Det.—2 L.F. Reaction control was by means of the right-hand variable condenser. A number of home-made wave-wound and double-basket coils can be seen on top of the set and in the various coil holders.

"The lower receiver was a two-valve short-wave job, with tapped, low-loss inductance which can be seen just inside the box and on the left of the panel.

"On the small table to the left of the picture can be seen an experimental transmitter for 180-metre working. This had three valves, one of which served as oscillator and the other two in parallel as a power-amplifier stage."



W. E. Beckett's 4-valver of 1925, with sloping front and bright-emitter valves.

A Four-valver

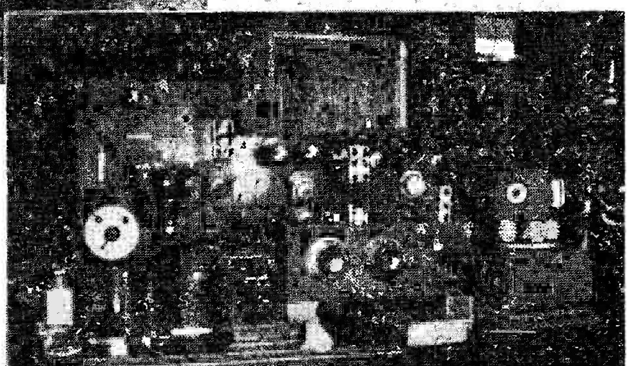
W. E. Beckett, of Maidenhead, writes concerning his early receiver:

"The photograph shows a set I made about 17 years ago; it is a tuned-anode four-valver using bright-emitter valves, and home-made coils."

An Early Layout

With reference to E. W. Bonson's layout, he writes:

"My experience of radio as a hobby dates back roughly 20 years, when one could read the paper by the light of the six-volters we had to use; also, when a variable condenser was needed, one had to go out and buy vanes, spacing washers, etc., and hope the resultant article was .001 or .0003 mfd. as required. Swinging coil reaction,

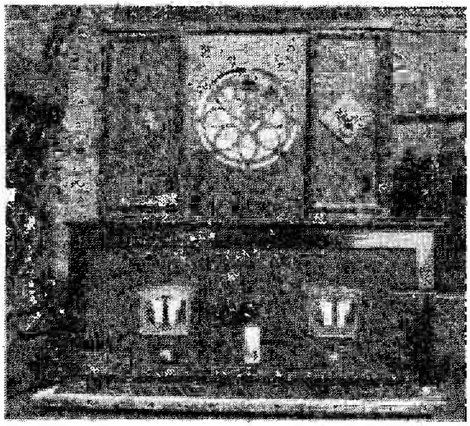


This layout of radio apparatus was used by E. W. Bonson about twenty years ago.

too, was the last word in modern refinement, except when the coil used to drop back after adjustment! The accompanying illustration shows the layout I used in the old days."

A Neat Outfit

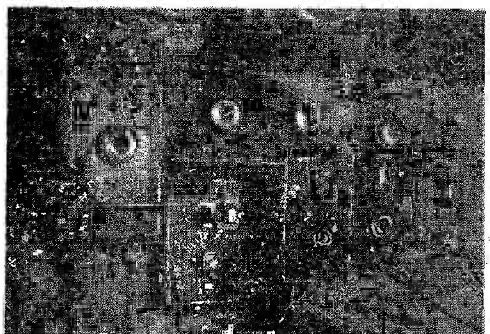
The illustration below shows an early receiver and cabinet speaker built by E. W. Bonson, whose complete layout is illustrated on the opposite page.



One of the early receivers and cabinet-speaker used by E. W. Bonson.

The Unit Principle

Here is J. McDowall's description of his receiver, built on the unit principle:



A receiver layout on the unit principle, built by J. K. McDowall in 1919.

"The receiver illustrated was built in 1919 on the unit principle; it was used as (1) Valve detector circuit. (2) H.F. or L.F. amplifier on crystal circuit. (3) Crystal circuit. The ATI went up to FL, where the time signals were the high spot! The horizontal unit contained a home-made cylinder-type variable condenser. The crystal unit included a choice of crystals, and the sight of that old hedgehog L.F. transformer and bright-emitter 'R' valve makes me feel an O.T. indeed."

(To be continued.)

A Refresher Course in Mathematics

By F. J. CAMM

(Continued from page 274, May issue)

Arithmetical, Geometrical, and Harmonical Progression : Proportion—Algebra

Examples in Arithmetical Progression

LAST month I gave all of the formulæ relevant to an arithmetical progression, and I now give examples in the application of those formulæ. I have presumed the same series throughout so that the reader may more easily follow the applications, 5 being the first term of the series described, the last term 125, and the constant difference 5, the sum being 1625. It is important to select the correct formula according to whether it is the sum, the last term, or the difference which is to be found. Thus, if the first term of a series is to be found when the last term and the difference is known a formula must be selected where a is the first unknown quantity.

Example.—The first term of a series in arithmetical progression is 5, and the last term 125, the constant difference being 5. Find the number of terms in the series.

$$n=\frac{z-a}{d}+1 \qquad =\frac{125-5}{5}+1$$
$$=24+1 \qquad =25$$

Or

$$n=\frac{2S}{a+z} \qquad =\frac{2\times 1625}{5+125}$$
$$=\frac{3250}{130} \qquad =25$$

Example.—There are 25 terms in a series, the first term of which is 5, the last 125, the common difference being 5. Find the sum of a series.

$$S=\frac{n(a+z)}{2} \qquad =\frac{25(5+125)}{2}$$
$$=\frac{25\times 130}{2} \qquad =\frac{3250}{2} \qquad =1625$$

Or,

$$S=n[a+\frac{d}{2}(n-1)] \qquad =25[(5+\frac{5}{2}(25-1)]$$
$$=25\ (5+60) \qquad =1625$$

Or,

$$S=n[z-\frac{d}{2}(n-1)] \qquad =25[125-\frac{5}{2}(25-1)]$$
$$=25\ [125-60] \qquad =25\times 65 \qquad =1625$$

Example.—Find the last term of a series: the first is 5, the common difference 5, and number of terms 25.

$$z=a+d\ (n-1) \qquad =5+5\ (25-1)$$
$$=5+120 \qquad =125$$

Or

$$z=\frac{S}{n}+\frac{d}{2}\ (n-1) \qquad =\frac{1625}{25}+\frac{5}{2}\ (25-1)$$
$$=65+\frac{5}{2}\ (24) \qquad =65+60 \qquad =125$$

If the sum of the series is known we could use anothe formula :

$$z=\frac{2S}{n}-a \qquad =\frac{2\times 1625}{25}-5$$
$$=\frac{3250}{25}-5 \qquad =130-5 \qquad =125$$

Example.—Find the first term of a series of 25 terms whose sum equals 1625, and last term is 125.

$$a=\frac{2S}{n}-z \qquad =\frac{2\times 1625}{25}-125$$
$$=130-125 \qquad =5$$

Or

$$a=z-d\ (n-1) \qquad =125-5\ (25-1)$$
$$=125-120 \qquad =5$$

Or

$$a=\frac{S}{n}-\frac{d}{2}\ (n-1) \qquad =\frac{1625}{25}-\frac{5}{2}\ (25-1)$$
$$=65-60 \qquad =5$$

Observe that the number outside the brackets is multiplied by the number within it. We do not subtract or add it (according to the sign which prefixes it) to the number to the left of it, for this would give an erroneous answer. In the last example, for instance :

$\frac{1625}{25}-\frac{5}{2}=65-2\frac{1}{2}=62\frac{1}{2}$, and $62\frac{1}{2}$ multiplied by $25-1=24$ would be 1500, obviously wrong.

Example.—Find the constant difference in a series of 25 terms, whose first term is 5, last term 125.

$$d=\frac{z-a}{n-1} \qquad =\frac{125-5}{25-1} \qquad =\frac{120}{24}=5$$

If the sum is also known :

$$d=\frac{(z+a)\ (z-a)}{2S-a-z} \qquad =\frac{(125+5)\ (125-5)}{2\times 1625-5-125}$$
$$=\frac{130\times 120}{3250-130} \qquad =\frac{15600}{3120}=5$$

Or,

$$d=\frac{2(S-an)}{n(n-1)} \qquad =2\left[\frac{1625-(5\times 25)}{25\ (25-1)}\right]$$
$$=\frac{2\ (1625-25)}{25\times 24} \qquad =\frac{3,000}{600}=5$$

Geometrical Progression

A series of numbers which increase or decrease by a *constant factor or common ratio* is known as a geometrical progression. For example, the series 3, 9, 27, 81, 243, 729 . . . is in geometrical progression, the constant factor being 3. A series such as $-\frac{1}{2}$, $^{1}/_{16}$, $-^{1}/_{128}$, $^{1}/_{1024}$ also in geometrical progression, the difference in this case being $-\frac{1}{8}$, and the terms are alternately positive and negative.

Let a = the first term of the series, z the last term, n the number of terms, r the constant factor and s the sum of the terms.

$$a=\frac{z}{r^{n-1}}. \quad a=S-r\ (S-z). \quad a=S\ \frac{r-1}{r^n-1}. \quad z=ar^{n-1}.$$

$$z=S-\frac{S-a}{r}. \quad z=S\ \left(\frac{r-1}{r^n-1}\right)\ r^{n-1}. \quad r=\sqrt[n-1]{\frac{z}{a}}.$$

$$r=\frac{S-a}{S-z}.$$

$$ar^n+S-rS-a=0. \quad S=a\ \frac{(r^n-1)}{r-1}. \quad S=a\ \frac{(1-r^n)}{1-r}$$

$$S=\frac{rz-a}{r-1}.$$

$$S=\frac{z(r^{n-1})}{(r-1)r^{n-1}}.\quad n=\tfrac{1}{4}+\frac{\log z-\log a.}{\log r}$$

$$n=1+\frac{\log z-\log a}{\log (S+a)-\log (S-z)}.$$

$$n=\frac{\log [a+S\ (r-1)]-\log a}{\log r}$$

$$n=1+\frac{\log z-\log[zr-S\ (r-1)]}{\log r}.$$

$$S=\frac{z^{n-1}\sqrt{z}-a^{n-1}\sqrt{a}.}{{}^{n-1}\sqrt{z}-{}^{n-1}\sqrt{a}}$$

The Geometric Mean of two quantities, A and $B=\sqrt{AB}$.

The reader will be able to understand the application of the formulæ for geometrical progression from the examples given for arithmetical progression.

Harmonical Progression

Quantities are in harmonical progression when any 3 consecutive terms being taken, the first is to the third as the difference between the first and second is to the difference between the second and third. Thus, if a, b, c are the consecutive terms in a series, then if a : c :: a-b : b-c, then a, b, c are in harmonical progression, and if quantities are in harmonical progression their reciprocals are in arithmetical progression. The harmonic mean of two quantities A and B is $\frac{2AB}{A+B}$.

There is no simple formula for the sum of a harmonical progression, but taking the ordinary harmonic series $1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\ldots\ldots\frac{1}{n}$ and calling its sum to n terms Sn, it can readily be shown approximately that—Log (n+1) <Sn <1+Log n. In other words, Sn differs by less than 1 from log n. More exactly it can be shown, though proof is long and difficult, that where n is very large Sn> log n, by an amount known as 8.

Euler's constant=0.5772 to four significant figures.

Averages

To find the average of a series of quantities, the total of the similar quantities is divided by the number of quantities. For example, the average earnings of ten men earning 30s., £2, 50s., £3, 70s., £4, 90s., £5, 110s., £6 respectively is £3 15s.

If a train completes a journey of 90 miles in 3 hours, its average speed is 30 miles an hour. It will be seen that the sum of the terms is equal to the average multiplied by the number of terms.

Another example:

What is the average of .36, .75, .42, .68, .101, 3.75?

The sum of these items is 6.061, and there are 6 terms. Dividing 6.061 by 6, we obtain 1.01016.

Ratio and Proportion

We often convey an idea of the size of an object or the length of time which it takes to perform a certain operation by comparing it with some other known object or period. For example, we could say that one car is three times the size of another, or that it takes twice as long to go from London to Birmingham as it does from London to Gloucester. This is the principle of proportion, and the relation which one quantity bears to another is called a ratio. When comparing two quantities of the same kind we consider how many times one quantity is contained in the other. We divide the first quantity by the second and the quotient expresses the ratio. For example, 2s. is to £1 as 1 is to 10. We have divided 2 into 20 and obtained 10 as the quotient. This ratio can be expressed as $\frac{20}{2}$, 20÷2, or 20 : 2. Dissimilar things cannot be expressed as a ratio.

When we desire to divide some number in a given ratio we add together the two terms of the ratio and express it as a denominator of the number. For example, divide 125 in the ratio 2 : 3. We add 3 and 2 together and obtain 5; thus, $\frac{125}{5}=25$. We now multiply each term of the ratio by 25, thus obtaining 50 and 75, which represents the number 125 divided in the ratio 2 : 3.

Similarly, if 125 were to be divided in the ratio $\frac{1}{2}:\frac{1}{3}$ we reduce these fractions to a common denominator first. Thus, $\frac{1}{2}=\frac{3}{6}$, and $\frac{1}{3}=\frac{2}{6}$. Now divide 125 by the sum of the two numerators 3 and 2, or 5, and using 5 as a denominator and 3 and 2 as numerators, we split up 125 in the ratio $\frac{1}{2}:\frac{1}{3}$. Thus $\frac{3}{5}\times\frac{125}{1}=75$, and $\frac{2}{5}\times\frac{125}{1}=50$. Hence, as we shall see later, $\frac{1}{2}:\frac{1}{3}$ as 75 : 50. Note that we do not take $\frac{1}{2}$ of 125 and $\frac{1}{3}$ of 125 to express the ratio.

The ratio 3 : 6 is the same as 6 : 12, and we can express this in the usual way as 3 : 6 : : 6 : 12. In this example the ratios are equal, and the terms are hence said to be *in proportion*. Expressed as a rule, *four quantities are proportional when the ratio of the first to the second is equal to the ratio of the third to the fourth.* Thus, 3 : 4 : : 9 : 12, or 7 : 10 : : 35 : 50 are in proportion. The first and last term of a proportional expression are called the *extremes*, and the two middle terms are called the *means*. It is important to note that the product of the extremes is equal to the product of the means, and this is a test of whether the terms are in proportion.

It will be observed from this that if three terms of a proportion are known the remaining one can be calculated. For example, find the second term of a proportion, the first, third and fourth terms of which are 3, 6 and 12. Multiply 3 by 12 to obtain 36. Divide by the remaining term (6), and obtain the second term, 6.

Quantities are in *direct proportion* when the first is to the second as the second is to the third. Thus, 2 : 4 : : 4 : 8 is a direct proportion.

When the second term is equal to the third each is a *mean proportional* to the other two. In the above example 6 is a mean proportional to 3 and 12.

When the ratio of the first to the second is the same as the second to the third, the latter is a third proportional to the other two.

The *geometrical mean* of two numbers is found by extracting the square root of their product, thus the geometrical mean of 4 and 16 is $\sqrt{4\times16}=8$.

The *arithmetical mean* is half the sum of two numbers. In the previous example the arithmetical mean would be $\frac{4+16}{2}=10$.

Percentages

A percentage is a number or fraction with a denominator of 100, and it represents the rate of increase or reduction of one quantity with another quantity of the same kind. Thus, $10\%=\frac{10}{100}$ or $\frac{1}{10}$, and $17\frac{1}{2}\%=\frac{35}{200}$, or $\frac{7}{40}$. For example, suppose the seating capacity of a theatre is 500 and 300 people turn up we say that $\frac{300}{500}\times\frac{100}{1}=60\%$ of the seating capacity is occupied. If we know that the seating capacity is 500 and we are told that the audience were 60 per cent. of the total capacity of the theatre we use 100 as a denominator; thus, $\frac{60}{100}\times500=300$.

Another example. What is $33\frac{1}{3}$ per cent. of £24 6s. 9d.? $\frac{33\frac{1}{3}}{100}=\frac{100}{300}=\frac{1}{3}$, and $\frac{1}{3}$ of £24 6s. 9d. is £8 2s. 3d.

Algebra

Whereas in ordinary arithmetical calculation we make use of the digits 1 to 0 to express quantities, in algebra we make use of letters of the alphabet as well as the digits. Figures can refer to yards, or feet, or any of the other units, such as 9ft., 10 gals., 4 amperes, 3 acres, 2 lbs., 16s., £27, and so on. The signs which we use in connection with arithmetic are also used in algebra, with modifications and additions.

It is customary in algebraic expressions to use the letters *a*, *b*, *c*, etc., for known quantities, and *x*, *y*, *x*, for unknown quantities. One of the difficulties which beginners in algebra always encounter is the correct use of the plus and the minus sign. For example, if we are considering the movement of a train, say, in one direction, we regard that as positive, whilst when the train travels in the reverse direction we regard that as negative. We should express the distance covered in the first direction or the speed at which the distance is covered, if those factors were known, as $+a$, and in the reverse direction as $-a$. In this connection the signs are used somewhat differently from their arithmetical use, for in the latter case the plus sign is merely used in addition sums, and the minus sign in subtraction sums. Moreover, it is necessary in algebra to get clearly established in the mind the fact that a quantity may be subtracted from another quantity smaller than itself. We must get accustomed to the fact that there are quantities less than nought. A man may have no money and we can say that his wealth is represented by o, but if he owes, say, £30, his wealth is represented by $-o$, and in temperatures we refer to degrees below freezing point by prefixing the $-$ sign to the number of degrees.

In algebra it is customary (although there are exceptions) to put the plus quantities first, and so eliminate the use of the plus sign. Thus, $x+y$ means $+x+y$, and $x-y$ means $+x-y$. It is convenient to regard the subtraction of one quantity from another as the addition of a negative quantity to a positive quantity. For example, by adding $+15$ and -24 we should obtain as an answer -9. This is known as the *algebraic sum*. It is important to get this point fixed in the mind. Whereas in arithmetic the minus sign means subtract, in algebra it means the addition of a negative quantity.

Also, in arithmetic the multiplication sign is used to indicate the two quantities that are to be multiplied together. Sometimes in algebra we also use the multiplication sign and in others it is omitted. For example, ab means that a and b are multiplied together, and the expression is more convenient than $a\times b$. If ordinary digits are included in an expression such as $25\times a\times b\times c$ we should express the quantity as $25abc$. Algebra thus differs from arithmetic, for 9×12 could not be expressed as 912.

When two quantities are separated by a plus sign and they have to be multiplied by two other quantities separated by a plus sign the expression is written: $(x+y)\times(a+b)$, or more simply $(a+b)(x+y)$.

Quantities such as $x+y-z$, or $17aby$ are known as *quantities*, or *algebraic expressions*.

A quantity such as $7x$ means that x is to be multiplied by 7. The numerical part of the quantity is called the *coefficient*. The quantity itself, when it consists of a coefficient and a letter is called a *term*.

Powers of quantities are expressed as in arithmetic; thus x^3 means the third power of x, x^2 means the square of x, $\sqrt{x}$ means the square root of x, and so on. As in logarithms the number indicating the power is called the *index* or *exponent*. In order that the reader may understand signs used in algebra the following examples are given:

$$x+y+z.$$

If $x=3$, $y=7$, and $z=6$, the value of the expression is

$$\begin{array}{l} x^2=9 \\ y=7 \\ z=6 \\ \hline 22 \end{array}$$

Similarly, x^2-y+2z, and giving the same values would provide $9-7+12$. Adding the positive quantities produces 21, and subtracting the negative quantity gives the answer 14.

Find the value of $\dfrac{3\times y+z}{ab-c^2}$, where $x=2$, $y=3$, $z=6$ $a=7$, $b=5$, and $c=4$.

We have $\dfrac{3\times 2\times 3+6}{7\times 5-16}=\dfrac{24}{19}$

Addition

When adding algebraic quantities all the like quantities are added together, particular note being taken of their signs. When the quantities have a similar sign, the coefficients are added and the letters annexed. For example: $5x+12x=17x$. Again, $3x+12x-3x+4a+4b=12x+4a+b$.

Subtraction

Here the terms are arranged as in addition, but the signs of the terms to be subtracted are changed, and then added to the expression. Thus, the minus signs in the terms to be subtracted are changed to plus and the plus terms are changed to minus. Hence, in subtracting $7x$ from $10x$, we write: $10x-7x=3x$.

Again, from $3x+2y-3z$ subtract $2x-z$

$$\begin{array}{l} 3x+2y-3z \\ 2x \quad\quad\;\; -z \\ \hline x+2y-2z \\ \hline \end{array}$$

It will be observed that the process of subtracting a negative quantity really means the adding of an equivalent negative quantity.

Multiplication

We have already seen that the multiplication sign can often be omitted in algebra, and that xy really means $x\times y$. Also, $x\ (x-y)$ is the same as $x\times(x-y)$. In multiplication like signs produce a positive result. When unlike signs are multiplied together the answer is negative. For example: $5x\times 3x=15x^2$, and $5x\times(-3x)=-15x^2$.

In multiplying terms which are powers, such as $2x^2\times 3x^3$ the coefficients are multiplied together, but the indices are added; thus, in this example, the answer would be $6x^5$.

A *continued product* is obtained when a number of quantities are multiplied together. For example: The continued product of $2x$, $3y$ and $4z$ is $24xyz$.

Division

The same rules as in arithmetic apply. For example: Divide $27xy^2\times 3xy$. This should be expressed:

$$\frac{17xy^2}{3xy}=9xy.$$

The result of any division sum can be checked by multiplying the divisor and quotient together and this should equal the dividend. The dividend and divisor are arranged according to the powers of the letter, and in descending order. Thus:

$$x^2+2xy+z^2)x^5+5x^4y+10x^3y^2+10x^2y^3+5xy^4+x^5(x^3+3x^3y+3xy^2+y^3$$
$$\begin{array}{l} x^5+2x^4y+x^3y^2 \\ \hline 3x^4y+9x^3y^2+10x^2y^3 \\ 3x^4y+6x^3y^2+3x^2y^3 \\ \hline 3x^3y^2+7x^2y^3+5xy^4 \\ 3x^3y^2+6x^2y^3+3xy^4 \\ \hline x^2y^3+2xy^4+x^5 \\ x^2y^3+2xy^4+x^5 \\ \hline \end{array}$$

Here it will be seen that x^2 has been divided into the first term x^5 to produce x^3. Then the whole of the divisor is multiplied by x^3 to produce $x^3+2x^4y+x^3y^2$, whilst x^3 itself is placed in the quotient.

Here are further examples:

$$a+b)a^3+3a^2b+3ab^2+b^3(a^2+2ab+b^2$$
$$\begin{array}{l} a^3+a^2b \\ \hline 2a^2b+3ab^2 \\ 2a^2b+2ab^2 \\ \hline ab^2+b^3 \\ ab^2+b^3 \\ \hline \end{array}$$

(To be continued.)

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).

An Appreciation from S. Africa

SIR,—I want to express my appreciation of PRACTICAL WIRELESS. I consider the new size to be an improvement, and when you return to weekly publication again I hope it will remain in its present size.

The articles on Resistance, Condensers and Capacity in the January issue were very helpful, and I hope that such articles will be continued.

Wishing the best wireless journal every success.—GERALD MORLEY (Port Elizabeth, S. Africa).

Heard on the Short Waves

SIR,—The following items of station news may be of interest to other readers. The RX is a home-built all-mains 1-v-1 (KTW63, KTZ63, KT63). Single wire antenna pointing S.E.

PMA: 19.38 mc/s, 15.48 m., Batavia, Java: news in English 13.45 hours daily. Announces: Nirom PMA.

HCJB: 12.46 mc/s, 24.08 m., Quito, Ecuador: approximately 23.30 hours, programme in English, "Ecuadoran Echos," followed by news relayed from WBOS (11.87 mc/s), Hull, U.S.A., power 10,000 watts.

COK: 11.62 mc/s, 25.82 m., Havana, Cuba: gives English talk, announces: "Short-wave COK, Havana, Cuba": gives morse V as interval signal.

SUX: 7.86 mc/s, 38.14 m., Cairo, Egypt: heard 23.30 hours. Sam Brewer speaking to New York.

VONF: 5.97 mc/s, 50.1 m., Newfoundland: news at 23.00 hours read by Al Barty.

CJCX: 6.16 mc/s, 49.0 m: news about 23.15 hours, badly interfered with.

PERNAMBUCO, Brazil, 6.1 mc/s: begins and ends news with "Tipperary"; 2 chimes on musical box after each item—uses Columbia Broadcast System.

COCW: 6.32 mc/s, 47.4 m. approx.: interval signal three chimes, announces, phonetically (Say-o-Say-Doubleday) Havana, Cuba.

There are several Dominican stations, between 6.15 mc/s and 6.5 mc/s, not properly identified yet. Can any readers help? Also heard: OPL, 20.04 mc/s; WCRC, 11.83 mc/s; LRA3, 11.73 mc/s; TAP, Brazzaville; WRUL, etc. As a very old reader, may I say I prefer the present size of PRACTICAL WIRELESS. Among the test equipment described, I cannot recall a buzzer wavemeter, and should like to see a description of one. N. HALES (Balham, S.W.).

B.B.C. Recordings

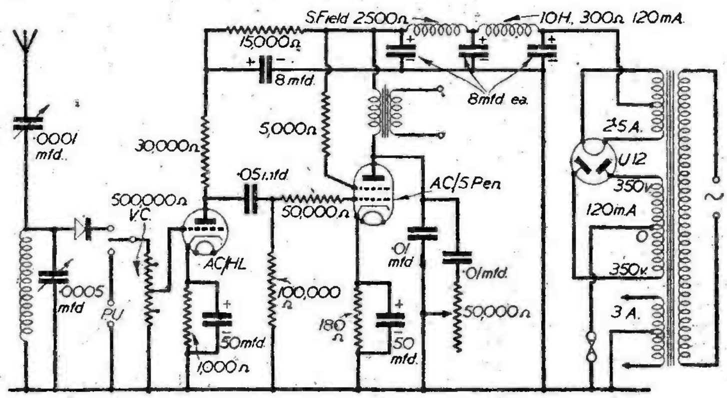
SIR,—For the benefit of readers interested in the important subject of sound recording, may I point out an inaccuracy which appears in the item headed "B.B.C. Records" (page 194, April issue).

The B.B.C. normally uses three methods of recording:

(1) The M.S.S.-Watts disc system (for studio and mobile car recording) employs metal-based blanks with a coating of nitro-cellulose (referred to as cellulose-acetate) which, after "cutting," can be played back immediately up to about 25 times without marked loss of quality, in contrast to the wax master method of ordinary gramophone recording, which requires electrolytic processing and pressings made for reproduction purposes. "Dubbed" (i.e., re-recorded) copies and solid-stock pressings can be made, when needed, from the M.S.S.-Watts discs.

(2) The Marconi-Stille magnetised steel-tape method, which is a development of the old Blattnerphone (named after the late Ludwig Blattner). In general, this system is confined to recording rehearsals and programmes to be broadcast shortly after, but which are not of permanent interest. In fact, the novel feature of this method is that the recording can be "washed out" magnetically and the tape used over and over again.

(3) The Philips-Miller system, in which the recording medium is an opaque coating on a film strip or tape. This is actually cut by a sapphire stylus so that a transparent track of variable area is produced, which is reproduced photo-electrically. The record is compact and permanent with a normal playing time of about 15 minutes per spool. This system is employed for high-quality recordings.—DONALD W. ALDOUS (Torquay).



Circuit diagram of J. Richardson's two-valve amplifier.

An Efficient Amplifier

SIR,—I have tried several amplifier designs published in PRACTICAL WIRELESS, including your latest one using negative feedback, and I find the amplifier circuit I enclose about the best of them all. Using two .01 condensers and the 50,000 ohms potentiometer across the speaker transformer gives better results than when using one condenser only. I get excellent results when using a crystal set for receiving the home service. I thought these particulars might interest other readers, as it is quite a satisfactory amplifier.—J. RICHARDSON (Morpeth)

S.W. Transmissions

SIR,—The Canadian radio station CFRX located in Toronto would appreciate reports on their 49.42 metres signal. They transmit daily from 23.15-05.00 G.M.T., and use the call "Rogers Being Co."

Further to my short-wave log in the January issue, here is some more news. All times stated are G.M.T. "Radio Saigon" (F.I.C.) heard closing at 17.30 after giving three notes. Also heard on approx. 31.95 m. giving English news at 15.45, and closing at 16.00. From Beirut (Syria) comes "Radio Levant," giving English news at 16.00 and sometimes at 16.30, on 37.34 m.—announced as such but is nearer 37.40 m. "Radio Congo-Belge OPM," 29.15 m., heard at 18.35. A new "Yank" on 16.8 m. is WCRC, which may have replaced WCBX. WRCA operates on a new frequency around 19.80 m. English news from WBOS, 25.25 m., at 23.00.

Thanks a lot for your S.W. station lists.—ROBT. W. IBALL (Worksop).

Diode-grid Detection : A Correction

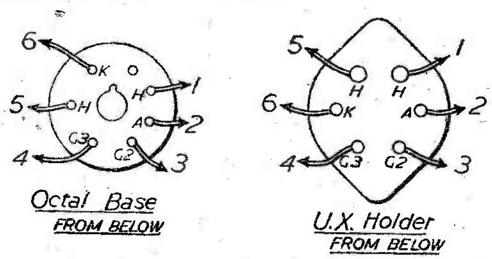
SIR,—I regret the error in my drawing of Fig. 3 of the article in the May issue. The H.T. should not be connected to the anode, but connected, via the leak or load resistor, to the grid of the valve.

Any reports on the working of diode-grid detector circuits would be appreciated.—D'ARCY FORD (Exeter).

The "Brains Trust"

SIR,—Many thanks for your criticism of the "Brains (?) Trust," which I consider was badly needed. It seems to me that the answers given are merely opinions in many cases.

Have you noticed that the "question master" for some reason is unable to announce the questions without numerous "ums" and "ers"?



Adaptors for alternative valves, as devised by A. M. Roulston.

I hope that you will continue to criticise the "Brains Trust" in PRACTICAL WIRELESS with a view to having a drastic clearing up, and the insistence on the men giving short and satisfactory answers to sensible questions.—STANLEY PASCOE (Falmouth).

Medium-wave DX Stations

SIR,—With regard to Mr. John L. Goldberg's letter in the May, 1942, issue, under the heading "Open to Discussion," asking for verification of the call signs of some M.W.DX stations, I am able to verify that of the Buffalo station, namely WKBW, having heard it relayed by WCBX (25.36 m.) at 10 p.m. on the night of October 1st, 1941. It is owned and operated by the Columbia Broadcasting System.

Some short-wave stations which I have received recently and which may interest readers are TGWA, Guatemala City; PMA, Batavia; KGEI, San Francisco; WCRC, Brentwood; and for the past week at 1 a.m. G.M.T., on 30.99 m., some fairly powerful signals from XEQQ in Mexico City. HCJB in Quito, Ecuador, is now relaying WBOS in Boston, usually about 11.30 p.m. G.M.T.—JOHN W. MACVEY (Forestfield).

Dry Cells for Battery Sets

SIR,—Why must it take a war to bring us several improvements from various quarters? For instance, our invaluable PRACTICAL WIRELESS has never been so good. Congratulations.

With reference to Mr. D'Arcy Ford's letter on the use of a bell cell, he does not give any details as to the size of the set which is supposed to give us such a wonderful performance. Purely as an experiment I tried a large cell (Siemens) on a straight three, Hivac H210—R.C.C. to HL210 and trans. to a small power valve. Using the set on an average of one hour per day the cell ran down after only eight days! Otherwise the results were quite satisfactory.

I wonder if any readers can suggest a solution to the following problem. Why—against all the written rules—do I get perfect response from my Class B set—the power being derived from an ordinary eliminator not fitted with any form of stabilising unit? Three makes of eliminator have been tried and the results in each case have produced perfect response. The circuit is plain Class B, using a Cossor 240B (it's the L.F. side of the circuit No. 31 in "PRACTICAL WIRELESS Circuits," with the inclusion of a choke in the output).

I also get good results using push-pull and Q.P.P., so there appears to be something wrong somewhere.—S. W. MANKTELOW (London, N.W.).

Adapting Alternative Valves

SIR,—Recently I bought a small American radio set, without valves, as they were difficult to obtain. Not wishing to go to the expense and trouble of buying the required valves (25Z6g, 25A6g, 6U7g, 6J7g), I adopted the following method which enabled me to use standard American valves which have practically the same characteristics. The valves I substituted in place of the octal base type are as follows:

Original valve	Substitutes
25Z6g	25Z5
25A6g	43
6U7g	6D6
6J7g	6C6

These valves were fitted into the octal type valveholders by means of "adaptors."

I bought several defective octal base valves for a few pence, and removed the bases. Into each pin I soldered a short length of copper wire, over which I put short lengths of systoflex sleeving, and wired these to the appropriate pins of U.X. valveholders placed on top of them. When the wiring was completed and checked the space between the holder and base was filled with pitch, to keep them rigid. The completed "adaptor" was fitted into the appropriate holder in the set, and the standard American valve pushed in on top. The accompanying sketches show the wiring connections for one of the adaptors which will suit the 6J7g and the 6U7g valves. This method allows U.X. valves to be put in temporarily without changing the valveholders.

Care should be taken to see that each adaptor is marked with the number of the valve it is intended for.—A. M. ROULSTON (Belfast).

Articles on Television!

SIR,—May I express my appreciation of the new PRACTICAL WIRELESS. In its new form it is handier to carry about, and makes a much more compact volume when bound.

I should like to see a series of articles on television. Although television is in "cold storage" for the duration, there will be a revival of interest after the war. Since television is a comparatively new industry, there will be many opportunities connected with this science in the future, and a comprehensive series of articles would be of value in preparing the amateur constructor and serviceman for this new field. Something on the lines of the series on "P.A. Equipment" is needed, covering all phases of the subject. The design of time bases, synchronising separators, D.C. restoration circuits, amplifiers to handle uniformly the very wide sidebands used, etc., present problems that are not met with in ordinary radio practice. I feel sure that other readers will agree that such a series of articles would be of great interest, if only for the theoretical knowledge they would impart.—G. R. BRIGGS (Wolverhampton).

Back Numbers Wanted

P. W. GOUGH, of Gattertop Cottage, near Leominster, Herefordshire, will be very grateful if any reader who has finished with the copies of PRACTICAL WIRELESS for December, 1941, and February, 1942, would be good enough to forward same to the above address. Postage and cost of books will be refunded.

Replies to Queries

Reaction Trouble

"I have a peculiar fault with the reaction circuit of my receiver. For some time now, when I advanced the reaction condenser to oscillation point, the speaker would emit a loud plop and all signals would cease, although I could still hear the rushing noise of the carrier wave. If the receiver was switched off and then, after a short delay, on again, reproduction would be normal. Yesterday, however, the same plop sound was reproduced and then silence, and since then I have not been able to obtain any results. In all other respects the set seems to be normal, except for the fact that there are no signals and the reaction is non-existent. All valves are in order, and the accumulator and eliminator are, so far as I am able to tell, above suspicion."—W. R. (Penzance).

WITHOUT a theoretical diagram of the circuit, it is not possible for us to give detailed advice. In the circumstances we can only suggest the likely sources of the trouble and recommend a systematic stage-by-stage test. In the first place, check all operating voltages and make quite sure that the receiver is not oscillating at a frequency above audibility. Give particular attention to the detector valve and all condensers associated with the smoothing, decoupling and coupling circuits. The volume control and switch contacts also call for a careful examination, and, during initial tests, we would suggest that you arrange the circuit so that only the detector and L.F. valves are in use. This will help to localise the possible source of trouble.

Universal Oscillator Unit

"In your November issue (1941) you publish details of an oscillator, the final details of which were given in the December issue, a copy of which I have. At the time of writing, I have been unable to get hold of the November number, so I am without any details about the coils. As you are now unable to supply a copy containing this information, would you please let me have the essential facts so that I can carry on with the constructional work and complete the unit."—E. J. K. (Maidenhead).

THE dimensions of the coil former are shown in Fig. 1, together with the number of turns required for each of the three windings. The medium-wave section is wound in three slots, each holding 20 turns of 26 S.W.G. D.C.C. wire. For the

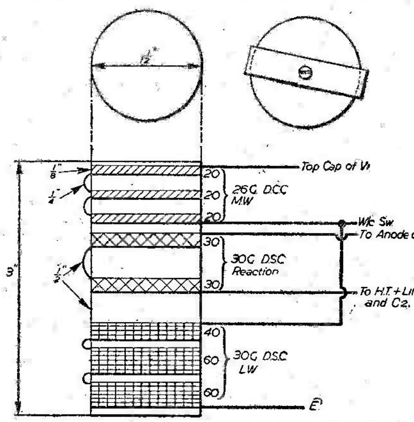


Fig. 1.—Details of the coil for the Universal Oscillator.

long-wave winding, three slots are used, the upper one having wound in it 40 turns, the second 60 turns and the bottom one also 60 turns. 30 S.W.G. D.S.C. wire is used for these and the reaction windings. The latter consists of 60 turns of wire wound in two slots of 30 each. The method of connecting the various windings is shown on the diagram.

Alternative Frequency-changer for Above

"I have constructed the Universal Oscillator, but now find that I am unable to obtain a Mullard F.C.2 valve or its equivalent. I have on hand various H.F. pentodes and S.G. valves, and would be pleased to know what circuit modification to make so as to utilise one of them in place of the specified F.C.2."—J. T. (Leeds).

WE would not advise the use of an H.F. pentode plus a separate triode for the circuit in question, as the specified F.C. utilises electron stream coupling. An oscillator-mixer circuit could, of course, be formed around the two valves mentioned above, but as this would mean considerable alteration to the original circuit we hesitate to recommend it for the Unit under consideration. Suppressor-grid modulation could be tried, if an H.F. pentode having a separate connection for its suppressor-grid is available.

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons:—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.
(5) Grant interviews to querists.

A stamped, addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

Requests for Blueprints must not be enclosed with queries, as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The Coupon on page iii of cover must be enclosed with every query.

Hum Elimination

"I am troubled with hum in an amplifier I have built, and I wonder which leads I ought to screen to cut out the trouble. It would appear that the hum is at mains frequency and I am not certain whether the ordinary type of screening sleeving would be suitable."—T. Parkin (Dartford).

THEORETICALLY, to screen leads or components for L.F. induction it is necessary to use iron. If the hum is induced from a lead carrying A.C., or from an inductive component such as a choke or transformer, then some form of iron screen is called for, but the standard braided sleeving often proves quite useful in spite of this fact. It should be possible to eliminate induction between leads by running them at right angles and by well spacing them.

Quality and Push-pull

"Can you advise me definitely whether Class A output amplification is the very best for quality results? I have heard so much about different forms of push-pull that I am rather at a loss to know just what type of push-pull may be considered to give the best reproduction and I wish to build up a good amplifier for use with records and with a special quality radio unit."—H. Higgins (Mitcham).

CLASS A is generally considered to be the most suitable for ordinary use. It gives the lowest percentage of second harmonic distortion, but includes harmonic distortion in other directions. Other forms of push-pull are generally modifications of Class A and have for their object either lower H.T. consumption or the removal of distortion due to the particular types of valve used, i.e., pentodes. Negative feed-back, low-loading, and similar schemes have certain features, but for general domestic use with the small powers called for, the standard or Class A form of push-pull may be regarded as the most satisfactory.

Ganged Condenser Trimming

"Could you tell me how to match a .0005 mfd. two-gang condenser without trimmers to a pair of matched dual-range coils?"—T. W. S. (S.E.23).

IF the condenser has split end-plates it might be possible for you to match up the two sections throughout the scale. This would, however, prove a rather tedious process, and we would suggest that you mount a small variable condenser on the panel and connect this in parallel with one section of the condenser. A two-plate variable would be adequate and then you could adjust this when a station is received and in that way accurately obtain the desired matching. For preference the trimmer should be mounted across the section of the condenser which does not form part of the aerial circuit.

Impedance Formulæ: A Correction

In our reply to a Query under the above heading on page 281 (May issue) the formulæ given for Z were incorrectly arranged owing to a printer's error. They should have read:

$$Z=\sqrt{R^2+(X_L-X_C)^2} \text{ and } \sqrt{R^2+(X_L \sim X_C)^2}$$

Classified Advertisements

ADVERTISEMENTS are accepted at 2s. per line or part of a line. Minimum 4s. Advertisements must be prepaid and addressed to Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

CABINETS

WE regret that, owing to all our employees having joined H.M. forces, we are unable to accept orders for cabinets except to callers. Limited stock only. We have a large stock of radio components.—H. L. Smith & Co., Ltd., 289, Edgware Road, London, W.2. Tel.: Pad. 5891.

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LOUDSPEAKER repairs, British, American, any make, moderate prices.—Sinclair Speakers, 12, Pembroke Street, Copenhagen Street, N.1.

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VOLUME CONTROLS, 2 meg., good line. 2/- each.
AERIAL ELIMINATORS. Lincoln Stewart, to clear. 1/6 each.
RESISTANCES. Brand new, 500, 12,000 and 100 ohms. 3/- dozen.
AMERICAN valveholders, 4, and 7-pin. 5d. each.
VARIABLE CONDENSERS, mica dielectric .0003 mfd., brand new, 6d. each, 5/- dozen.
MICROPHONES. Complete with transformer. Solid ebonite job, full instructions included. New line, 6/- each.
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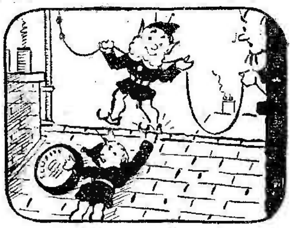
(Continued at top of column 3.)



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(Continued at top of page 328.)

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(Continued from page 327)

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POWER PACK and Amplifier Chassis. Includes transformer 350-0-350, 120 m.a. with 4 tappings. High voltage transformer for C.R. tube. Condensers, including 16 x 16 mfd. 550 v. working, 1-16 mfd. 450 v. working, 50 x 50 x 2 mfd. B.I. electrolytics, etc. Pentode output transformer; chokes; resistors; trimmers; bias electrolytics; mica and tubular condensers; short-wave coils, etc. Brand new, **67/6,** plus 2/6 for packing.

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UNIVERSAL TEMPOVOX chassis, 5 valve, less valves and speakers but with various useful components, not guaranteed complete, **22/6** each.

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(Continued in next column.)

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Practical Wireless
BLUEPRINT SERVICE

PRACTICAL WIRELESS	Date of Issue.	No. of Blueprint.
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" crystal Set	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprints 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	28.8.38	PW93
Two-valve : Blueprint. 1s.		
The Signet Two (D & 1 F)	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	—	PW39
Hall Mark Cadet (D, LF, Pen (RC))	—	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	—	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	—	PW62
The Centaur Three (SG, D, P)	—	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	—	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	—	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det, Pen)	—	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	—	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	—	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	—	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	—	PW92
Four-valve : Blueprints, 1s. each.		
Fury Four (2 SG, D, Pen)	—	PW11
Beta Universal Four (SG, D, LF, Cl.B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P)	—	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	—	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90
Mains Operated		
Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D (Pen))	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47
SUPERHETS.		
Battery Sets : Blueprints, 1s. each.		
£5 Superhet (Three-valve)	—	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
A.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	—	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model / Push Button 4, A.C. Mains Model	22.10.38	PW95
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
Simple S.W. One-valver	23-12-39	PW88
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	—	PW68
PORTABLES		
Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86
MISCELLANEOUS		
Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE		
CRYSTAL SETS.		
Blueprints, 6d. each.		
Four-station Crystal Set	—	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G. 3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three : De Luxe Version (SG, D, Trans)	19.5.34	AW435
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	—	WM327
Economy Pentode Three (SG, D Pen)	—	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	—	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minitube Three (SG, D, Trans)	Oct. '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans)	—	AW370
Self-contained Four (SG, D, LF, Cl. B)	—	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2LF)	—	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF, Pen, HF Pen, DDT, Pen)	Apr. '36	WM404
Five-valve : Blueprints, 1s. 6d. each		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340
Mains Operated.		
Two-valve : Blueprints, 1s. each		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (H.F. Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	—	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	—	WM329
Harris' Jubilee Radiogram (HF, Pen D, LF, P)	May '35	WM386
SUPERHETS.		
Battery Sets : Blueprints, 1s. 6d. each.		
'Varsity Four	Oct. '35	WM395
The Request All-Waver	—	WM407
Mains Sets : Blueprints, 1s. each.		
Heptode Super Three A.C.	May '34	WM359
PORTABLES		
Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Tyers Portable (SG, D, 2 Trans)	—	WM367
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
S.W. One-valver for America	P.W.15.10.38	AW429
Roma Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det, Pen)	Feb. '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve : Blueprints, 1s. each.		
Experimenter's 5-metre Set (D, Trans, Super-regen)	—	AW438
The Carrier Short-waver (SG, D, P)	July '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF, Pen, D, RC, Trans)	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valver Short-waver (SG, D, LF, P)	—	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super	—	WM397
Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	P.W.13.1.40	AW453
Three-valve : Blueprints, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans)	—	WM391
MISCELLANEOUS		
S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM 392 (1/-)	—	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	—	WM403
New Style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	—	WM405
Wilson Tone Master (1/-)	—	WM406
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PRACTICAL WIRELESS, JUNE, 1942.

Published on the 7th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and printed in England by THE NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand: GORDON & GOTCH, LTD. South Africa: CENTRAL NEWS AGENCY, LTD. Subscription rates including postage: Inland 10s. 6d. per annum; Abroad 10s. per annum. Registered at the General Post Office for the Canadian Magazine Post.