FURTHER STEPS TO HIGH QUALITY—See page 10.

A NEWNES PUBLICATION

Practical Wireless and PRACTICAL TELEVISION

3D. EVERY WEDNESDAY

Edited by F. J. CAMM

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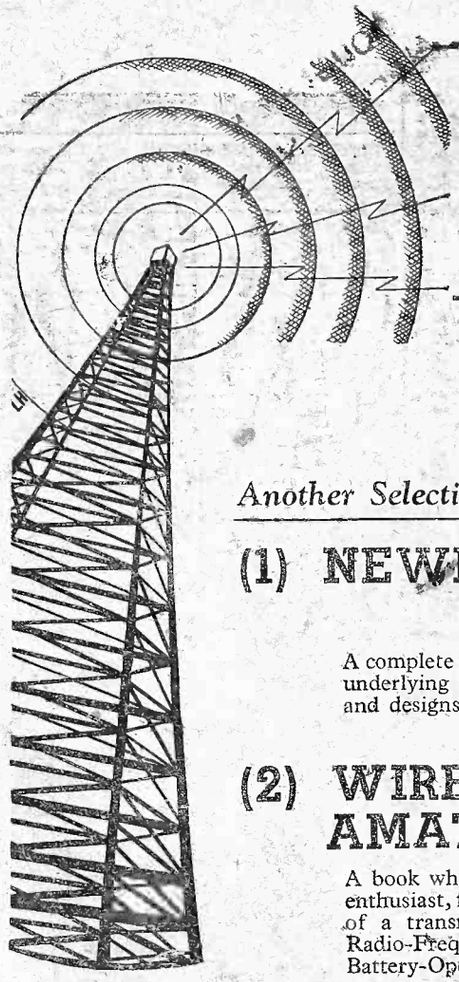

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EVERY WEDNESDAY
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EDITED BY F. J. CAMM
Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Direct Coupling

MANY attempts have been made in the past to obtain improved quality by departing from normal methods of coupling in the L.F. stages. Generally speaking there are only resistance-capacity and transformer coupling, and although these may be combined, the principles remain the same. In each case the grid of the amplifying valve is isolated from the H.T. supply, either by a condenser or through the fact that the two transformer windings are electrically separate. Many years ago a system was developed in which the grid was joined direct to a battery, and it was claimed that a great improvement was obtained, due to the lack of a time constant in the grid circuit. Since those days many attempts have been made to improve on the arrangement, and in this issue we give constructional details of an amplifier in which the grid is actually connected, through resistances of course, to the H.T. positive line. This system, known as direct-coupling owing to the fact that the preceding anode is joined direct to the following grid, has advantages when it is properly made up, and we hope that the details given will enable readers who are interested in this arrangement to try out the scheme.

Licence for Valves

IN last week's issue we published a list of valves which can only be obtained when a licence form has been sent to the postal authorities. The form in question was previously only obtainable from Head Post Offices, but supplies have now been sent to all branch and sub-offices and it is thus possible to obtain the form from any normal post office. This does not include the smaller type of office which is found in conjunction with general stores, etc.

Gerald Cock

THE B.B.C. announce that Mr. Gerald Cock, M.V.O., has been appointed its North American representative in the place of Mr. Felix Greene. The appointment of North American Representative is made for a limited period. Mr. Greene in the normal course would have returned to England last autumn, but his replacement was delayed by the war.

Mr. Cock, who is the B.B.C.'s Director of Television, lived for some years in America and revisited New York last spring. The war-time suspension of the television service has made it possible for him to succeed Mr. Greene as the B.B.C.'s representative in New York.

Lemmy Caution Calling

BEN WRIGHT has been chosen to create the radio character of Lemmy Caution in a new series of short plays specially written for broadcasting by Peter Cheyney. He will be heard in the For the Forces broadcast on March 14th.

"Lemmy Caution Calling," is the title of the series, and the first episode is "The Big Shot." The series should provide some good, rousing dramatic fare for listeners in the various Services, for they are full of action and based on strong gangster situations, with the celebrated Lemmy as the "G" man whose aim is to bring the criminals to the electric chair.

Jimmy Leonard, WLW announcer, who makes things not too easy and not too hard for contestants on "Marathon Melodies," radiated by that station to NBC on Fridays at 10.30 p.m., E.S.T. Leonard grew up in Florida, and made his radio début with his good friend Red Barber, the sports announcer. Others on the "Marathon Melodies" show with him are Sylvia Rhodes, vocalist, and Josef Cherniavsk, orchestra.

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The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

The Bing Boys

"THE Bing Boys are Here." "The Bing Girls" and "The Bing Boys on Broadway," three brilliant, colourful shows of the last war, are the subjects of the Keith Ayling and Leslie Baily programme, the second in the series "The Story Behind the Show," to be heard on March 15th. The collaborators have prepared a most interesting script, and it is hoped to have in the studio George Robey, the original Lucifer Bing; Violet Lorraine; Clifford Grey, the lyric writer; and Nat D. Ayer, the composer. They will revive some of the high spots of the shows to which went the fathers and mothers of men now in uniform.

"The Bing Boys are Here," was produced at the Alhambra on February 12th, 1916, and ran for 378 performances. The third of the shows, "The Bing Boys on Broadway," was still running after the war was over. Most people will have some outstanding memories of these great productions.

At the "Black Dog"

"AT the 'Black Dog'," the popular feature which started in the Empire Programme over two years ago and which ultimately became a regular fixture in the Home Programme, will be revived for the Forces on March 15th. Later on, it may take its place in the Home Service. There was always a wonderful feeling of spontaneity about the series, and the friendly atmosphere of a small pub was most successfully conveyed to listeners. No scripts were used, and those taking part would probably have an hour or so to get to know each other before actually going on the air.

The Visitors' Book at the "Black Dog" is a grand mixed bag and includes the names of film stars, musicians, radio artists, churchmen, writers, footballers and people from every conceivable trade or profession. Gracie Fields has been there, and other famous names which come to mind at random are A. F. Tschiffely, the great horseman and writer; Valerie Hobson, one of the best of our British film stars; George Allison, the well-known football manager; S. I. Hsiung, the author of "Lady Precious Stream"; Leslie Howard; Jean Batten, the airwoman; Primo Carnera; and F. S. Smythe of the Everest expeditions.

Designing Mains Transformers—3

How to Select Suitable Core Stampings, and How to Assemble the Transformer - - - By L. O. SPARKS

WHEN selecting stampings, it is preferable to use those of a square rather than a shallow oblong shape, as the former will invariably give a better voltage regulation figure. In addition to this important consideration, the completed transformer will be more rigid and the construction, generally speaking, more satisfactory. Insulation is one item which calls for particular consideration; bearing in mind the voltages developed across the H.T. secondary windings, it is absolutely essential to see that adequate insulation is provided between layers. It is not sufficiently appreciated by many amateur transformer constructors that a single short-circuited turn can cause currents to flow large enough to burn out the rest of the windings or, at least, ruin all insulation beyond repair.

One naturally thinks of the H.T. secondaries carrying high voltages, but the winding used for the heater of a rectifying valve is so often given no more consideration than the other L.T. windings that a word of warning would not be amiss. It must be appreciated that the rectifier heater is the supply point for the H.T. positive line and that the maximum voltage (A.C.) of the H.T. secondary winding will have to be considered with respect to the heater and the primary of the transformer.

When carrying out the winding operations, try and maintain a constant examination of the wire, as any defective insulation must be made good, and on no account should minute kinks be allowed to pass on to the bobbin. Tapping loops or points also call for special care. If they are brought out through holes in the cheeks of the bobbins, see that the wire does not cut into other turns and that a strip of insulating material is placed above and below the tapping wire.

Screened Primary

In most modern radio transformers it is usual to provide a screen between primary and secondary windings to assist in preventing the passage of high-frequency currents between the two sections. It is not a difficult matter to embody a suitable screen as this need only consist of a strip of copper foil, the width of the bobbin, long enough to go round the primary winding *except* for, say, 1/16th inch. In other words, the foil must not be allowed to form a *complete* loop, a small gap being left between its two ends. The primary winding should be covered with empire cloth or dry paper before placing the foil in position, and another strip of insulating material placed over the screen before winding on the secondary. When cutting the foil, leave a narrow strip on one edge to be brought out to form its connection to earth.

General Assembly

When all windings are finished, it is advisable to mark all leads with some means of identification, thus preventing any errors in that direction. Once they are marked, they should be twisted together lightly so that they form the least obstruction to the assembly of the stampings around and through the bobbin.

Before starting the assembly, sort out the stampings into their respective groups so that alternate shapes can be picked up easily and quickly, although there is no need to rush this part of the work. It is advisable to take a little time over the matter and see that the stampings are packed together in the proper manner and as tightly as possible. Sufficient material must be available, and used, to *fill* the core aperture of the bobbin, and a little light tapping is permissible to get the last two or three stampings in position, but don't go to the extremes and use sufficient force to cut into the bobbin.

Once a compact body has been built, clamping bars, preferably of metal, must be fixed in position across two sides of the assembly, these being held in position by nuts and bolts as indicated by Fig. 1. The bolts or threaded rod must be strong enough to allow a reasonable pressure to be exerted, as it is essential for the clamps to be really tight to prevent any possible vibration of the stampings. Pronounced hum can be introduced into radio apparatus by failure to attend to this item. The clamping strips can be bent at right angles at one end to form feet for fixing purposes if so desired.

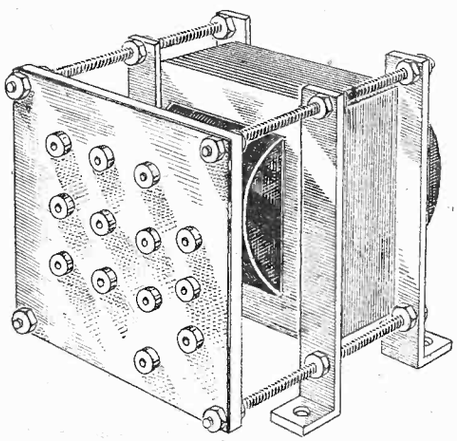


Fig. 1.—Showing how the clamping strips are made and fixed, and a suggestion for a terminal board.

Terminal Strip

Most experimenters find it more advantageous to fit a proper terminal strip for the connections to the various windings than to leave loose wire ends. This is to be recommended, as it not only allows frequent connections to be made to clearly marked points but it also removes the risk of the original wires breaking off, usually just inside the cheek of the bobbin, by the movement likely to be caused when connections are made or undone. Fig. 2 shows a simple method of mounting a terminal strip which should, of course, be made from reasonably stout insulating material. Ebonite about ⅛in. thick, or fibre ⅛in. thick, are the most suitable materials, as they are easy to work and have good insulating properties. The example shown makes use of sockets for the individual connections, but there is no reason why terminals should not be used, in fact they would, no doubt, provide an easier and quicker method for most experimenters.

Bobbins

Although these can be purchased, most constructors prefer to make their own according to the core and stampings being used. Providing a little care is taken in the selection of the material, its marking out and the actual construction, it is not so difficult as it might appear at first sight.

Cardboard, even when it is stiff and thick, is not satisfactory. It does not possess sufficient rigidity and, if it is thick enough to be strong, it makes a very clumsy looking bobbin. The best material is sheet prespahn or bakelised board, as these are strong, rigid and easy to work.

The centre of the bobbin should be marked out and cut as shown in Fig. 2, the dotted lines indicating the folding points which, to obtain a neat bend, should be scored with a penknife. Don't let the ends overlap, otherwise a pronounced bulge will be produced. If they butt together and, when the former is folded to shape, fit firmly into the cheeks, covered with a layer of empire cloth, a neat and strong job will be made.

The cheeks should just fit on to the ends of the centre former, but it is essential to see that all measurements *are* accurate. There are several good adhesives on the market for cementing all the parts together, but don't be too impatient over this part of the work, do give the adhesive time to set firmly.

Final Remarks

Whenever possible, meter tests should be applied to all windings, with and without current loads, before putting the transformer into active use. The voltage and current of the various windings should be checked and, if a meggar is available, insulation tests applied between all windings and the core and all windings.

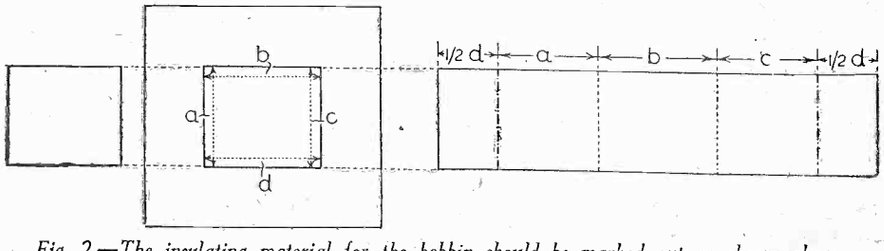


Fig. 2.—The insulating material for the bobbin should be marked out as shown above. Accurate dimensions are essential.

Radio in the Services

A Refresher Course for the Radio Mechanic—1

By Frank Preston

THE announcement, made in these pages a fortnight ago, that the R.A.F. were encouraging applications from those wishing to enrol as radio mechanics has created a considerable amount of interest among readers. Large numbers have inquired about the test which they will be asked to undergo should they apply for enrolment; most are anxious to have a fairly clear idea as to the standard of radio knowledge required. It is suggested that those who are interested should make inquiries at their local recruiting office, but it is possible to pass on the information obtained from representatives of the Royal Air Force.

Keen Constructors Encouraged

The main requirement is for keen amateurs and from those who have had some experience as service engineers. It is by no means essential that applicants should have an extensive knowledge of wireless theory, but they should have a fairly sound understanding of the fundamental principles. An ability to reason and apply logical methods of deduction are essential, but that is tantamount to saying that sound common sense, blended with a certain amount of experience in radio construction, testing and fault-finding, is required. The recruiting officer approached was anxious to make it clear that they are prepared to give earnest consideration to all applicants who can be classed as successful home constructors; naturally, additional ability is appreciated and will greatly increase the possibility of rapid promotion, with the consequential increase in pay.

A point which should not be overlooked is that all successful applicants will be given a course of training in the particular type of work which their duties will entail. This means, in effect, that the keen amateur will have an excellent opportunity to learn more about his hobby, so that he can turn it to successful account as a profession—first in the Services and later, no doubt, in civilian life.

Knowledge of the Superhet

It is not necessary here to go any more deeply into the question of prospects and requirements, for additional information can be obtained at any R.A.F. recruiting office. It will be better, instead, to consider the matter of the type of questions which may be asked. Quite naturally, it is impossible to state what questions will be asked, or even what questions previous applicants have been required to answer. But it is evident that a fair knowledge of the superhet is necessary; at least the recruiting officer with whom the matter was discussed laid emphasis on the superhet.

Those making application for enrolment as radio mechanics are required to pass a test. Success in this may mean immediate promotion. At the end of this article are some questions of a type which may be asked (it is not suggested that any of them have been asked) along with what can be considered suitable replies

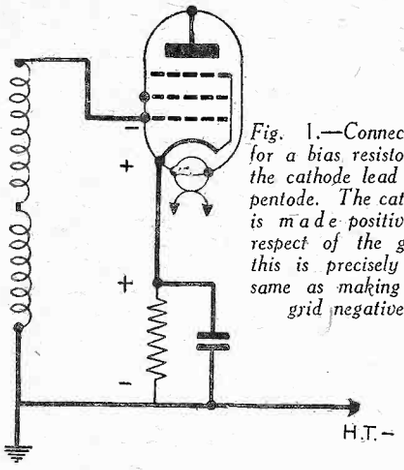


Fig. 1.—Connections for a bias resistor in the cathode lead of a pentode. The cathode is made positive in respect of the grid; this is precisely the same as making the grid negative.

That fact will, I know, tend to upset a few readers because there is still a small minority who look upon the superhet as a very complicated arrangement which is difficult to understand. The majority know that this idea is false.

Nevertheless, it is a fact that it is impossible to have anything like a sound knowledge of superhet operation if a simple "straight" circuit is not understood first, and if the underlying principles of design of all the widely-used components are not known. It would therefore be almost useless to commence an intensive study of the superhet before making quite sure that you have a fair working knowledge of simpler circuits.

Helpful Books

Obviously, it would not be possible in the course of two or three articles to pretend to give a complete course in wireless, and it is therefore suggested that those who wish to "start at the beginning" should obtain a copy of "The Practical Wireless Encyclopædia." Other books which will also be extremely useful are "Everyman's Wireless Book," "Sixty Tested Wireless Circuits" and "Coils, Chokes and Transformers." Any or all of these can be obtained from any bookseller or direct from The Publisher, George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2, who can also supply a catalogue of wireless books.

Instead of attempting to provide a complete course of instruction in this series, I shall simply ask and answer a number of questions which are, in my opinion, of a type which may be asked by the examining officer. The questions will not be graded in order of difficulty, or in any other order for that matter, but will be taken almost at random. It is not suggested that any reader who learned all the questions and answers by heart would stand the remotest chance of passing the examining officer. But I believe that any reader who can make an intelligent attempt at them would have excellent prospects. This is because to answer them the reader must know far more of his subject than is wrapped up in the actual answers. In reading the questions and suggested replies it should be found that many other points are brought to mind. Those points also should be settled without delay, preferably by working out a suitable answer and then by checking it by making reference to one of the books referred to above.

Some Questions and Answers

Let us start with a few fairly simple questions; others of a slightly more advanced nature will be given in later articles of this series.

How is grid-bias applied to an indirectly-heated valve, and how can the value of the bias resistor be found when the characteristics of the valve and its associated circuit are known?

Bias is obtained by making use of the voltage drop across a resistor included between the cathode of the valve and the earth or H.T.— line, as shown in Fig. 1. Since the H.T. current for the valve flows through the resistor, there is a drop in voltage or potential across it. The voltage is proportional to the value of the resistor, in ohms, and the current passing through it.

It is generally necessary to by-pass the resistor by means of a fixed condenser; this provides a free path for H.F. or audio-frequency currents. The condenser may have a value of about 1 mfd. for an H.F. or I.F. valve, but the value should be increased up to, say, 25 mfd. (electrolytic) for an L.F. valve.

The value of the resistor is found by dividing the required G.B. voltage by the anode current (expressed in amps.). Thus, if the required G.B. voltage were 10 and the total H.T. (anode plus screen) current were 8 mA. or 8/1,000 amp., the resistance should have an ohmic value of ten times 1,000/8, which equals 1,250 ohms.

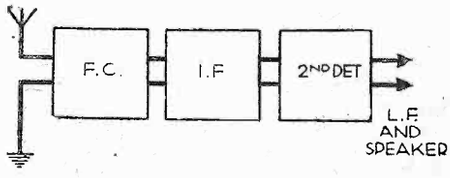


Fig. 2.—Essential parts of a superhet, where rectangles are used to indicate the stages.

What is meant by the term "intermediate-frequency amplification"?

This term, used in superhet practice, refers to amplification which takes place between the frequency-changer and the second detector (see Fig. 2). In a superhet the aerial or input circuit is tuned to the frequency of the signal being received,

(Continued on page 13)

Comment, Chat and Criticism

Listening to Music—2

Further Notes on How to Derive Pleasure and Instruction from Listening to Good Music, by Our Music Critic, MAURICE REEVE

UNQUESTIONABLY the greatest aid to the full understanding and comprehension of a work of music of any pretension—next to key—is a grasp of the plan, or form, to which it is written. Nothing can be entirely formless and at the same time intelligent. And the abstract qualities of music render this problem of even greater importance than usual—great as it is in all things. Naturally, the harmonic and melodic patterns and weavings are almost entirely ruled by the type of framework into which they are going to be fitted. A composer sets out to write a symphony or sonata just as a builder sets out to build a house. Not a note of the one or a brick of the other is laid until the plan has been decided upon and studied in the fullest detail. But owing to the "concrete" character of a house, and to our lifelong usage of it, as opposed to the "abstract" qualities of music, the house is to us as a language is, something which we can understand, and of which we can use the amenities. With a major work of music, however, it is, for the opposite reasons, impossible to find our way about it with any reasonable prospect of deriving either benefit or pleasure, without first studying the "plans" with a modicum of care.

"Sonata" form is a subject I hope to deal with shortly in a separate article. It is by far the most important of the forms, and is used for the construction of almost all the major works of music outside of opera and church music. Even a slight acquaintance with it will throw a beam of light on a symphony, sonata, or quartet that will rescue it for us from a veritable "black-out "and enable us to view it in the brilliant sunshine.

Rhythm and Accent

With form is linked up rhythm and accent, the construction of a phrase and of different types of phrases (themes, melodies, subjects, according to their character and allotted place in the scheme), and the recurring rhythmic pulse and accents.

A knowledge of harmony would complete, or round off, our knowledge of key as discussed in the last article. It takes us far beyond the mere recognition, anticipation and blending of keys as colours do the ability to trace a single line of notes (part or voice) through the texture. Then we follow two lines together and so on, until we hear the whole pattern as we would see one if looking at a carpet.

I think the facility for picking up these branches of listening (also the faculty to recognise the tones of the different instruments in an orchestra), will be greatly enhanced if the basic principle of key and key recognition are first mastered. The incentive will most certainly receive an added impetus and encouragement, because, when all is said and done, key *is* music. It is the heart and the core, and in thousands of cases it is the *only* thing that matters—in the small forms such as songs, carols, and ditties of all sorts. It is only when we begin to climb the ladder of, shall I say, musical sophistication, and its ever-enlarging horizons, that these other subjects, more especially form, enter.

I would like to conclude this brief sketch by getting back to its title, "Listening to Music." What we have done so far, as necessary here as anywhere, is to gather the material together essential for good, keen and intelligent listening; now enters that element which to many will seem the most urgent, the complete enjoyment of great music. "For," they may well say, "although you have helped us to understand the niceties of a symphony, and the polyphony of a quartet, you have not given us any guarantee that we will enjoy these things when we hear them. That is what we want the ability to do, rather than to criticise and be scholarly." True, my friends. You want to be like thousands are who watch cricket, who, whilst wishing to intelligently understand what is going on, don't wish to feel as though they were umpiring a test match. They want to browse on the grass round the boundary, quietly smoking, or drinking lemonade.

Mental Attitude

This will depend on the correct mental state we approach great music in, no matter how advanced or elementary our knowledge of it may be. It seems there are two requirements here. Firstly, never begin to listen to it in a totally unprepared frame of mind as you would always be when anything comes upon you unawares. Never be casual about it; always try to ascertain beforehand that it is taking place at such and such a time, and that you will be there. For, I am afraid, it is not a "hardy" plant which we can casually confront with pleasure, like so much of the entertainment we get nowadays. It is not entertainment at all. It is a forced, hot-house plant of the most exotic perfumes and colourings, and, like all such things, cannot stand the frequent icy blasts of casuality and promiscuity which surround many other art forms. The air which we frequently give to a radio item of "That sounds nice; we'll leave it on for a bit and see what it's like," is absolutely fatal. If, under such conditions, you should succeed in obtaining any mental reaction to the work at all, it would almost bound to be unfavourable. If, on the other hand, it should be favourable, this happy state would not be reached until the work was nearing its conclusion, upon which the effect would immediately evaporate. The result would of necessity be that, long before the next item had also been brought to an end, your favourable impressions of the former item would almost, if not entirely, have evaporated. Certainly your ability to retain even a slight recollection of a beautiful theme or other striking passage would be very small.

In fairness to the music, make adequate preparation for listening to it, and be certain that you will at least be in a mood and a frame of mind for appreciating it. You cannot enjoy excellent food or wine unless you are hungry for it, and it is the same with good music.

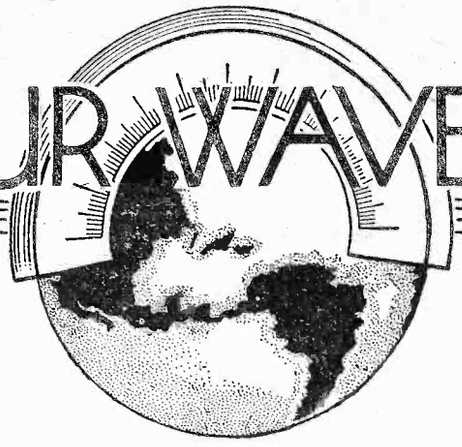
Secondly comes the all-important question of the proper frame of mind, or mental state, in which we should try to be when listening to good music. How should we approach the music? What should we look for in it or expect from it? Should we expect anything? You may reply that all this will depend on what the music is. We couldn't avoid looking on Beethoven's third symphony from even a slightly different angle than the one from which we view his seventh. And we certainly can't avoid thinking of Beethoven or Mozart in a very different light from Tschaikowsky or Ravel, and expecting something quite different from each.

Treating Music as Absolute

But I have, personally, always adopted the principle, and a few exceptions here and there will only serve to emphasise the general soundness of the idea. Treat all good music as "absolute," as I defined that word in a previous article. Certainly do not look for stories and programmes where none exist, or ever did exist. And even in such classic examples of programme music as Beethoven's Pastoral Symphony they are much more enjoyable and satisfying when divorced from their programme. At least, I find them so. I do not suggest for one moment that it is not helpful, as it is certainly interesting, to know of the story or motive which inspired the work. Even such an extraneous and unnecessary appendage as the "Napoleonic dedication to the Eroica Symphony" is helpful. But what I mean is this: forget all about Napoleon, cows, cuckoos or thunderstorms when listening to either of those works. Concerning the former, at any rate, the pastoral loveliness pervading every bar of it obtrudes itself with such an ample sufficiency that there should be no possible need for anyone to want to refer to their programme notes to see what it is all about.

Of course some works must stand or fall by the realism with which they portray what they set out to paint if for the very reason that they intended from the outset to do little else. Operatic music comes into this category. All Wagner's genius would not have been sufficient to place him in his pre-eminent position had he failed to sweep us off our feet with the marvellous realism of his canvases. The Venesbury music, the "Ride of Valkyries," and a hundred other examples, are as vivid as any painting, providing we know the story they set out to portray. They are the supreme examples of programme music, unmatched in their ability to transport us to the scenes and places they describe. But the fact that they do this to millions of people whilst listening to them in the concert hall, without any aid whatever from scenery, costume or words, is surely proof positive that *all* music can, and should, be listened to as I have tried to advocate in this article.

ON YOUR WAVELENGTH



By Thermion

The QSL Exchange

YOU will remember that I raised the question some weeks ago of the QSL exchange. I expressed the opinion that it was unfair for a reader to adorn his den with verification cards which he had not obtained in the orthodox way, but merely by exchanging them with other short-wave fans. I said that a den so adorned was intended to give the impression that the owner of the den himself had received programmes from the stations represented, and had obtained verifications. Thus the whole value of the verification card was lost.

Since that time both sides have expressed their views in the correspondence page, and we have received about an equal quantity of letters from those in favour and from those against. I am asked to exercise my casting vote, and I now say that the motion that we should continue to publish requests for QSL exchanges is lost. Therefore, will readers please note that we cannot publish further offers to exchange. It is not my wish that the QSL card shall have no greater value than a cigarette picture.

Wireless as a Profession

THE recent broadcast appeal for those with technical knowledge of radio to join the new wireless trade created in connection with the Services has produced to date nearly 15,000 applications. Our recent survey of radio careers was a much-appreciated feature, and we are still receiving large numbers of letters from readers who want to enter the radio trade as a profession, or to study for it. The suggestion has been made that we should run a regular feature dealing with radio careers. I therefore invite the opinion of my readers on this suggestion so that I can lay mass evidence, if any, before the Editor.

I understand that a large number of those who have already applied for the vacancies which have been advertised are readers of this journal, who have paid graceful and grateful tribute to the Editor and for the technical knowledge supplied by PRACTICAL WIRELESS and the technical books we issue in connection with it. Those who wish to obtain a first-class knowledge of radio cannot do better than study our series of handbooks which include "The Practical Wireless Encyclopædia" (now, unfortunately, increased in price to 7s. 6d., but worth ten times the price), "The Practical Wireless Short-wave Manual," "Everyman's Wireless Book," "The Short-wave Manual" (a new volume), "Wireless Transmission for Amateurs" (now increased in price to 3s. 6d.), "Wireless Coils, Chokes and Transformers," "Sixty Tested Wireless Circuits," "Television and Short-wave Handbook," "Workshop Calculations, Tables and Formulæ," and "The Practical Mechanics Handbook." A catalogue of our technical books will be sent free to any reader applying to the Manager of the Book Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Those engaged in the manufacturing side should certainly take each week our new companion weekly, *Practical Engineering* (4d. every Thursday).

Distortion

ONE of the queries which frequently arises in letters addressed to me personally concerns the cure and forms of distortion. For perfect reproduction the sound issuing from the loudpseaker should be an aural replica of what is taking place in the broadcasting studio. When this fails to happen, as judged by a critical ear, or by movements of a tell-tale needle inserted at correct points in the power feeds, distortion is taking place. It is not generally believed that the high-frequency section of a wireless receiver is often the cause of distortion blamed on the low-frequency side. The introduction of so many high-powered broadcasting stations has made the question of selectivity rather an acute one. When a station is sending out speech or music it broadcasts, in addition to the carrier wave, other frequencies which are known as sidebands. These are spaced equally on either side of the carrier frequency, and may extend as far as 7,000 to 8,000 cycles either side.

A receiver of the ordinary type boasting of razor-edge selectivity cuts off a large section of these sidebands, or at least reduces their amplification to such an extent that they compare very unfavourably with the amount of amplification accorded to the lower frequencies. Anyone musically inclined will realise that the higher frequencies bring about the brilliance or timbre, and if they are not present, then quality must to a certain extent be reduced.

If the constructor of a wireless receiver finds himself in a cleft stick, owing to his desire for adequate selectivity without cutting sidebands, he can adopt what has come to be known as band-pass tuning.

In the modern arrangement we have three main types. In every case it will be noticed that there are two tuned circuits, and energy is transferred from one circuit to the other by a mutual magnetic interaction, a coil common to both tuned circuits, or a carefully controlled capacity coupling.

The frequency response of each circuit is thus combined, and it is possible to make the complete circuit accept frequencies over quite a wide range and almost wholly reject the others. In other words, brilliance and reproduction are maintained, together with selectivity.

Another very marked cause of distortion is the use of "shoddy" components of doubtful origin. Too often is a set blamed for distortion when the fault is located in the fact that it is being starved of its H.T.

Returning now to the question of frequency distortion, the items chiefly responsible for this are the methods of coupling between the valves and the loudspeaker itself. Taking the first-named, it must be remembered that if L.F. transformers are employed, the primary or input winding must have an adequate primary inductance. This does not necessarily mean that the transformer with the largest size is going to give the best results. Modern development has produced transformer cores which are quite small compared to the early types. It is also necessary to maintain the inductance high even when quite large anode currents from the valve pass through the primary winding, so in this case it is necessary to learn whether a manufacturer guarantees the inductance in henries to be a certain value up to a given current, and then take steps not to exceed that current.

With inadequate primary inductance in transformers, there will be a loss of the bass frequencies, so that even if you have the most perfect sound reproducer coupled to the set, if the bass frequencies are lost they will not be heard from the loudspeaker.

Wireless for the Blind Fund

IT is interesting to note that during the ten years since its inception in 1929 to the end of last October, nearly £166,000 had been collected for the British Wireless for the Blind Fund. Of this sum, £151,500 was expended on sets and accessories for blind listeners, and there was a balance of nearly £2,000 in hand.

All sets provided by the Fund, says the annual report, are of modern loudspeaker type. Their distribution is carried out by 150 local welfare agencies.

B.B.C. Handbook for 1940

THE B.B.C. is taking its part in the dissemination of news all over the world in counteracting falsehood, in helping to make known the British point of view, but there is another side to the radio war. The B.B.C.'s war-time job is also to learn what is being said about Britain by others. It has to listen night in, night out, to the "news" and the propaganda broadcast from Germany and it has also to keep track of what neutral countries are thinking. The B.B.C. is not only the Voice of Britain; it has become the Ear of Britain. An article entitled "Listening Post, 1939," in the B.B.C. Handbook for 1940, which was published on March 4th, traces the growth of the new Monitoring Service which records, translates, summarises and distributes daily some two hundred broadcasts in twenty-five languages.

Listeners who are interested in the story of events behind the microphone can obtain the B.B.C. Handbook from booksellers and bookstalls, or direct from the B.B.C. Publications Department, The Grammar School, Scarle Road, Wembley, Middlesex, or on application to any Regional Office. Its price is two shillings, or 2s. 4d. by post.

Headphone Listening

Precautions to be Taken When Using Headphones with a Mains Set, and Points About Matching

IN the earlier days of radio headphones were the only practicable means of reproduction, since the power output of the set was too small for any other means. As loudspeakers became more efficient and less costly, headphones passed out of general use. The disadvantage of being tied to the set by 'phones contributed to their displacement, since several

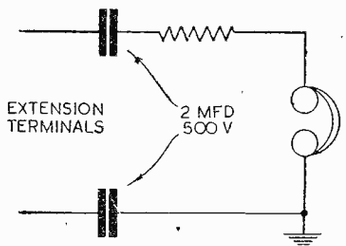


Fig. 1.—One method of phone isolation, with high impedance extension.

people could listen simultaneously to a speaker.

There are, nowadays, many circumstances in which the use of headphones is an advantage. Some people may switch off the set because of the nuisance caused to others who may not want to listen. Again, for a deaf person to hear in comfort, the volume level of the set speaker must be raised to a level unbearable for those with normal hearing. As shown by the Queries Section of this journal there are many people wanting a safe and efficient method of using headphones with their sets.

Precautions To Be Taken

The connection of 'phones to any set is subject to several important precautions, especially if the set is mains operated. Indiscriminate connection is highly dangerous and must be rigorously discouraged.

The chief precaution to be taken is against the risk of shock to the wearer of the 'phones, due to the contact of the metal headband or other metal parts of the 'phones with the listener's head. It is essential to earth efficiently one side of the 'phones, so that the voltage at the earpieces cannot rise to a dangerous value. For this to be done the 'phones must be isolated from the set. The two methods recommended for this are shown in Figs. 1 and 2. Either condensers are used, one 2 mfd. 500 volts working at least in each lead, or, better still, a transformer of suitable ratio is fitted between the 'phones and the output from the set. Two condensers should be used, since in some A.C.-D.C. sets a mains leakage may occur across some internal component in the set, or it may not be possible to earth one side of the speaker circuit. The transformer method is the better: the transformer used should be dependable and efficiently insulated.

Matching 'Phones To Set

It is desirable for the apparent volume from the 'phones to be the same as that from the speaker, so that the two units may be used simultaneously. It is more difficult to match 'phones to the set than it is to match extension speakers, where it is merely a question of matching impedances. With 'phones the impedance does not concern us; but only a fraction of the power output is required, and so if the 'phones are used alone the surplus power must be dissipated in some way. The volume of the speaker and 'phones varies with their sensitivities, and so the following details are not critical, but will give good results with average units.

The most readily accessible place for any connection to the set is the extension speaker socket. Here any output impedance from 1 ohm to about 20,000 ohms may be encountered.

If the output is of high impedance, then either a suitable step-down transformer between 'phones and the output, or else a high resistance in series with the 'phones will be needed to reduce the volume to bearable limits. To give a typical case, a battery output pentode of impedance about 11,000 ohms would need a step-down transformer of ratio 7-1 to match 'phones of 4,000 ohms overall resistance. If the

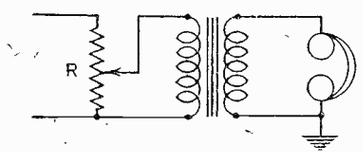


Fig. 3.—Volume control circuit for either high or low impedance extensions. For impedance Z value of R=2Z ohms.

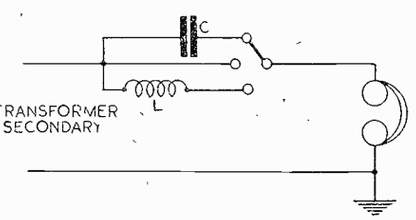
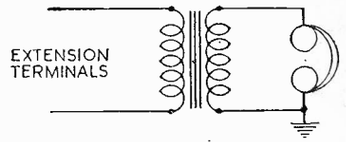


Fig. 4.—Simple type of tone control for use in conjunction with Fig. 2.
C .01 to .1 mfd.
L .3 to 12 henries.

other method is used a 500,000 ohm variable resistance is suitable. This serves as a rough volume control.

The extension impedance is commonly of the order of 5 ohms. For 'phones of 4,000 ohms a step-up transformer of ratio about 3-1 will serve.

If 7.5 or 15 ohm impedances are required, then a transformer of ratio 1-1 will be suitable. Here it is advisable to reduce the overall resistance of the 'phones from



LOW IMPEDANCE EXTENSION – STEP UP
HIGH IMPEDANCE EXTENSION – STEP DOWN

Fig. 2.—An alternative method of phone isolation, with low impedance extension.

4,000 ohms to 1,000 ohms by changing them from the usual series connection to parallel. In doing this care must be taken that the two positive and the two negative 'phone terminals respectively, are connected together. Otherwise the sounds fed to each ear will be out of phase, with unpleasant results.

For high impedance extensions the transformer ratio is roughly $\sqrt{\frac{Z.}{200,}}$ and for low impedance extensions is $\sqrt{\frac{200}{Z,}}$ where Z is the extension impedance.

For high impedance a step-down, and for low impedance a step-up, transformer is used.

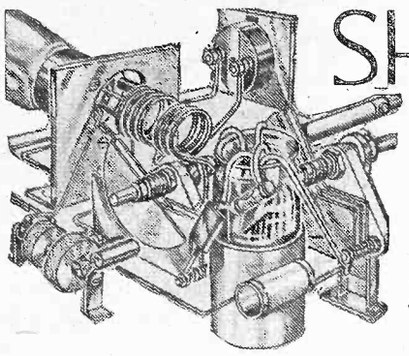
The ratio is not very critical, and may even be twice or half as much.

'Phones Used Alone

It has been assumed so far that the load on the output stage is being maintained by the connection of either the set speaker, or some extension simultaneously with the 'phones. If the 'phones alone are to be connected, as may frequently be the case, some means of dissipating the unwanted power is to be incorporated. The primary or secondary of the 'phone transformer is shunted by a suitable resistance, and since this must be capable of dissipating the full power output of the set, it is best placed across the primary of the transformer. It should be of about 3 or 5 watts rating. Here again the value of the resistance is not critical, but it should be about twice the extension impedance value. A potentiometer is used, this also serving as a volume control for the 'phones. Fig. 3 shows a suitable arrangement for both high and low impedance extensions. This will give a range of volume both below and above the set speaker volume, whether speakers are connected simultaneously or not. The 'phone transformer need not be expensive; since its power handling capacity is small, a midget type will be suitable.

Tone Control

Since the normal tone controls of the set will work just as well with 'phones as with the set speaker, there is no need to fit any additional control for the normal listener. The frequency range of normal 'phones is not wide, but with a transformer of suitable ratio most people will be satisfied by the quality of reproduction. If some degree of tone control is required, however, and deaf persons may need either bass or treble lift, this is easily incorporated as shown in Fig. 4. With low impedance extension, a transformer of higher step-up, and with high impedance one of lower step-down, ratio than usual is used, with an inductive or reactive network between the 'phones and the transformer secondary. Experiment must determine the best values of the components for individual requirements. The condenser capacity may be .01 to .1 mfd., and the choke .3 to 12 henries. The 'phones should be paralleled as described before to give a resistance of 1,000 ohms, since then the effect of the inductive impedances will be improved.



SHORT-WAVE SECTION

SHORT-WAVE REACTION EFFICIENCY

Points Which Underline the Design of an Effective Reacting Detector Circuit

By W. J. DELANEY

MANY listeners attempt to use a simple single-valve set for short-wave work and succeed in obtaining only a few long-distance stations. Others, as may be seen from the extensive logs published in our correspondence columns from time to time, succeed with a similar simple set in obtaining signals from the farthest ends of the earth. In many cases, of course, local conditions and existing climatic conditions will play a large part in the performance of a receiver, but with a simple detector stage the efficiency of the reaction circuit is of the utmost importance. A detector valve without reaction is very little better than a crystal receiver, but when reaction is applied the results are comparable with the addition of a good H.F. stage to the crystal. Owing to the peculiar working of reaction circuits, however, very few listeners realise how valuable this part of the set can prove. The reaction control should operate exactly the same as an L.F. volume control in a receiver, building up signal strength gradually, and just as smoothly taking the set out of oscillation. But how often is this effect found? Try the control on your receiver, with the set tuned to a very weak distant station. What do you find? Probably, as the control is turned the signal builds up and suddenly there is a "plop" as the set goes into oscillation. What happens then? You turn the control in the opposite direction until the set comes out of oscillation, and when this has been accomplished you have a given signal strength. But on advancing the reaction control again you can obtain an increase to the point where the oscillation occurs. But owing to the overlap, or backlash as it is called, you find you have to try three or four times before you can get the reaction control to the exact point where signals are at maximum and oscillation or howling does not set in.

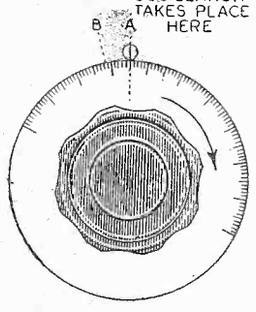


Fig. 1.—Reaction backlash is shown by an overlap of the control. Oscillation should cease at the same point as that at which it commences.

Threshold Howl

This overlap is indicated in Fig. 1, where the point of oscillation on an imaginary dial is indicated and the point to which the control has to be turned to stop oscillation is also shown. The ideal condition is that where the same movement of the control is needed to take the set out of oscillation as is needed to take it into oscillation. This can be accomplished quite easily. Before dealing with the effects and the cure, however, there is another trouble which is often experienced in a reaction circuit, and that is where as soon as the set has broken into oscillation as already mentioned a high-pitched howl also sets in, and cannot be stopped until the set has been taken out of oscillation. This, from the fact that you are trying to work on the "threshold of oscillation," and that a howl is set up, gives rise to the term "threshold howl," and also is fairly easily cured.

Detector Anode Circuit

To understand fully the causes of the two effects just described, let us look at the anode circuit of the detector valve. There will usually be an H.F. choke connected direct to the anode, and then, between the low-potential end of the choke and the H.T. supply there will be a pair of 'phones, a transformer primary or a resistance—dependent upon the type of receiver in use. Across the choke and the anode component, whatever it may be, there will be a voltage drop, dependent upon the anode current of the valve. If, now, you include a milliammeter in the anode circuit of a valve which is provided with a reaction control, you will see that with no reaction there will be a steady anode current reading dependent upon the H.T. voltage and the particular characteristics of the valve. If, now, the reaction control is set hard over, so that the valve oscillates, you will find that the anode current reading has fallen. This is, in fact, the method of testing for oscillation, as by earthing the grid of the valve, by touching it with the finger, the oscillation will cease and the meter needle will rise to the original reading, or a point very near it. Now from standard electric formulæ we know that the voltage drop across a resistance is dependent upon the current flowing through it, and the greater the current, the greater the voltage drop, or the difference in potential between the ends of the resistance.

From this it will therefore be obvious that under certain conditions there will be a given anode voltage applied to the detector valve, but as reaction is advanced and the valve passes into an oscillating condition, the actual voltage applied to the anode will vary, the H.T. voltage *increasing* as reaction increases, due to the lowered anode current and the consequent reduced voltage drop across the anode load. There is thus a double effect on the valve. Whilst you are increasing the coupling between the anode and grid—or, in other words, increasing reaction—the H.T. is automatically increasing and the two combine to produce the sudden bursting into oscillation already referred to. Turning back the reaction control does not reduce the oscillation until a large adjustment has been made, as it has no effect on the H.T. whilst the oscillation is taking place, and thus a relatively large movement is necessary to produce stability, and this is at a point beyond that at which the set went into oscillation.

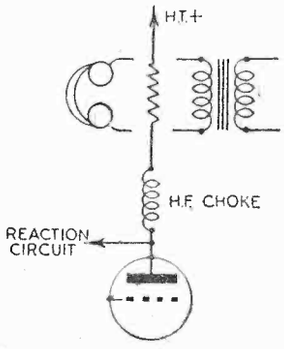


Fig. 2.—Typical anode circuit indicating the components which are found there. This explains the reasons for threshold howl.

Cures

The threshold howl is due to the fact that when the valve bursts into oscillation a momentary change in anode current takes place and this stops the oscillation, but the reaction control is in such a position that the change in the H.T. voltage due to the cessation of oscillation again causes a condition of oscillation, which just as quickly ceases again. This oscillation and stopping takes place fairly rapidly and produces the howl already referred to. It is obvious from these remarks that the first and most important factor to be watched is the H.T. voltage applied to the anode. This must be of such a value that the changes which take place due to the oscillation have the least effect. The voltage varies according to the valve, and tests may have to be carried out to find the best working voltage, although the valve-makers usually give the necessary value on their data sheets. Next, the value of the grid leak and condenser must be so selected that the working point on the curve of the valve also takes up a position where the effects just mentioned are at a minimum. Thus, there are three essential points to be watched—H.T., value of grid leak, and grid condenser. A little experiment should enable suitable values to be found where, with the particular valve in use, the valve goes smoothly into oscillation and just as smoothly slides out.

NEW SERIES

RADIO ENGINEER'S POCKET-BOOK

No. 23.

INTERNATIONAL "Q" CODE

Abbrev.	Question	Answer for Advice
QRA	What is the name of your station ? ...	The name of my station is . . .
QRB	How far approximately are you from my station ?	The approximate distance is . . . miles
QRD	Where are you bound and where are you from ?	I am bound for . . . from . . . .
QRG	Will you tell me my exact frequency in kilocycles ? ...	Your exact frequency is . . . kc
QRH	Does my frequency vary ?	Your frequency varies.
QRI	Is my note good ? ...	Your note varies.
QRJ	Do you receive me badly ?	I cannot receive you.
	Are my signals weak ?	Your signals are too weak.
QRK	Do you receive me well ?	I receive you well.
	Are my signals good ?	Your signals are good.
QRL	Are you busy ? ...	I am busy. Please do not interfere.
QRM	Are you being interfered with ? ...	I am being interfered with.
QRN	Are you troubled by atmospherics ? ...	I am troubled by atmospherics.
QRO	Shall I increase power ?	Increase power.
QRP	Shall I decrease power ?	Decrease power.
QRQ	Shall I send faster ?	Send faster (. . . words per minute).
QRS	Shall I send more slowly ?	Send more slowly (. . . words per minute).
QRT	Shall I stop sending ?	Stop sending.
QRU	Have you anything for me ?	I have nothing for you.

No. 24.

INTERNATIONAL "Q" CODE

Abbrev.	Question	Answer for Advice
QRV	Are you ready ? ...	I am ready.
QRX	Shall I wait ? When will you call me again ?	Wait (or wait until I have finished communicating with . . .) I will call you at . . . GMT.
QRZ	Who is calling me ?	You are being called by . . . .
QSA	What is the strength of my signals ? (1 to 5)	The strength of your signals is . . . (1 to 5).
QSB	Does the strength of my signals vary ?	The strength of your signals varies.
QSD	Is my keying correct? Are my signals distinct ?	Your keying is indistinct. Your signals are bad.
QSL	Can you give me acknowledgment of receipt ? ...	I give you acknowledgment of receipt.
QSM	Shall I repeat the last telegram (message) I sent you ? ...	Repeat the last telegram (message) you have sent me.
QSO	Can you communicate with . . . direct (or through the medium of . . .) ? ...	I can communicate with . . . direct or through the medium of . . .).
QSP	Will you retransmit to . . . ?	I will retransmit to . . .
QSV	Shall I send a series of V's ?	Send a series of V's.
QSX	Will you listen for . . . (call sign) on . . . kc ?	I am listening for . . . (call sign) on . . . kc.
QSZ	Shall I send each word or group twice ? ...	Send each word or group twice.
QTH	What is your position in latitude and longitude ?... ...	My position is . . . latitude . . . longitude.
QTR	What is the exact time ?	The exact time is . . .

No. 25.

MISCELLANEOUS INTERNATIONAL ABBREVIATIONS

Abbrev.	*Meaning*	*Abbrev.*	*Meaning*
C	... Yes	GA	... Resume sending
N	... No	MN	... Minute/minutes
W	... Word	NW	... I resume transmission
AA	... All after		
AB	... All before	OK	... Agreed
AL	... All that has just been sent	UA	... Are we agreed ?
		WA	... Word after . . .
BN	... All between	WB	... Word before . . .
CL	... I am closing my station	XS	... Atmospherics

AMATEUR ABBREVIATIONS

Abbrev.	*Meaning*	*Abbrev.*	*Meaning*
ABT	... About	FM	... From
AGN	... Again	GA	... Go ahead, or Good afternoon
ANI	.. Any		
BA	... Buffer amplifier	GB	... Good-bye
BCL	... Broadcast listener	GE	... Good evening
BD	... Bad	GM	... Good morning
BI	... By	GN	... Good night
BK	... Break in	HAM	... Radio amateur
BN	... Been	HI	... Laughter
CK	... Check	HR	... Hear, or here
CKT	... Circuit	HRD	... Heard
CLD	... Called	HV	... Have
CO	... Crystal oscillator	LTR	... Later
CUD	... Could	MILS	... Milliamperes
CUL	... See you later	MO	... Mater Oscillator
DX	... Long distance	ND	... Nothing doing
ECO	... Electron-coupled oscillator	NIL	... Nothing
		NM	... No more
ES	... And	NR	... Number
FB	... Fine business (good work)	NW	... Now
		OB	... Old boy
FD	... Frequency doubler	OM	... Old Man
OT	... Old timer	TNX	... Thanks
PA	... Power amplifier	TPTG	... Tuned plate tuned grid
PSE	... Please		
R	... Received all sent	TX	... Transmitter
RAC	... Rectified A.C.	U	... You
RCD	... Received	UR	... You are
RX	... Receiver	VY	... Very
SA	... Say	WDS	... Words
SED	... Said	WKG	... Working
SIGS	... Signals	WL	... Will
SIGN	... Signature	WUD	... Would
SSS	... Single Signal superheterodyne receiver	WX	... Weather
		YF	... Wife
		YL	... Young lady
SKD	... Schedule	YR	... Your
TKS	... Thanks	73	... Kind regards
TMN	... To-morrow	88	... Love and kisses

No. 26.

QSA CODE (Signal Strength)

QSA1 .. Hardly perceptible; unreadable.
QSA2 .. Weak, readable now and then.
QSA3 .. Fairly good; readable, but with difficulty.
QSA4 .. Good; readable.
QSA5 .. Very good; perfectly readable.

QRK CODE (Audibility)

R1 .. Faint signals; just readable.
R2 .. Weak signals; barely readable.
R3 .. Weak signals; but can be copied.
R4 .. Fair signals; easily readable.
R5 .. Moderately strong signals.
R6 .. Good signals.
R7 .. Good strong signals.
R8 .. Very strong signals.
R9 .. Extremely strong signals.

RST CODE (Readability)

1 .. Unreadable.
2 .. Barely readable, occasional words distinguishable.
3 .. Readable with considerable difficulty.
4 .. Readable with practically no difficulty.
5 .. Perfectly readable.

(Signal Strength)

1 .. Faint, signals barely perceptible.
2 .. Very weak signals.
3 .. Weak signals.
4 .. Fair signals.
5 .. Fairly good signals.
6 .. Good signals.
7 .. Moderately strong signals.
8 .. Strong signals.
9 .. Extremely strong signals.

(Tone)

1 .. Extremely rough hissing note.
2 .. Very rough A.C. note, no trace of musicality.
3 .. Rough, low-pitched A.C. note, slightly musical.
4 .. Rather rough A.C. note, moderately musical.
5 .. Musically modulated note.
6 .. Modulated note, slight trace of whistle.
7 .. Near D.C. note, smooth ripple.
8 .. Good D.C. note, just a trace of ripple.
9 .. Purest D.C. note.

(If the note appears to be crystal-controlled add an X after the appropriate number).

No. 27.

INTERNATIONAL MORSE CODE.

A	dit dah	· –
B	dah dit dit dit	– · · ·
C	dah dit dah dit	– · – ·
D	dah dit dit	– · ·
E	dit	·
F	dit dit dah dit	· · – ·
G	dah dah dit	– – ·
H	dit dit dit dit	· · · ·
I	dit dit	· ·
J	dit dah dah dah	· – – –
K	dah dit dah	– · –
L	dit dah dit dit	· – · ·
M	dah dah	– –
N	dah dit	– ·
O	dah dah dah	– – –
P	dit dah dah dit	· – – ·
Q	dah dah dit dah	– – · –
R	dit dah dit	· – ·
S	dit dit dit	· · ·
T	dah	–
U	dit dit dah	· · –
V	dit dit dit dah	· · · –
W	dit dah dah	· – –
X	dah dit dit dah	– · · –
Y	dah dit dah dah	– · – –
Z	dah dah dit dit	– – · ·

Number Code

1	dit dah dah dah dah	· – – – –
2	dit dit dah dah dah	· · – – –
3	dit dit dit dah dah	· · · – –
4	dit dit dit dit dah	· · · · –
5	dit dit dit dit dit	· · · · ·
6	dah dit dit dit dit	– · · · ·
7	dah dah dit dit dit	– – · · ·
8	dah dah dah dit dit	– – – · ·
9	dah dah dah dah dit	– – – – ·
0	dah dah dah dah dah	– – – – –

Note of interrogation	dit dit dah dah dit dit	· · – – · ·
Note of exclamation	dah dah dit dit dah dah	– – · · – –
Apostrophe	dit dah dah dah dah dit	· – – – – ·
Hyphen	dah dit dit dit dit dah	– · · · · –
Fractional bar	dah dit dit dah dit	– · · – ·
Brackets	dah dit dah dah dit dah	– · – – · –
Inverted commas	dit dah dit dit dah dit	· – · · – ·
Underline	dit dit dah dah dit dah	· · – – · –
Prelim. call	dah dit dah dit dah	– · – · –
Break sign	dah dit dit dit dah	– · · · –
End message	dit dah dit dah dit	· – · – ·
Error	dit dit dit dit dit dit dit dit	· · · · · · · ·

No. 28.

INTERNATIONAL AMATEUR CALL-SIGNS

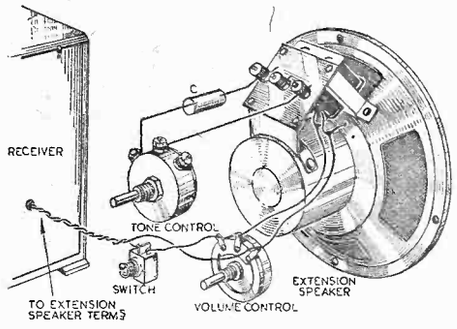
AC4	Tibet	FU	French New Hebrides
AR	Syria	FY	Guyane (French Guiana)
CE	Chile		
CM	Cuba	G	British Isles (G-England ; GM-Scotland ; GW-Wales)
CN1	Tangier Zon.		
CN8	Morocco		
CO	Cuba (fone)		
CP	Bolivia	GI	North Ireland
CR4	Cape Verde Islands	HA	Hungary
CR5	Portuguese Guinea	HB	Switzerland
CR6	Angola	HC	Ecuador
CR7	Mozambique	HH	Haiti
CR8	Portuguese India	HI	Dominican Republic
CR9	Macao		
CR10	Timor	HK	Colombia
CT1	Portugal	HP	Republic of Panama
CT2	Azores		
CT3	Madeira Island	HR	Honduras
CX	Uruguay	HS	Siam
D	Germany	HZ	Hedjaz
EA	Spain	I	Italy
EA6	Balearic Islands	J	Japan
EA8	Canary Islands	J8	Chosen (Korea)
EA9	Spanish Morocco	J9	Formosa
EI	Irish Free State	K4	Virgin Islands
EL	Liberia	K5	Canal Zone
EP	Iran (Persia)	K6	Hawaii
EQ	Iran (Persia)	K6	Guam
ES	Estonia	K6	Samoa
ET	Ethiopia (Abyssinia)	K6	Midway and Wake Islands
F	France	K7	Alaska
FA	Algeria	KA	Philippines
FB	Madagascar	LA	Norway
FD	French Togoland	LU	Argentina
FE	French Cameroons	LX	Luxembourg
FF	French West Africa	LY	Lithuania
FG	Guadeloupe	LZ	Bulgaria
FI	French Indo-China	MX	Manchukuo
FK	New Caledonia	NY	Canal Zone
FL	French Somaliland	OA	Peru
FM	Martinique	OE	Austria
FN	French India	OH	Finland
FO	French Oceania	OK	Czechoslovakia
FP	St. Pierre and Miquelon	OM	Guam
		ON	Belgium
FQ	French Equatorial Africa	OQ5	Belgian Congo
		OX	Greenland
FR	Reunion Island	OY	Faroe Islands
FT	Tunisia	OZ	Denmark

Practical Hints

Speaker Volume Control

DURING my experiments I found the necessity for a tone control, volume control, and switch on each low-impedance extension speaker, so I connected them as in the diagram below.

I have not seen low-impedance speakers



A volume control arrangement for an extension speaker.

connected like this, and I believe it is original. The volume control can be varied according to the impedance of the speech coil.—R. JOHNSON (Yatesbury).

Adjustable Nut Tweezers

ONE of the troubles that I find particularly annoying when "doctoring" a wireless chassis is that when replacing a component on the chassis after testing, bolts are sure to slip and fall on to the chassis, so that it either has to be turned upside down or the missing bolts have to be fished for with a pair of long-nosed pliers, which, owing to their breadth, cannot always be used in the limited space in a wireless chassis.

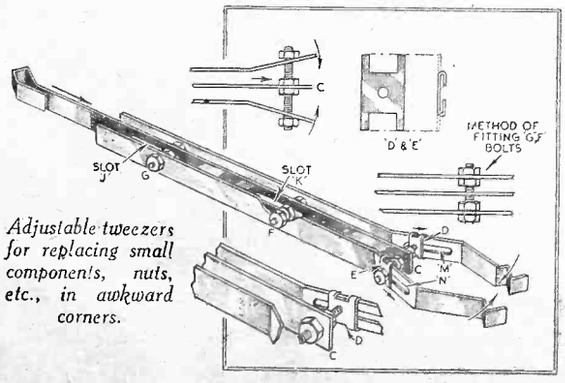
I decided to cure this trouble and have evolved an instrument of reasonable efficiency, the design of which I enclose.

The instrument itself should be constructed of some fairly thick metal which has some degree of springiness. The two pieces of metal marked D and E are of thin tin, and are bent over the strips, so as to form sliding collars.

The size of the holes drilled depends on the size of the threaded bar used, so is not marked in sketch.

The width between the jaws is controlled by the middle bar, which is moved backwards and forwards between the two outer bars. The distance between the two pairs of bolts at F and G, which keep the two outer bars rigidly connected, should be just enough to allow the middle bar to slide smoothly. The longest of the three bars at the extreme end of the strip C should be about an inch long and should be rigidly connected at the middle to the strip C, while the ends should be passed through the bolt holes in the tin collars and anchored outside by bolts, the loosening and tightening of which controls the width between the jaws.

The best way of making the inch-long slots at J, K, M, and N is to drill a row of holes close together after which the burr should be filed down.—J. R. WOOD (Aberdeen).



Adjustable tweezers for replacing small components, nuts, etc., in awkward corners.

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SPECIAL NOTICE

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

A Station Indicating Extension Speaker System

HAVING built a new radiogram, using the original receiver chassis only, it occurred to me that it would be well worth while converting the original receiver cabinet into a self-indicating extension speaker, retaining the original appearance by keeping the control knobs as they were.

To carry out this idea properly, I decided that some sort of remote control scheme was necessary with regard to the station indicating lights, this being effected by simply attaching an extension shaft to the receiver tuning condenser, a simple ebonite cam and contact assembly being incorporated on this shaft.

A separate switch was fitted to the receiver to interrupt the extension lighting arrangement, and in view of the short leads between the receiver and the extension speaker, very little voltage drop occurred through the resistance of the flex, the leads being taken through the skirting boards and wall, as is depicted in the inset drawing.

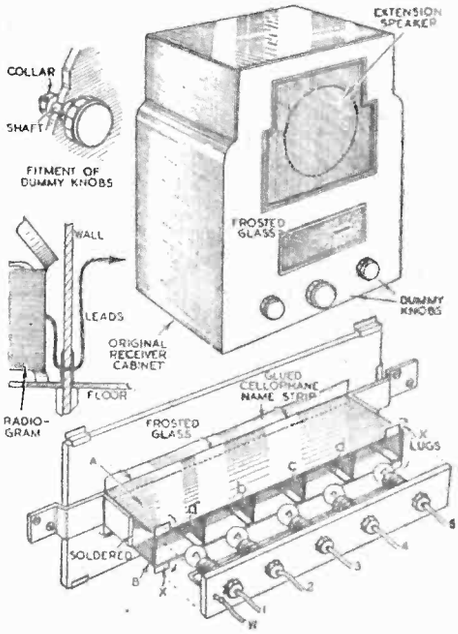
The diagrammatical illustration shows the method I adopted for the station indicating lights in the extension speaker cabinet, and the following is briefly the way it is constructed.

The housing for the bulbs comprises two tin strips "A" and "B," these having been bent to form a box when soldered together. Into this box I soldered four separating pieces of tin, as indicated by a, b, c and d.

An ebonite strip provides the mount for the five bulbs which, by the way, are 2 volt .06a type: this ebonite strip is finally secured to the housing by bending over the tin lugs provided, and indicated by "X."

Each bulb holder is fitted with a 6BA screw nut and shakeproof washer, the connections 1-5 being made by soldering, whilst a common contact "W" is made by soldering a length of heavy gauge copper wire across all holders. The housing is secured to the inside of the cabinet by two brass angle strips, these being soldered to the housing, as shown.

The knobs are rendered dummy by using short lengths of ¼in. brass rod, brass



A novel method of station indication for an extension speaker system.

collars securing these internally, as illustrated. The use of thick frosted glass gives a really attractive appearance, enhanced by the station lighting, the names of the stations being printed in indian ink on a Cellophane strip, as depicted.—J. L. HARBURN (Loughton).

FURTHER STEPS T

A New Receiver Using Direct C

IT is refreshing to note that in war-time a deep interest is still being taken in high-quality reproduction, and that designers are paying careful attention to both the amplifier and the loudspeaker.

The object of this article is to call attention to a simple yet effective method of coupling low-frequency valves with a view to attaining a really high standard of reproduction. For gramophone work I do not think it can be excelled, but it especially commends itself to those who wish to obtain the best possible results from the B.B.C. Home Service transmissions.

Before describing the amplifier, I feel it necessary to say a word on the subject of linear rectification of radio signals. The diode is still very popular with high-quality enthusiasts, but there are numbers of listeners who are unable to load the diode sufficiently; that is, the signal input is not enough to ensure linear rectification even with the assistance of a stage of high-frequency amplification. If the high-frequency amplifier is developed beyond a certain point of efficiency, distortion is inevitable. The leaky-grid detector is sensitive but is easily overloaded, while anode-bend detection introduces its own form of distortion. The negative feed-back detector requires skilful design and complicates the circuit unduly. What is left? There is the crystal, to which many of us are still attached; but the crystal does not like a big input, and we may very easily fall between two stools, with the crystal on the one hand overloaded and the diode on the other hand underloaded, if we try one or the other. A complete solution of the problem occurred to me about a year ago, and this was to employ *both* crystal and diode together *in series*. What could be simpler? It is almost impossible to overload this combination, and a small signal input does not produce distortion. I have accordingly adopted this method of detection in the receiver under consideration.

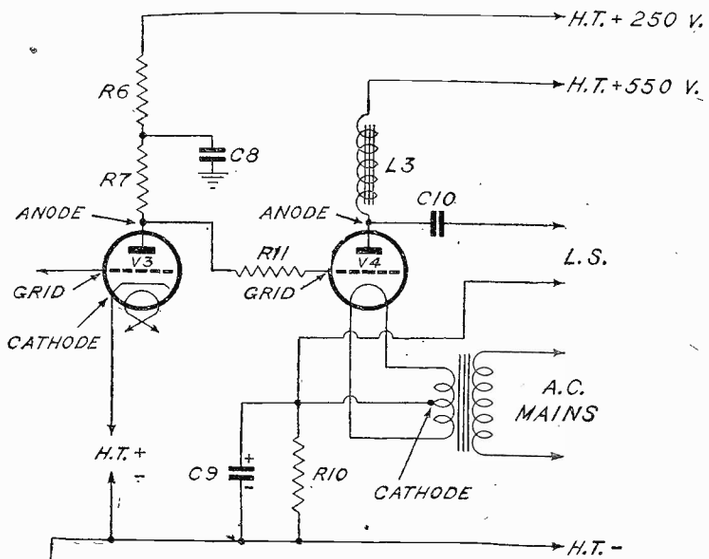


Fig. 1.—The last two stages of the amplifier described in this article.

L.F. Coupling

The most generally used methods of coupling low-frequency valves are transformer and resistance-capacity coupling. In these methods the anode of the valve is coupled to the grid of the next valve through a core in the case of the transformer or through a condenser in the case of resistance coupling. In the latter case it is not possible to get the best results except by push-pulling each stage thus coupled, as probably most readers are aware. Many amateur constructors hesitate to build such an amplifier because of the difficulties involved. But even better results are obtainable if a suitable form of what is called "direct coupling" is employed. In this method of coupling the anode of the valve is directly connected to the grid of the following valve, so that the voltage applied to the anode of the first valve is the same as that applied to the grid of the second valve. Since the grid of the latter valve has to be kept negative in respect of the cathode, it is necessary to apply a positive voltage to the cathode. Thus direct coupling is a method by which the potentials of anode, grid and cathode are carefully balanced or proportioned to enable the valve to function as a low-frequency amplifier. In order to accomplish this it is usual to employ a potential voltage divider or a number of potentiometers connected in series, and to tap off the required voltages for each electrode. The maximum voltage may be anything from 400 to 2,000. The only resistances employed are those required for the anode circuits of the amplifier. It is obvious that such a system of coupling is beyond the resources of the average amateur, and I have worked out a simpler method which I hope will prove attractive to readers. The advantages derived from the direct method are (1) the elimination of the coupling condenser; (2) absence of the "time constant factor"; (3) response to a very wide range of frequencies; (4) faithful reproduction of transients; (5) a straight-line response characteristic; (6) absence of harmonic distortion, and (7) simplicity of design.

Disadvantages

It is only fair, however, to mention the disadvantages from the constructional point of view. It is necessary to employ a high-voltage output stage; and the circuit will naturally make a more direct appeal to those who happen to possess an output valve of the PX25 class, or who obtain a permit for acquiring one. The second disadvantage is the necessity of using indirectly-heated A.C. valves in the early stages of the amplifier, so that only those who have access to electric light mains supply can avail themselves of this method of coupling. It is also most desirable to have a separate high-tension source for the output stage, and this means employing two eliminators as indicated in the diagram. The first two valves of the amplifier have their anodes supplied from a small high-tension eliminator giving a maximum output of 250 volts, and this eliminator can also be used for supplying the voltage to the high-frequency stage where such exists. For this purpose a Westinghouse metal rectifier type H.T.15 is quite satisfactory. The output valve requires an anode voltage of at least 360, after deducting the voltage dropped through the auto-bias resistor and the output choke. There must be quite a number of amateur constructors who already employ a similar output stage, and these will only be asked to make a few simple alterations.

Having stated the disadvantages thus early, I now feel less compunction in describing the main features of the circuit. Let us take a look at the diagram in Fig. 1. This shows the last two stages of the amplifier, represented by V3 and V4. When working out the direct coupled circuit it is necessary to plan from the output stage backwards. We will suppose that from a high-tension source of 250 volts a voltage of 130 is dropped through the resistances R6 and R7. It then follows that 120 volts are applied to the anode of V3. If we connect the anode of V3 to the grid of V4 (ignoring the grid-stopper R11 for the moment), then a positive voltage of 120 is applied to the grid of V4. It will now be necessary to make the grid of V4 negative in respect of its cathode, in other words, to bias the valve sufficiently to enable it to function on its straight line characteristic. This is done by applying to its cathode a positive voltage in excess of the positive grid voltage. If we apply approximately 150 volts to the cathode we shall achieve our object, and the simplest way to do this is to insert an auto-bias resistor R10 in the cathode circuit of V4 in the usual manner. The value of R10 must, however, be much larger than that

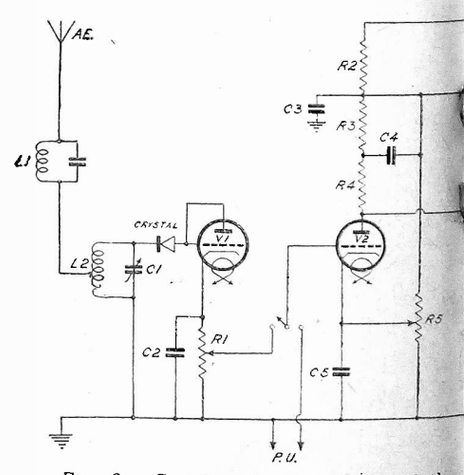


Fig. 2.—Complete circuit diagram of the system

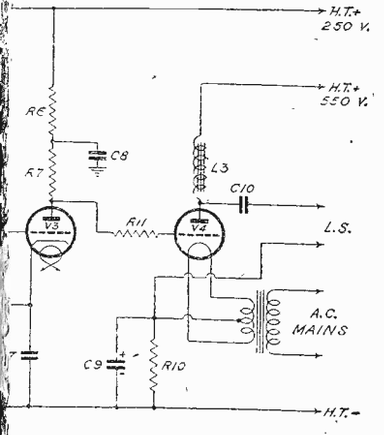
HIGH QUALITY

ling. By N. A. B. Hunt

selected in an orthodox resistance-coupled circuit, otherwise we shall not get the positive voltage required. Assuming that a voltage of 360 is applied to the anode of V4 and a current of 50 milliamperes is passed, then a bias resistance of 3,000 ohms will be found to provide the desired voltage for the cathode. The valve, which is a PX25, or its equivalent, will have a negative grid-bias of 30 volts. It must, however, be borne in mind that these values are calculated without the imposition of any signal from a transmitting station. As soon as a signal is applied the anode current of V4 is increased according to the field-strength of the transmitter. This need not worry us, as the other values alter themselves in due proportion, so that the valve is still working on its correct characteristic curve provided the signal is not so great as to overload it.

Input Stages

Let us now turn our attention to the stages represented by V2 and V3 (see Fig. 2). A valve of the small power class will be found suitable for V2, such as AC/P or ML4. For V3 a valve of the MHL4 type is recommended. The amplifier works very satisfactorily if a voltage of approximately 25 is applied to the anode of V2 and a voltage of approximately 120 is applied to the anode of V3. If these voltages are altered they must be altered in proportion and the output valve (V4) must also be biased accordingly. In order to apply 25 volts to the anode of V2 we have to drop 225 volts from the 250 volts supplied by the eliminator. To get the best results it is necessary to use anode resistances of high value in each stage, and the value of R4 and R7 will therefore be a quarter megohm. The current passed on the anode of each valve has to be very low, only a fraction of a milliampere. If a current of 0.32 milliampere is passed on the anode of V2 and 0.34 on the anode of V3, then we must calculate the values of the dropping resistances accordingly. The value of R2 may be 150,000 ohms, and that of R6 100,000 ohms. The anode of V3 will then have a voltage applied to it of approximately 120 at 0.34 milliampere, assuming the valve is correctly biased. In order to drop the required 225 volts on the anode of V2 a further resistance (employed for de-coupling) of a quarter megohm must be added to the network, namely R3. The condensers C3, C4, C6, C8 are all by-pass condensers of 2 microfarad capacity. The anode of V2 is connected to the grid of V3. The biasing of these two valves must not be effected by the usual auto-bias resistor with high capacity shunt to preserve the lower frequencies. Electrolytic condensers are not suitable for direct coupling, as, when the current is switched on, the condensers are temporarily short-circuited and take an appreciable time to settle down. Nor is the result satisfactory even when they are doing their work. It is far better to apply a positive voltage to the cathode of each valve by means of a potentiometer connected to the high-tension line. R5 and R8 are 50,000 ohm potentiometers, their sliders being taken to the cathodes of V2 and V3 respectively and each by-passed to earth through the condensers C5 and C7, which need not be more than 0.1 microfarad. The upper end of R5 is connected to the junction point of R2, R3; while the upper end of R8 is also connected to this point through the resistance R9, which is a quarter megohm. The bottom ends of the potentiometers are connected to earth and high tension negative.



...m section using the direct-coupling

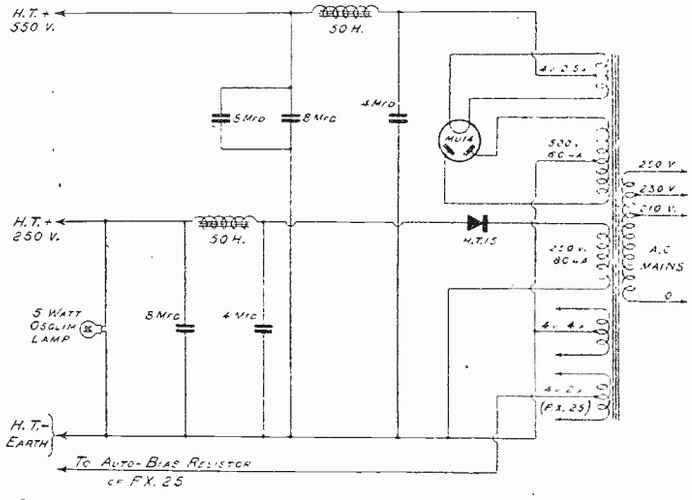


Fig. 3.—Mains section of the receiver, showing the separate H.T. feeds.

The sliders of R5 and R8 must be adjusted to settings that enable the milliammeter in the anode circuit of V2 to read a current of 0.11 milliampere, and in the anode circuit of V3 to read a current of 0.34 milliampere. The positive voltage applied to the cathode of V2 is of the order of two, and that to the cathode of V3 is approximately 35. Without the help of these two meters it will not be so easy to set the two sliders, though, of course, it is possible to form a passable judgment by aural results, and by the reasonable steadiness of the output meter needle when signals are applied.

If a Westinghouse rectifier, such as the H.T.15, is used for the smaller eliminator, it will be necessary to shunt an Osglim pilot five watt lamp across the output of this eliminator as shown in the diagram, Fig. 3, as otherwise the current drawn will be insufficient, even if a stage of high frequency is added, the rule being that a metal rectifier should not give less than a quarter of the full rated output. The total current consumed by the valves V2 and V3 is only about 0.66 milliampere. The actual *reading* of the milliammeter in the anode circuit of V2 is 0.11, but the current passed through the network R2, R8, R9 has to be added to this; so that the actual current passed is 0.32 mA.

Stability

With further reference to the output stage, I would suggest that the choke L3 should have a higher inductance than that usually adopted. Instead of the normal 20-henry inductance it is advisable to choose an inductance of 70 henries at 60 milliamperes. This will have a D.C. resistance of approximately 650 ohms. It is also a good plan to add in series with this, i.e., between the high tension positive and the output choke, a de-coupling choke of 20 henries by-passed to earth by a 4 microfarad condenser. I have not included the latter components in the circuit diagram of Fig. 2, as it is not essential to the working of the amplifier: in fact, one may regard the de-coupling choke as a refinement. If the large eliminator is designed to give a maximum output of 550 volts, there will be sufficient high tension voltage for the two chokes in series and the bias resistor between them to drop about 180 volts and leave 360 volts on the plate of the PX25 valve. Another important point is the omission of a large capacity shunt condenser across the bias resistor R10. If the loudspeaker lead is connected to the cathode (or centre tap of the heater) instead of to earth, there can be attenuation at low frequencies even if no condenser is placed there. The frequency response is linear using a plain bias resistance. A small capacity shunt is, however, desirable

(*Continued on page 14*)

LIST OF COMPONENT VALUES

Resistances:	R1, 0.5 megohm R2, 150,000 ohms. R3, R4, R7, R9, 0.25 megohm. R5, R8, 50,000 ohms. R6, 100,000 ohms. R10, 3,000 ohms (50 watts). R11, 5,000 ohms.
Condensers:	C1, 0.0005 mfd. (variable). C2, 0.0001 mfd. C3, C4, C6, C8, 2 mfd. (250 volt working). C5, C7, C9, 0.1 mfd. (non inductive) or two 32 mfd. (320 volt type) in parallel. C10, 4 to 8 mfd. (500 volt working).
Valves:	V1 (diode), any A.C. valve, e.g., MHL4; V2, AC/P or ML4; V3, MHL4 or 41MP; V4, PX25 or DO24 or PP4/500.

PRACTICAL TELEVISION

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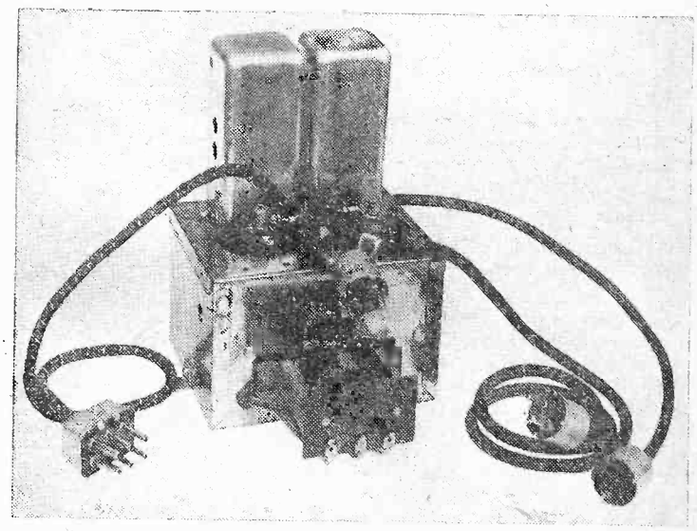
Caption Scanning

IN every television service which provides high-definition television pictures for radiation into the home, the necessity for some form of caption scanner will be immediately apparent. The visual announcement of items, names of artists and so on are frequently interspersed with the words spoken by the announcer, so as to add variety to the mode of presentation, and the equipment necessary for such a purpose as this can take a variety of forms. In the low-definition television days, Broadcasting House had its simple caption scanner built up from equipment resembling very much a mirror drum receiver. The beam of light from a small projection lamp was directed against the mirrors of the revolving drum and then focused on to the caption drawn in rough detail, because of the 30-line picture dissection, and the light reflected from the moving spot area, as it traced rapidly over the caption, was reflected on to photo-electric cells to generate the required television signal. A similar spot-light method has been used very successfully for high-definition working but the mechanical system has been replaced by a projection type of cathode-ray tube. This tube can be the straight through projection type, where the light area of the fluorescent screen formed by the impact of the beams of electrons is projected right through the screen and focused on to the caption cards or solid objects. A pair of photo-electric cells "collects" the reflected light or if a transparency is being televised, then a single cell placed behind serves as the light signal convertor. As an alternative to this, the cathode-ray tube can take the indirect form, where the screen is an opaque fluorescent coating mounted inside the glass envelope at an angle to the scanning beam. In this case a correction has to be applied electrically to overcome any trapezoidal scanning or focusing distortion.

Special Cells

UNDER service practical conditions the caption scanner of this form, comprising cathode-ray tube, power supplies, first stage amplifiers, scanning and focusing circuits, object platform and photo-electric cells, can be built into a single rack, or if preferred, into smaller interconnection units when transport from place to place becomes necessary. To obtain the best results from this apparatus it is essential to employ specially sensitive photo-electric cells, which have a mush or noise level very low in comparison with the main vision signal generated by the cells and scanning equipment. Then, again, it is advantageous to make these cells sensitive to the particular colour of the scanning spot, as this improves the efficiency of the combination. In some cases, it is found better to make up a caption scanner from an image dissector tube, but this is only applicable to transparencies and cannot handle the variety of subjects undertaken with the modern spotlight scanner. The keen experimenter will find an outlet for his capabilities if he applies his skill to building up his own caption scanner for transparencies, using the standard form of relatively small diameter cathode-ray tube. For home use, small interconnected units are naturally to be preferred, and some time ago apparatus of this character was described in detail in these columns. It is as well to remember that with this home-built equipment, in addition to transparencies such as films or lantern slides, relatively flat solid objects can be held in position against the face of the transmitter cathode-ray tube, and they will then appear as shadowgraphs on the receiver screen. Useful experimental information covering a very wide field can be derived from apparatus set up in this way, and although very elaborate equipment would naturally prove somewhat costly, the home constructor need not be put to much outlay if he uses components or power units already in his possession. In laying out the apparatus in units, it is necessary to avoid the possibility of stray electric or magnetic fields upsetting the regular formation of the scanning fields on the cathode-ray tubes. Furthermore, the photo-electric cell and amplifier must be accommodated in a metal screened case and a reliable earthing system employed to remove any traces of hum that would otherwise be apparent on the screens if due care was not taken.



A neat pre-amplifier unit for extending the range of reception of a television receiver.

The "T" and "B" Problems

THE increased use of the iconoscope form of television camera has brought into prominence once more the two terms "tilt" and "band," to which reference is so often made but the significance of which is frequently lost sight of by those endeavouring to understand the operation of the equipment at the transmitting end. The terms have come into common use as far as television engineers are concerned, but unless well versed in the intricacies of camera technique they fail to convey any real meaning to the lay mind. There is no doubt that the choice of such terms is unfortunate, but like many other radio terms that have become well established both in conversation and literature, there seems little opportunity at this juncture of remedying matters. These two terms came into use because of the graphical representation of certain inherent characteristics of the iconoscope. Due to certain defects, it is found that when a picture is being produced by this piece of electronic apparatus there is a gradual change of illumination from left to right which had no relation to the light and shade changes of the picture itself. The datum line of the illumination graph is therefore inclined or tilted in an upward direction. This has to be rectified at the transmitting end, and since the measure of tilt is not constant, the only reliable method of countering the defect is to electrically introduce a countering effect so as to keep this line horizontal and arrange for this degree of tilt nullification to be undertaken manually. It is quite a tricky operation and the engineer charged with this responsibility has to maintain a constant watch on the picture to ensure that his manipulation of the control is within the necessary limits. Another inherent defect in the same equipment is the fact that the illumination is greater or less in the middle of the picture than at the edges. A plotted characteristic will therefore show a concave or convex line, that is one with a bend in it, hence the significance of the term. The combination of the two is represented by a tilted, bent line and electrically this "bend" has to be countered by manual operation in just the same way as tilt. By a suitable combination of these controls it is possible to ensure that the general brightness of the picture is made uniform over the area of the picture. A failure to attend to these two features would tend to spoil the received picture very materially, and it is a good thing that the rectification of these two points is the onus of the transmitting engineers and not of the viewers, otherwise the receive controls would be complicated and continually need adjustment.

A RESISTANCE PROBLEM

SIR,—As the unfortunate possessor of a surname which Radio now associates with individuals of an inquisitive turn of mind, I cannot refrain from commenting on Dr. Fleming's article on "A Resistance Problem," which appeared in your February 17th issue, and which raises some interesting points.

It is not necessary to introduce determinants or even simultaneous equations to prove the example he gives.

As he states, the points a and b are, from symmetry, at equal potential. Likewise points b and f. Hence the current divides equally at the point A. Similarly the currents in the three branches at B are equal.

Also from these results, it follows that the potential drop across ae is equal to that across ac, hence the current also divides equally at point a. Similarly for the remaining points.

Thus assuming that the total current is 6i. the distribution is that shown above.

Considering the path AacB, the voltage drop is $2ir+ir+2ir=5ir$, and if R is the equivalent resistance of the frame, this $=6iR$, whence $R=5r/6$.

Another case besides those mentioned, of course, is the one where connections are made to opposite corners of the same face.

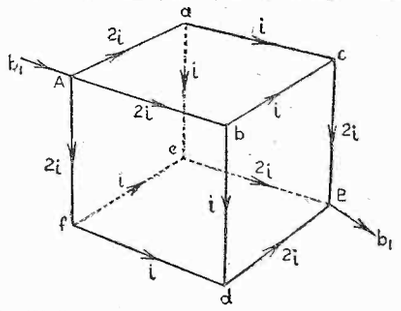
A more interesting problem arises where the cube has sides of sheet metal with points of current entry and exit at opposite, adjacent or alternate corners.

Or if this is found to be too easy, some readers may like to consider the case of a solid cube, particularly for adjacent corners.

As my radio namesake might well say, this last is "a fine old how-d'ye-do to bump into."—R. C. WALKER (Caversham).

* * * * *

MR. WALKER'S letter does not make any point against me. The problem of the resistance of a skeleton cube of unit wires between diagonal corners happens to be one in which the component resistances are symmetrically placed with respect to the diagonal line, and therefore the joint resistance can be found by the empirical method Mr. Walker uses. I gave a perfectly general method of dealing with problems in networks of conductors to the Physical Society of London in June, 1885, and it was published in the *Philosophical Magazine*, for September, 1885, or 55 years ago. I employed this method in solving the cube problem submitted to me. An empirical method, able to deal only with a few cases, is of no value compared with a mathematical method which is valid for all cases. Take, for instance, the problem of the Wheatstone's Bridge. Let Mr. Walker find an expression for the electric current through the bridge or galvanometer circuit when the resistances of the four arms of the bridge are P, Q, R, S ohms and the voltage in the Conjugate circuit is 1 volt.



Mr. Walker's arrangement of the resistance cube.

My method, as described in the Paper referred to, enables the expression for the bridge current to be written down at once as the quotient of two determinants and I doubt whether any empirical method will so easily solve this problem.—SIR AMBROSE FLEMING.

RADIO IN THE SERVICES

(*Continued from page 3*)

while the oscillator circuit is tuned to a frequency which is higher or lower than the signal frequency by a definite amount. As a result, the frequency of the received signal is changed to one equal to the difference between the input and oscillator frequencies. This is the intermediate frequency, and it is approximately 465 kc/s in most modern superhets. The I.F. amplifier is similar in all major respects to an H.F. amplifier, with the exception that it is pre-tuned.

If the loudspeaker was silent, despite the fact that the set was switched on, how could you tell whether the fault lay in the speaker or in the set itself?

With a battery-operated set, a rough check of the speaker could be made by disconnecting it and holding a lead from one of its terminals against the negative terminal of the L.T. accumulator, while the other lead was touched against the positive terminal. If the speaker was in working order a pronounced click would be heard as the contact was made, and again as it was broken. Absence of these clicks would point to a fault in the speaker, its built-in transformer or one of the connecting leads.

FURTHER STEPS TO HIGH QUALITY

(Continued from page 11)

for reasons of stability, and a 0.1 microfarad is quite satisfactory.

Should the constructor be troubled with mains hum—and some mains are more "noisy" than others—a complete cure can be effected in 99 cases out of a 100 by interposing between the mains and the eliminator input a step-down transformer with a screened primary, the screen being connected to earth. The anti-hum transformer has its primary winding connected to the mains. If, for instance, the voltage of the mains is 230 A.C., then the primary is wound to take this. The secondary is wound to step the 230 volts down to 210 volts, and the lower voltage is that supplied to the eliminator transformer primary. The voltage can, of course, be stepped up again as required and applied to the rectifier valve.

The transformers and chokes in my own amplifier and eliminator were made and supplied to me by Mr. N. Partridge, of King's Buildings, Dean Stanley Street, Westminster, S.W.1.

The detector, as already explained, consists of an ordinary crystal and a valve in series. Any A.C. valve can be used for the diode, the grid being strapped to the plate. The crystal can be omitted, or short-circuited by means of a switch, when it is desired to use the diode alone. The potentiometer R1 acts both as the output load and a volume control. Its value is half a megohm, and C2 is the usual high-frequency by-pass shunt of 0.0001 microfarad. L1 is a wave trap, which may be necessary in some districts. I can recommend the traps made by Messrs. Postlethwaite Bros., of Kinver, Staffs. The object of the trap is to cut out any one powerful interfering station by rejecting that particular wavelength. If "fading" is experienced, it is advisable to use an indoor aerial and a stage of high-frequency amplification. This, of course, is said with particular reference to existing conditions.

Provision has been made for the insertion of a gramophone pick-up in the grid of V2 by means of the usual change-over switch. A separate volume control must, of course, be employed for the pick-up.

In conclusion, I hope that at least some of my readers will be able to try out this amplifier. Its exceptional qualities will help to cheer the listener during black-out hours, and I venture to predict a new thrill for him.

IMPRESSIONS ON THE WAX

ONE of the most interesting records issued by the Decca Company this month is *Decca F* 7355. On to this single 10in. disc they have condensed the whole of "Runaway Love," the musical show that is now running at the Saville Theatre, London.

This record was actually recorded in the theatre and features the original artists—George Gee, Luanne Shaw, Eric Fawcett and Hal Gordon, ably abetted by Billy Mayerl and his Multitone Piano Orchestra. No fewer than seven tunes are included on the one record.

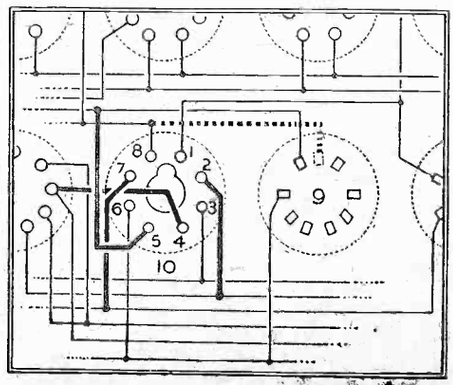
Irving Berlin Album

THE versatility of Paul Whiteman is well displayed in a new Brunswick album devoted to the music of Irving Berlin. The album has five records. The first is by the full orchestra, the second by his Swing Wing Group, the third by his Bouncing Brass, the fourth by his Sax Socktette and the fifth by his Swinging Strings. Thus each department of the orchestra becomes a band of its own. To pick out one side only sounds unfair; nevertheless, the large band record of "Alexander's Ragtime Band" is good. The Modernaires vocal quartet sing specially written words which tell the life story of the tune and by means of ingenious recording we hear the song as it was played in its youth—*Brunswick O* 2859-63.

Making a Valve-tester

IN our issue dated February 24th we published a wiring diagram for the valve panel of this valve-tester. Two small draughtsman's errors occur in the wiring of this, and will be found on the octal valve-holder and on the holder immediately to the right of it. There was an additional contact on this latter holder which should not be there, and this is indicated by the broken lines on the corrected diagram shown herewith. The octal valve base should be wired as shown also in this diagram.

The rest of the connections are correct, and although in one or two exceptional cases the filament sockets may not be those shown, these are so rare that the use of the separate panel would rectify the matter.—(F. D. L.).



Corrected diagram of part of the valve-tester.

RADIO CLUBS & SOCIETIES

Club Reports should not exceed 200 *words in length and should be received First Post each Monday morning for publication in the following week's issue.*

CLAYESMORE RADIO CLUB

Hon. Sec.: A. W. G. Wilson, Clayesmore School, Iwerne Minster, Dorset.

VERY little constructional work has been done this term, as most of the members are now seniors, and are finding themselves with plenty of work of another kind on their hands. However, a S.G.-Det.-Pen. mains set has been built by Coxe, and although it has only, as yet, worked on gramo owing to the lack of a pair of coils, it should be working well shortly. The secretary has constructed a 3½-watt quality amplifier for use with microphone and gramophone.

Other members of the club and the secretary have gained valuable knowledge in power amplifier practice while operating the school cinema.

A 15-25 watt amplifier is to be put under construction shortly for Speech Day, next term. It should be finished shortly after Easter.

A REGULATED AERIAL

AN aerial is for most people a necessary inconvenience, a piece of any wire, thick or thin, connected anyhow to the set. When listeners found that modern sets could operate without aerial and even earth, and when the announcements of manufacturers told them that "this need had disappeared," they gave up all external aerials and earths. So the local and most powerful nearer stations come in because various stray wires act as an aerial; far distant reception, however, is very poor.

People with an indoor aerial or short outdoor aerials often have a lot of trouble with distant stations. It is, therefore, a good plan to "regulate" an inefficient aerial by means of a special filter, which will "lengthen" or "shorten" the aerial as needed. Usually the success of this little device is amazing, and the efficacy of the coil can easily be tested by turning the pointer of the rotary switch to different taps of the coil. There will always be a point where the volume of sound is absolutely sufficient with full rich bass and realistic preservation of the high notes. On short waves the efficacy is not so obvious, but the regulation of the aerial will always make the tuning in and the steadiness of reception somewhat easier.

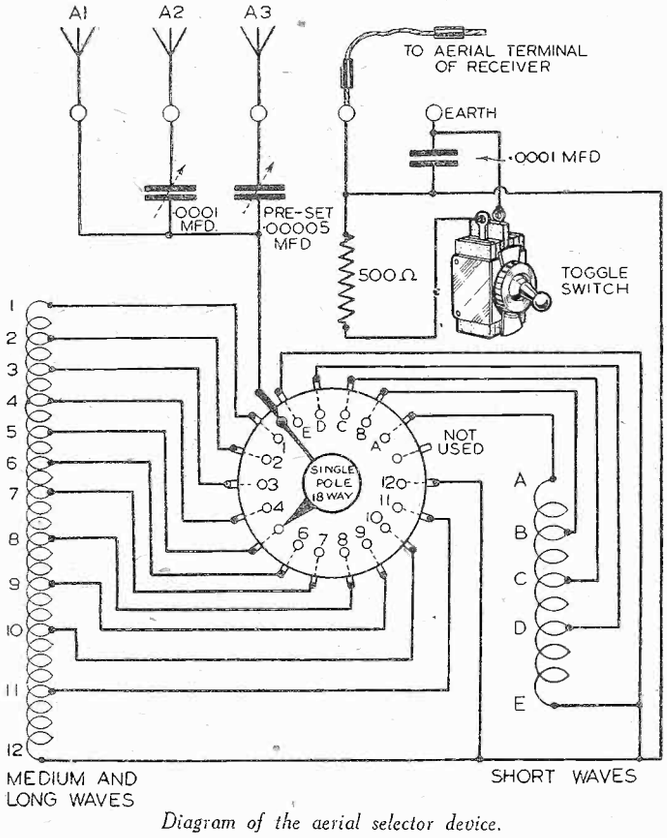


Diagram of the aerial selector device.

Constructional Details

The device is made up with a coil of about 300 turns of d.c.c. wire (29 s.w.g.), wound on a 2½in. former. The coil may be tapped every 50 turns. This gives five taps and the end of the winding for use with, say, a single pole 7-way rotary switch. I had better success, however, by tapping the coil of 300 turns at 30, 50, 75, 90, 100, 120, 150, 175, 200 and 250 turns. This gives 12 taps, including the beginning and the end of the windings. A standard rotary selector switch, single pole 18-way, meets the demands of the 12 taps. The remainder of six ways may then be used for the taps of the short-wave coil. This coil contains 28 turns of 18 s.w.g. enamel covered wire with taps at every seventh turn. The coils, condensers, switches, etc., can be built into a small plywood box.

The small variable (.0001 mfd.), being not absolutely necessary, assists the regulation of the aerial and is also a very effective and smooth volume control. The fixed .0001 mfd. condenser, however, is essential.

When the outdoor aerial is useful and not too bad, the whole box should be screened with thin copper foil and the aerial lead to the box and from the box to the aerial terminal of the set should be made of screened low-capacity wire, all screening well connected to earth.

Components

The main point is a first-class switch with silver-plated self-cleaning contacts (Bulgin List No.S.205). The other switch is a small toggle switch only (Bulgin List No. 112). This switch and the ¼ watt 500 ohms resistance between the aerial and the earth terminal are not important. This is a small device and is independent of the aerial regulation. It is a "local-distance" switch for use if the signals from the local station are too powerful. To avoid overloading of the first valve the switch contacts should be closed. For distant reception, the contacts must be open.

Put the plug of your aerial in A1 or A2 and an earth plug in "Earth" of the box and turn the knob of the rotary switch from point to point, after having tuned to the station you desire in the usual way. You will soon find a point where the reception is better than usual. When using A2 you will find that the volume of sound decreases when the vanes of the variable condenser are turned out.

A3 is for short-wave reception only. Initially the pre-set condenser must be adjusted by means of a screwdriver to the greatest volume of sound of a good audible short-wave station, and further adjustment is not necessary. The short-wave regulation should be tested on A, B, C, D and E, in the same way as the other coil. When receiving short waves the earth plug of the box should be removed. The earth terminal of the radio set, of course, must always be connected with earth.

W. F.

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).

Listening Contest for Club Members !

SIR,—I was at a local radio club meeting recently when one of the members suggested a listening contest between the club's members. As some of us know, there is a DX contest coming off soon in America, which would be ideal for such a purpose. I don't know whether any other club is doing anything like this, but I think it would relieve the monotony, and provide an opportunity for trying out the new receivers which a lot of us have been building.

What do other club members think of the idea ?—G. F. SWAYSLAND (Gravesend).

Readers' Dens

SIR,—I enclose a photo of my den taken on Saturday morning, March 2nd. It is interesting to compare this with the one appearing in the January 13th issue of PRACTICAL WIRELESS, and to note the difference resulting from a visit by the G.P.O. and the removal of my transmitter. —S. E. JANES (Croydon).

SIR,—I have received my B.L.D.L.C. certificate and am very pleased with it.

I enclose a snap of my den, which may interest other readers. My RX is a straight three using an Eddystone coil, and the set runs off A.C. mains 230v. The aerial points due south and is 40ft. long, and 26ft. high.

Of late I have been experimenting with a frame aerial, and have had fair results. The first TX received was the Irish station testing on 31.27 m. Several others came through at good strength, but I could not listen long enough to pick up the call sign. In fact I did not think a frame aerial would be of any use on the short waves.

If James Stitt should happen to read this letter I would be glad to hear from him.

Wishing PRACTICAL WIRELESS much success in the future.—GEO. B. COTTON (Liverpool).

Exchanging Q.S.Ls.

SIR,—Referring to my letter, which you so kindly published in your issue of February 17th, 1940, on the "Exchanging of Q.S.Ls. by post," and bearing in mind your invitation to put the matter "Open to Discussion," in your columns, I find it necessary to ask you to add a further instalment to my original letter. I do not wish to commence an argument in writing with your readers, but in view of Mr. H. W. Darvill's letter, published in March 2nd issue, I think that a few details will show that in the majority of cases published, it is not one of a S.W.L. exchanging with a S.W.L. as he suggests, or nomenclative errors.

During the last 13 issues of PRACTICAL WIRELESS I have noted 18 letters on this Exchange business. Six of these only are S.W.Ls. offering to exchange with S.W.Ls., which I also agree is harmless, though at the same time is a little off the true line.

However, of these six, two offer to Q.S.L. 100 per cent. in return which cannot or should not be done by a S.W.L., for no "Ham" would call himself a S.W.L. in error. If he does make this mistake why does he not quote his call sign ? Then again, I ask, can a Ham rightly send his Q.S.L. in exchange for a S.W.L. without having received anything, for the usual S.W.L. does not transmit.

Moreover, of the 18 cases quoted, 10 wish to send their S.W.L. cards not only to S.W.Ls. but A.As. and Hams in order to get a Q.S.L. in return. Out of these 12 I mention, 2 say they will Q.S.L. in return.

Now I think it would be much clearer if these "fans" who wish to Q.S.L. in return, would quote the call signs with their signatures and addresses, and if this was made a rule we should all know where we stand.

On these grounds I venture to say that if Mr. Darvill cares to examine his back issues of PRACTICAL WIRELESS he will conclude that 12 out of 18 readers could not make a nomenclative error as he suggests and I still contend that this Q.S.L. exchange business is not only a ramp but a dishonourable action in the view of genuine S.W.Ls., A.As. and Hams.

I strongly appeal to all those readers who conscientiously work at their RX, furnish genuine useful reports to all parts of the world, and who hope to get a Q.S.L. back for their trouble, to put their heads together with the help of our worthy editor to put a stop to this growing exchange business with other than S.W.Ls., as in fact the Q.S.L. should not be used for other than verification of wireless reception of the other fellow's transmission.

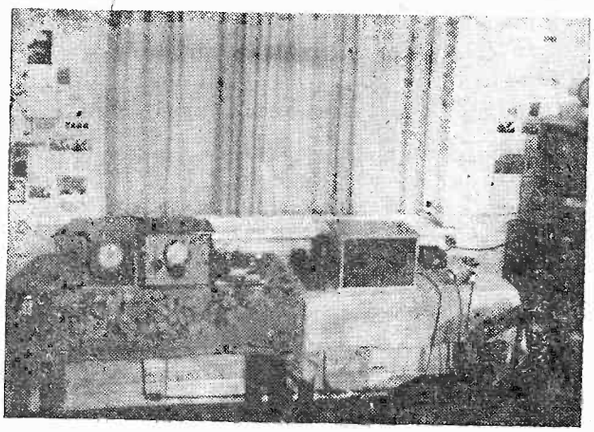
I trust, Mr. Editor, that I have made the position as I see it, quite clear, and hope for your valuable support to maintain the value of a Q.S.L. used in the correct manner by authorised persons.—F. W. J. COOPER (Belmont, Middlesex).

[*See note in Thermion's Commentary, page 5.*—ED.]

Correspondents Wanted

SIR,—I should like to correspond with any reader of your paper aged about 16-20 years who is interested in short-wave radio. My receiver, which is under construction, will be a 5-valve mains short-waver. I should like to take this opportunity of congratulating you on your excellent paper which I have only just started reading.—J. M. GOYMOUR (24, Goring Road, Ipswich, Suffolk).

SIR,—I would like to correspond with a young reader of PRACTICAL WIRELESS who is interested in short-wave wireless.—D. E. PARRISH ("Goodwood," Hadnock Road, Monmouth).



On the left is Mr. S.E. Janes's den—minus his transmitter.

On the right is seen Mr. G. B. Cotton, of Liverpool, in his radio room.

Prize Problems

PROBLEM No. 391.

MARSHALL had a three-valve battery receiver operated from dry batteries. He decided to include auto-grid bias and obtained an appropriate resistance and condenser which he joined between his H.T. negative plug and the earth terminal of his set. When he switched on signals were very distorted, but in spite of verification he found that the resistance was of the correct value and was not defective. What was wrong ? Three books will be awarded for the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 391 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, March 18th, 1940.

Solution to Problem No. 390.

When Bradley connected the filaments in series he restricted the current through the entire filament circuit and accordingly the valves were all underrun. This would give the same effect as when using a run-down L.T. battery.

The following three readers successfully solved Problem No. 389 and books have accordingly been forwarded to them : F. Y. Fairhall, Canterbury Bell, Sandhurst, Kent ; N. C. Hughes, 13, Broadway, Ketley, Wellington, Shrops ; T. Woodward, 50, Lillington Street, S.W.1.

LATEST PATENT NEWS

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume or in bound volumes price 2s. each.

Abstracts Published.

ELECTRICAL MUSICAL INSTRUMENTS.—Selmer and Co., Ltd., H., and Davis, B. No. 501685.

In a piano, with or without a soundboard, and having electro-static pick-up means feeding a loudspeaker, the pick-ups consist of screws 3 (Fig. 1) with flat plate-like heads 3*a* opposite each string C or set of strings sounding a note. In an upright, some of the screws 3 of the middle range of strings may be behind the strings. The screws 3 screw for adjustment into insulating strips 2*b* on the iron frame 1, or into a wooden bar mounted on the piano body, and are connected by a lead or a metal strip.

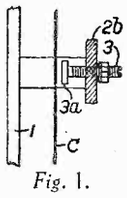


Fig. 1.

Reference has been directed by the Comptroller to U.S.A. Specification 2027074.

TRANSFORMERS; COUPLING COILS.—Michaelis, E. No. 507655.

In inductively coupled oscillatory circuits the coupling is adjusted without effecting detuning by movement of a magnetic dust core in relation to the windings. The coils 2, 3, Fig. 2, of a back-coupled oscillator, for example, may be mounted on an insulating former 1 within which the whole of the core 4 or a part thereof is so moved in relation to the windings that any detuning arising from change in coupling is compensated by change in self inductance of the coil 2. In a modification in which a part only of the core is moved to effect a change in coupling, Fig. 3 (not shown), the remaining part is independently movable to serve as a "balancing pin." Fig. 4 shows the invention applied to a frequency filter of adjustable band width in which the coils are mounted on fixed cores 11, 12 and the movable part 14 is adjusted laterally. In an alternative arrangement the fixed cores are axially bored to receive independently and axially movable core parts. Fig. 5 shows another form in which movable core parts 14, 15 are mounted for rotation with respect to fixed parts 11, 12 carrying the windings.

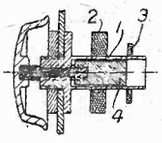


Fig. 2.

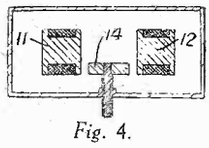


Fig. 4.

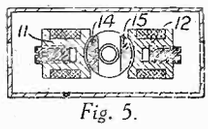


Fig. 5.

CONVERTING.—Telefunken Ges. Fur Drahtlose Telegraphie. No. 504923.

In an arrangement for supplying a load such as a wireless receiver with A.C. from either a D.C. or an A.C. source and comprising a transformer and vibratory interrupter, the transformer primary is divided into two symmetrical parts L1, L2 which may be connected at will either through the interrupter P to a D.C. source *a*, *b* so as to function alternately, or directly to an A.C. source (Fig. 6). In the latter case, either one part alone or the two parts in parallel may be used. The moving contacts of the interrupter are spring-mounted on a vibrating reed F, Fig. 7, so that they dwell on the fixed contacts and thus cause the current produced in the winding parts L1, L2, when the arrangement operates on a D.C. source, to be of rectangular wave form. Thus, when the arrangement operates on an A.C. source of a frequency, not more than half the frequency of the interrupter, the voltage produced in the secondary of the transformer is equal to that which is produced when the arrangement operates on a D.C. source of the same voltage as the R.M.S. value of the A.C. source. Symmetrical tappings *g*, *h* may be provided on the winding parts L1, L2 for adapting the arrangement to different voltages.

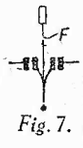


Fig. 7.

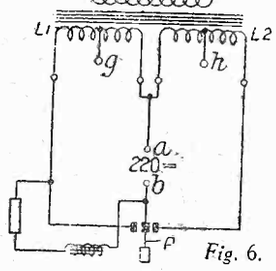


Fig. 6.

Reference has been directed by the Comptroller to Specifications 2824/08, [*Class* 38], 344, 948 *and* 359331.

NEW PATENTS

These particulars of New Patents of interest to readers have been selected from the Official Journal of Patents and are published by permission of the Controller of H.M. Stationery Office. The Official Journal of Patents can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. weekly (annual subscription £2 10s.).

Latest Patent Applications.

3138.—Hazeltine Corporation.—Television synchronizing-signal separators. February 19th.

3139.—Hazeltine Corporation.—Television receiving-apparatus. February 19th.

Specifications Published.

518128.—Rudkin, E. P.—Wireless receiving system.

518031.—Standard Telephones and Cables, Ltd.—Indicator systems for wireless apparatus or the like.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

Practical Wireless

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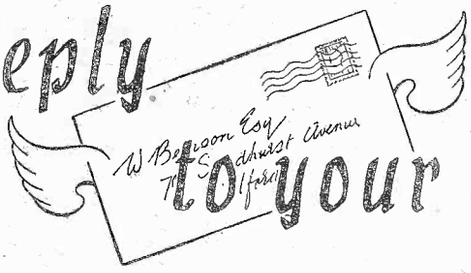
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	22.5.37	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D, (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	12.6.37	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	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)	21.3.36	PW62
The Centaur Three (SG, D, P)	14.8.37	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D, Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve : Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	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)	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	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)	28.7.34	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	11.5.35	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)	5.6.37	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4	31.7.37	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	16.1.37	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)	30.7.38	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	1.10.38	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))	19.3.38	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	23.7.38	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
Lucerne Minor (D, Pen)	—	AW426
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
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	*Mar.* '34	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
2HF Four (2 SG, D, Pen)	—	AW421
Self-contained Four (SG, D, LF, Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	*Feb.* '35	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 (HF, Pen. D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan'* 36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	*July* '33	WM328
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May* '35	WM386
SUPERHETS.		
Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. 6d. each.		
Heptode Super Three A.C.	*May* '34	WM359
"W.M." Radiogram Super A.C.	—	WM366
PORTABLES.		
Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two H.F. Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans)	—	WM367
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
S.W. One-valver for America	15.10.38	AW429
Rome 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.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	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-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super	*Nov.* '35	WM397
Mains Operated		
Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
"W.M. Long-wave Converter	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, R,C Trans)	*Aug.* '35	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 WM392 (1/-)	*Nov.* '35	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	*Mar.* '36	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/-)	*May* '36	WM405
Wilson Tone Master (1/-)	*June* '36	WM406
The W.M., A.C. Short-wave Converter (1/-)	—	WM408

In reply to your letter



Auto-grid Bias

"I wish to fit auto-grid bias as recently described in your pages but am doubtful about one point. In my set H.T.— leads to a fuse-bulb, which in turn is anchored to the metal chassis. Will this affect the scheme in any way? To put it another way, am I right in assuming that the resistor would be in parallel with the fuse-bulb, and would this be in order?"—E. J. W. (Liverpool, 4).

THE bias resistor must not be in parallel with the fuse. In your case you must disconnect the fuse-bulb holder from the chassis and connect it instead to one side of the bias resistor and condenser. The other side of the resistor and condenser is then joined direct to the chassis. The grid return lead, that is, the grid leak or G.B. terminal of the L.F. transformer, is then connected to the junction of the fuse and bias resistor.

Resistance Wattage Rating

"I am fitting up a small mains unit and am rather doubtful regarding the wattage of the two resistors which I have to include for H.T. dropping. Can you tell me how to work out the rating so that I shall obtain the correct types of component and avoid burning out?"—A. F. (Amersham).

THE wattage of a resistor is calculated from the current which flows through it and therefore your first task is to ascertain the current at each part of your circuit. You can do this with a milliammeter connected in series when using a battery supply. The value of the resistor is then calculated by taking the voltage to be dropped and dividing this by the current in milliamps and multiplying the answer by 1,000. The wattage is then calculated in either of two ways. Firstly, you can multiply the current by the voltage dropped across the resistor, or you can multiply the resistance in ohms by the current squared. In each case the current is expressed in amps., 1 milliamp being .001 amps.

Doublet Aerial

"I wish to put up a doublet receiving aerial for use mainly on 30 metres. Could you give me some measurements for a horizontal aerial of this type? I understand that it will also operate on 15 metres and multiples of the fundamental, and I should be glad if you would confirm this."—J. H. (Birmingham).

THE exact measurements need not be rigidly adhered to as they will be in odd inches. We suggest you try an arrangement consisting of two lengths of 25ft. of standard stranded wire, with a 6in. supporting rope in the centre. Each end of each wire must, of course, be well insulated. From the centre ends of the two wires take a twisted leader to the receiver, and ordinary flex may be used for this purpose. The aerial will operate quite well on 15 metres and so on, the efficiency dropping off below 15 metres. Further details regarding short-wave aerials will be found in our new Short-Wave Manual, price 5s.

Battery Connections

"I wonder if you have ever published any hint or suggestion for simplifying battery connections? I have a four-valve battery set which has four separate H.T. positive connections, and one negative connection, and I use a multi-cable battery cord. Unfortunately, one of the plugs is always coming out, and as the battery is underneath the set in a cupboard I find it awkward when getting no signals to have to grope down and find the battery and see which plug is out. I wonder if you can assist me, therefore, to overcome this little difficulty?"—L. E. R. (Watford).

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 must be enclosed with every query.

THE trouble should not arise if you use good plugs. The standard split plug may be opened with a penknife blade so that it fits tightly, although perhaps you have obtained the solid type of plug which is intended for a slotted socket, not the solid socket found on batteries. The only hint we can offer for battery connections is to mount a strip of ebonite near the set, and connect the leads to this, making the strip with plugs and fitted sockets to the receiver so that the entire strip may be plugged in when battery connections are needed. This saves taking out each plug separately when tests are being carried out, but your trouble is undoubtedly due to the unsuitability of the plugs you are using.

Unusual Components

"I have recently had a small set given to me and I have dismantled it to use up the parts. I am familiar with most of them, but there are two items which I have never seen before and which I cannot understand. One is a small thing like a hollow cone with wires at each end and it is enamelled. It is about ⅜in. in diameter and ½in. overall length. The other is a small, bell-shaped metal thing with a rubber across one end,

(Continued on following page.)

IN REPLY TO YOUR LETTER

(Continued from previous page.)

and there are no tags or wires attached to it. I should be glad if you could help me to identify these items."—J. G. T. (Kentish Town).

ALTHOUGH the descriptions are brief, we think we identify the two components as a small ceramic type fixed condenser and a grid-bias cell. We imagine that the set is of American origin, and the small condenser would have a capacity of a few mmfd. The other item is a Mallory grid bias cell, which is generally mounted in a small clip near a grid terminal and applies a bias of 1.5 volts or thereabouts.

American Valve Data

"I have one or two American valves and I am not certain regarding the connections. Is there any book available in this country which gives the connections and data relative to various American valves? If so, could you tell me where I could obtain one?"—J. M. (Ilfracombe).

DATA and base connections for a large number of American valves may be found in the back of the catalogue issued by the Premier Radio Company, price 6d. Messrs. Holliday & Hemmerdinger, of 74-78, Hardman Street, Manchester, 3, can also supply the receiving valve manual ssued by the Radio Corporation of America, and this gives the characteristics and connections of all their valves, which are standardised throughout America.

REPLIES IN BRIEF

The following replies to queries are given in abbreviated form either because of non-compliance with our rules, or because the point raised is not of general interest.

L. R. (Bangor). The transformer is specially designed for the purpose and will therefore be quite satisfactory.

H. T. E. (York). The article in this issue will answer all the points raised by you.

B. K. (Basingstoke). A pre-set would be preferable, and you should try and obtain one of the type which has a locking adjustment so that the setting may be made permanent.

T. G. (E.C.3). The Eddystone component would be perfectly suitable. Make certain that you obtain one of the latest types, as they have been modified recently.

R. J. (Boxmoor). 1.5 volts will be insufficient. Try at least 6 volts. A good G.B. battery will be adequate from the current point of view.

E. S. (Southwark). 36 S.W.G. enamel wire will be suitable at about 2,000 turns. Be careful with the insulation.

L. R. (Bletchley). Ordinary grease is unsuitable. Use a graphite preparation and use it sparingly.

S. P. (Cambridge). We regret that we cannot grant you space in our editorial columns, and can only suggest that you insert a small advertisement. We would be inundated with similar requests if we permitted our editorial space to be used for the purpose outlined in your letter.

S. J. B. (Bristol, 5). We refer you to our blueprint list published weekly.

W. A. (Riverstown). Perhaps now that the valve tester has been completed, the various details about which you were uncertain have been cleared up. See especially the final article on the subject.

W. J. (Wellingboro'). We regret that we cannot supply a blueprint of a receiver utilising the coil in question.

M. H. B. (Rugby). The coils are not now on the market, but standard 6-pin plug-in coils could be substituted.

L. W. (Sparkbrook). The unit is probably overloaded by your 5-valve set. The unit is intended primarily for addition to a simple two or three-valve set.

G. J. (Stepney). Class B usually does not require negative grid bias, and, therefore, perhaps you are trying to use the set in the wrong manner. We cannot deal fully with your query without further details.

L. A. D. (E.8). There is no frequency to D.C. mains and therefore we think you are under some misapprehension regarding your supply. If the mains are 50 cycles we think you will find they are A.C. In any case, the mains transformer will be burnt out if connected to a D.C. supply.

The coupon on page iii of cover must be attached to every query.

Classified Advertisements

ADVERTISEMENTS are accepted for these columns at the rate of 2d. per word (minimum charge 2/- each paragraph). Series discounts of 5 per cent. for 13, 10 per cent. for 26 and 15 per cent. for 52 insertions are allowed. All advertisements must be prepaid.

EACH paragraph will commence with the first word printed in bold face capitals. Additional words in bold face capitals are charged at 4d. per word.

ALL communications should be addressed to the Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

CABINETS

A CABINET for Every Radio Purpose. Surplus Cabinets from noted makers under cost of manufacture. Radiogram Cabinets from 30/-. Undrilled table, console and loudspeaker cabinets from 4/6. Inspection invited.
H. L. SMITH AND CO., LTD., 289, Edgware Road, W.2. Tel.: Pad. 5891.

COMMUNICATION RECEIVERS

THE famous HALLICRAFTER SX23, released by the makers only in July, 1939, can still be supplied by Webb's Radio at
PRE-WAR PRICES.
We fortunately had good supplies delivered in August. NO price increase on present stock of this model only, £33 10s., H.P. terms available. Write for descriptive booklet.—P. Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

CONVERTERS

E.D.C. Rotary Converter, 200-250 D.C. to 200-250 A.C. 120 watts in silence, cabinet with filter, perfect £5/15/-. 180-watt ditto, £7/15/-.—Johnson Engineering, 86, Great Portland Street, W.1.

LITERATURE

NEW Edition. American Amateur Relay League Handbook. 500 pages of up-to-the-minute technical information, 7/- post free. 1940 Jones Handbook; approximately 700 pages dealing with every aspect of Short-wave Radio, 8/6, post free.—Webb's Radio, 14, Soho St., London, W.1. 'Phone: Gerrard 2089.

LOUDSPEAKER REPAIRS

LOUDSPEAKER repairs, British, American, any make. 24-hour service, moderate prices.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

REPAIRS to moving coil speakers. Cones/coils fitted or rewound. Fields altered or wound. Prices quoted, including eliminators. Pick-ups and speaker transformers rewound, 4/6. Trade invited. Guaranteed satisfaction. Prompt service.
L.S. Repair Service, 5, Balham Grove, London, S.W.12. Battersea 1321.

MISCELLANEOUS

BE TALLER!! Inches put you Miles Ahead!! Details 6d. stamp.—Malcolm Ross, Height Specialist, Scarborough.

MORSE EQUIPMENT

FULL range of Transmitting Keys, Practice Sets, Oscillators, Recorders and other Radio Telegraph Apparatus, designed and manufactured by T. R. McElroy, World's Champion Telegraphist. Sole distributors: Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

MORSE TRAINING

WIRELESS Code Courses. "Book of Facts" Free.—Candler System Co. (L.O.), 121, Kingsway, London, W.C.2.

MORSE Code easily learnt by gramophone records. All speeds 2-15 words per minute. Full particulars. Stamp.—Masters, Forest Way, Pound Hill, Crawley.

NEW CHASSIS

ARMSTRONG CO. recommending the following economically priced Radio Chassis for good quality reproduction.
ARMSTRONG Model AW38.—S-valve All-wave Radio-gram chassis, incorporating the latest circuit, including 6 watts push-pull output. Price £8/8/0 + 5% war increase.
Armstrong Co. have many other models of equal interest, please write for catalogue.
Armstrong Manufacturing Co., Warlters Rd., Holloway, London, N.5.

NEW LOUDSPEAKERS

3,000 Speakers from 6/6 each, P.M. and energised 4in. to 14in., including several Epoch 18in.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

PUBLIC APPOINTMENTS

AIR MINISTRY.
AERONAUTICAL INSPECTION DIRECTORATE.
Vacancies exist for unestablished appointments as Examiners in the General Engineering and W/T and Instrument Branches.
QUALIFICATIONS.
All candidates must have good general education, be able to read drawings, understand specifications, use micrometers and other measuring instruments.
(a) Applicants for the General Engineering Branch must have had practical experience in an engineering works. An elementary knowledge of materials testing is desirable.
(b) Applicants for the Instrument Branch must have knowledge of physics and training in light engineering or instrument making. Candidates with knowledge of optical instruments are also required.
(c) Applicants for the W/T Branch must have practical knowledge of W/T and electrical equipment with technical training in radio communication equal to City and Guilds final examination standard.
APPLICATIONS from candidates previously interviewed and declared unsuccessful will be considered provided the necessary additional experience has been gained.
ACCEPTED candidates will undergo a period of training in inspection as applied to the above subjects, not exceeding three months, and will be paid £3 10s. 0d. weekly during training. Subsistence allowance of £1 5s. 0d. weekly during training is payable to married men normally residing outside the training area. On successful completion of training, candidates will be appointed as Examiners at a salary of £246 9s. 0d. per annum (payable monthly, in arrear) if service is satisfactory, and must be prepared to serve in any part of the United Kingdom.
NORMAL age limits 25 to 55.
CANDIDATES should indicate on their applications for which vacancy they wish to be considered—a, b or c.
APPLICATION must be made on Form 786, copies of which can be obtained on application, *by postcard only,* to: The Inspector-in-Charge, A.I.D. Training School (I.C.S./REC. 52), Brandon Steep, Bristol, 1.

RADIO MAP AND GLOBE

WEBB'S Radio Map of the World enables you to locate any station heard. Size 40" by 30" 2 colour heavy Art Paper, 4/6. Limited supply on Linen, 10/6. WEBB'S Radio Globe—superb 12" full-colour model. Radio prefixes, zones, etc. Heavy oxydised mount. Post Paid, 27/6.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

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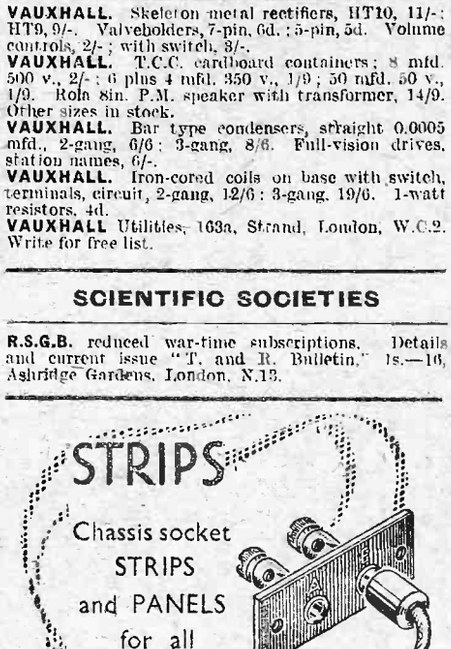

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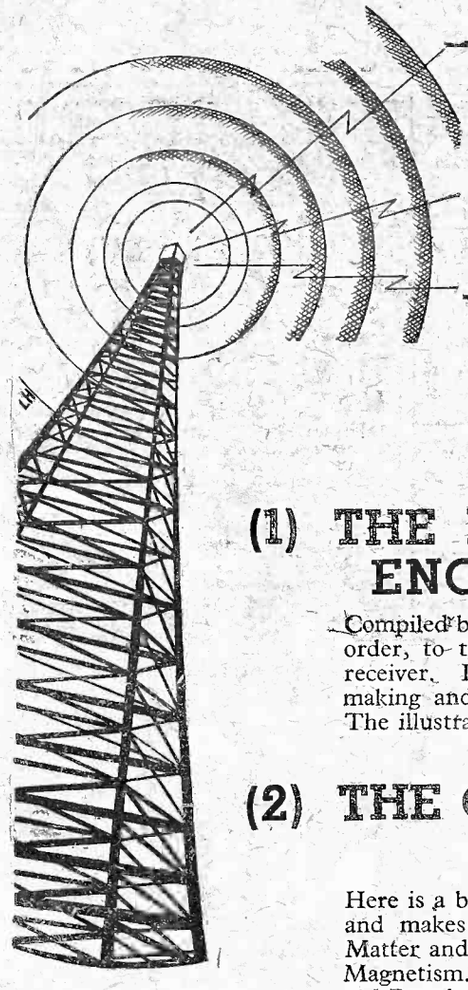

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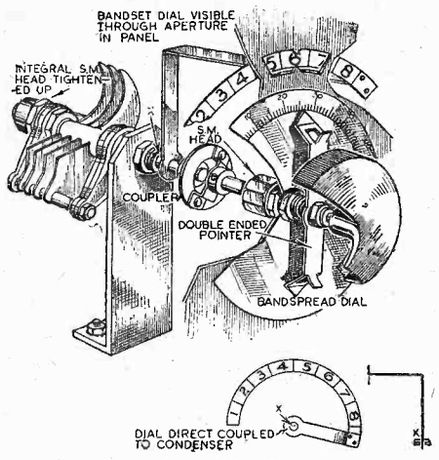
Practical Hints

A Bandspread Drive

BELOW, I give details of a very simple mechanical bandspread drive which I devised for use in my short-wave receiver.

The condenser which I had previously used had an integral reduction device of 8-1, and by coupling this to an additional slow-motion driving head, as shown in the



A simple mechanical bandspread drive.

sketch, a total reduction (in my case) of 72-1 was obtained. The pointer traversing the "bandspread" dial must be double ended, and by providing it with suitable projectors it can be used for more rapid "band-setting." This pointer is fastened to the usual place on the driving head, i.e., to the condenser through its integral reduction device.

The "band-set" dial is home constructed, and is divided into a number of divisions equal to the reduction rates of the condenser's integral device (in my case 8). The actual position of the dial depends on the form of mounting, etc., and a suggestion is given in the sketch. The dial is coupled direct to the condenser vanes.

In order to eliminate possible slipping, it is best to tighten up the condenser's integral reduction device slightly, and then if the knob is rotated when the vanes are all in (or out), it will only be the additional driving head that slips. For the same reason, care must be taken if the pointer is used as a quick "band-setter," as suggested. —J. W. HORWOOD (West Bergholt).

A Screened Input Jack

BEING unable to obtain a shielded jack for a mains-driven amplifier at short notice, I hit on the following dodge. I obtained an empty mustard tin, of oval shape, about 1¾in. deep. First, I drilled a ½in. hole in the centre of the lid (to take the neck of an ordinary single circuit jack), and then I drilled another 3/16 in. hole in the bottom of the tin for the output grid lead.

THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Practical Hints." DO NOT enclose Queries with your hints.

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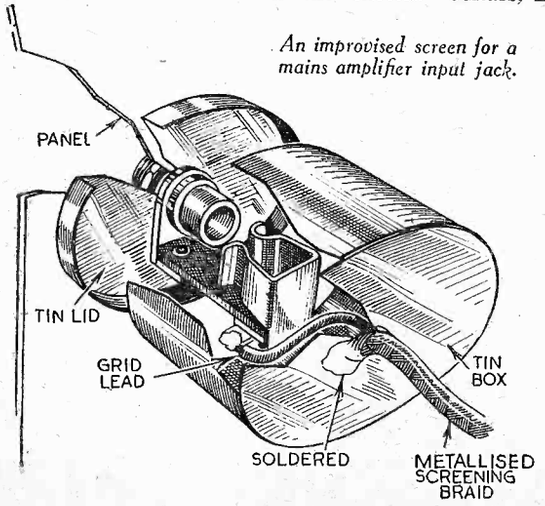
It was but a minute's work then to push the jack through the lid (using it instead of one of the spacing washers) and screw it up tight to the panel. I then pushed the lead through the hole in the bottom of the tin—pushed the box on to the lid, and the jack was completely enclosed and screened. The remainder of the grid lead between the screening box and the valve pin was covered with metallised braiding, soldered at one end to the box, and earthed to chassis at the other. This removed the last vestage of hum, and also has the merit of cheapness.—JAS. THRELFALL (Blackpool).

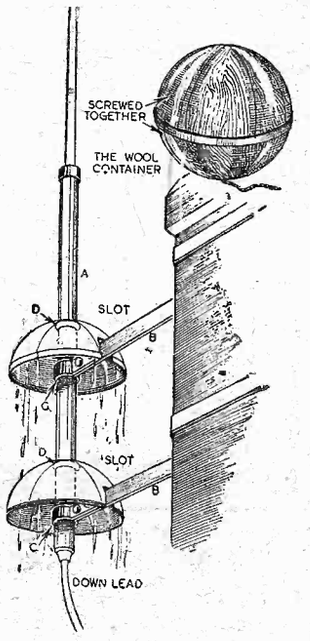


An improvised screen for a mains amplifier input jack.

Preventing Aerial Leakage to Earth

THE accompanying sketch shows a dodge for minimising aerial leakage to earth due to rain, or moisture accumulating during misty weather.

The vertical aerial, A, is supported by brackets, B, fixed to the chimney stack. The aerial rod is insulated from these brackets at the points marked C. To keep the insulating material reasonably dry for preventing leakage I used the two halves of a circular wool container, which can be purchased at any cheap stores for 6d. A hole is made in the centre of each part, and also a slot in each to fit over the brackets, as indicated in the sketch. Collars, D, are also fitted to support the semi-circular shields, the joints at these points being



A novel dodge for preventing aerial leakage to earth.

sealed with bitumen.—L. BURTON (Sheffield).

A Simple Qu

Constructional Details o Intended for Reproductio

HOWEVER good the B.B.C. Home Service may be, it cannot please every listener all the time. It can only hope to please some of the listeners part of the time.

The absence of any alternative programme has resulted in a great deal of attention being paid to gramophone record reproduction, and we describe here an amplifier which is very suitable for this class of work. Its cost, including two valves, rectifier and mains transformer, is less than £5 10s. It is very simple to build, uses only standard and inexpensive components, is economical in operation and, with a good pick-up and loudspeaker, will give a wealth of entertainment and good reproduction from gramophone records.

Further, by the addition of a simple leaky-grid detector unit, which may conveniently be pre-tuned, the amplifier can be converted into a suitable three-valve receiver for the B.B.C. Home Service. As such, it has already given a good account of itself in an isolated area.

The input to the receiver consists of a potentiometer volume-control feeding into the grid of a high-impedance triode valve of the M.H.4 class. The features of high amplification factor, combined with high mutual conductance to be found in this class of valve, enable a high stage-gain to be obtained, and the P.X.4 output valve can be adequately loaded, by transformer coupling, without the need for an intermediate L.F. stage.

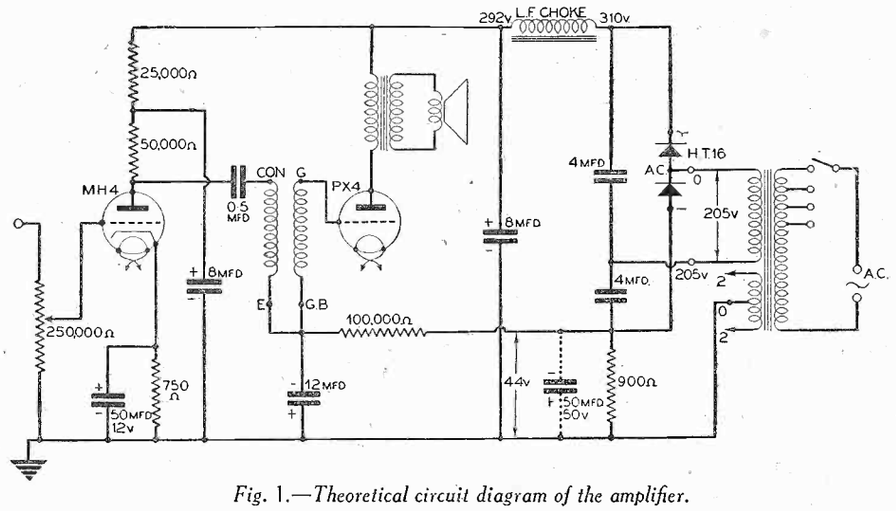


Fig. 1.—Theoretical circuit diagram of the amplifier.

Circuit Details

The anode circuit of the valve is decoupled by the 25,000-ohm resistance and 8-mfd. condenser (see theoretical diagram Fig. 1), while bias is applied to the valve by means of the self-bias resistance of 750 ohms connected in the cathode circuit. The bias resistance is shunted by the usual 50-mfd. electrolytic smoothing condenser.

The optimum load of the M.H.4 valve is 50,000 ohms, so a load resistance of this value is included in the anode-circuit.

The voltages developed across this load resistance are fed via a 0.5-mfd. coupling condenser to the primary of the parallel-feed transformer of ratio 1 : 4, the secondary of which is connected to the grid circuit of the P.X.4 output valve.

This valve has a mutual conductance of 6.0 mA./volt, with an amplification factor of 5, and gives considerable power output with an anode voltage up to 300 volts.

The valve is of the directly-heated type, and bias is usually obtained by the insertion of a self-bias resistance between the centre-tap of the filament transformer winding and the chassis, to which, of course, is connected H.T. negative of the rectifier. This biasing arrangement means a separate filament winding for the P.X.4 valve, and another for the M.H.4 (or any other preceding valves, as well of the indirectly-heated type). A common filament winding with the bias resistance in the centre-tap/chassis circuit is quite impracticable when indirectly heated, and directly-heated valves are fed from a common filament winding.

Grid-bias Arrangement

To overcome the necessity of using a non-standard mains transformer with two separate and independent filament windings, we have resorted to a rather unusual method of obtaining the grid-bias for the directly-heated output valve.

If a resistance is inserted between the H.T. negative terminal of the rectifier and the earth-line (chassis) the current flows from the rectifier through the smoothing circuit and valves and back to the rectifier through the bias-resistance, and produces a voltage drop across it.

This means that the chassis (earth-line) is more positive than the true H.T. negative of the rectifier by a voltage depending upon that produced across the resistance, i.e., on the total current flowing through the resistance and the value of the resistance.

If, therefore, we insert a 900-ohm self-bias resistance between H.T. negative of the rectifier and chassis, connect the grid circuit of the output valve to the rectifier H.T. negative terminal, and earth the centre-tap of the filament winding in the normal manner, we make the grid more negative than the heater by the amount of the voltage developed across the resistance, and thus apply grid-bias to the valve. The 900-ohm resistance produces a voltage drop of some 44 volts, which is the bias necessary for the P.X.4 valve with an anode voltage of 292 volts. The usual cathode by-pass condenser may be connected across this resistance, but it is very important to note that it must be of the 50-v. working type and that the positive terminal must be connected to the chassis,

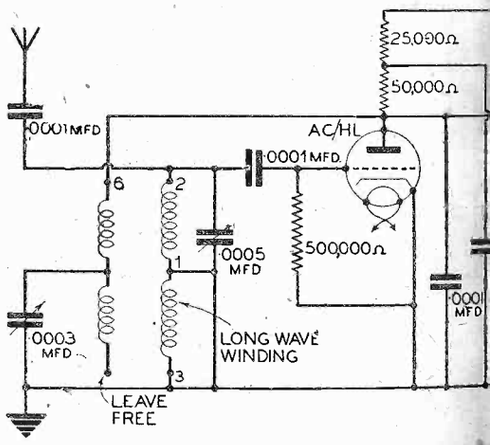


Fig. 2.—Circuit diagram of a suggested detector unit for

LIST OF COMPONENTS FOR A SIMPLE QUALITY AMPLIFIER

AMPLIFIER	£ s. d.	£ s. d.
2 insulated terminals, Bulgin type T.L.	0 0 7	
1 250,000 ohm volume control and switch, Dubilier type J	0 4 0	
2 5-pin valveholders, Bulgin VH.48	0 1 0	
1 25,000 ohm ½-watt resistance, Dubilier F½	0 0 3	
1 50,000 ohm ½-watt resistance, Dubilier F½	0 0 3	
1 750 ohm ½-watt resistance, Dubilier F½	0 0 3	
1 8 mfd. surge-proof electrolytic condenser, Dubilier 0281, style A	0 4 0	
1 0.5 mfd. tubular condenser, Dubilier 4608/S	0 1 8	
1 parallel fed L.F. transformer, ratio 1 : 4, Bulgin "Senator"	0 6 6	
1 50 mfd. 12 volt dry electrolytic condenser, Dubilier 3016	0 1 6	
1 M.H.4 valve, Osram	0 7 6	
1 P.X.4 valve, Osram	0 9 6	
		1 17 0
POWER PACK		
1 Westinghouse H.T.16 Metal Rectifier	0 13 0	
1 mains transformer, suitable for H.T.16, Varley E.P.37	1 5 6	
1 smoothing choke, 20hy. 120mA. 250 ohms, Varley DP.51	0 12 0	
1 4+4 mfd. paper condenser block, Dubilier BE.355	0 13 0	
1 8 mfd. surge-proof electrolytic condenser, Dubilier 0281, style A.	0 4 0	
1 900 ohm 10-watt power resistor, Bulgin A.R.I.K.	0 1 0	
1 100,000 ohm ½-watt resistance, Dubilier F½	0 0 3	
1 12 mfd. 50v. electrolytic condenser, Dubilier 3016	0 1 6	
		3 10 3
		5 7 3

The above prices may be subject to some slight increase in some instances due to war conditions.

lity Amplifier

Useful Unit Especially Gramophone Records

as the latter is more positive than H.T. negative (see dotted connections, Fig. 1).

A cheaper, and probably just as simple, means of smoothing the bias to the output valve is to decouple it by means of a resistance and 12-mfd. electrolytic condenser, as shown in the theoretical diagram. It is important that this resistance should not exceed a value of 250,000 ohms with the P.X.4 valve, and 100,000 ohms is a good value to use and quite effective.

It should be noted that the current of the M.H.4 valve also flows through the biasing resistance, but it is so low as to make no appreciable difference to the bias voltage developed across the resistance. Actually, the bias developed is just under 4 per cent. higher than the correct bias for the P.X.4 valve, but this does no harm. Slight over-biasing is far preferable to under-biasing.

Should it be decided to run other valves from the same filament winding, it will be necessary to take into account their total current consumption and to alter the value of the biasing resistance accordingly. For example, suppose the total consumption of the valve in use rose to 60mA and that the resistance was kept at a value of 900 ohms. It is quite a simple matter to calculate from Ohm's Law that the voltage developed across the resistance would be 54 volts, and this would mean that the P.X.4 valve was greatly over-biased. In this case, it would be necessary to use a resistance with a value of only 700 ohms to obtain a bias of 44 volts.

the amplifier.

The fact that the earth line, or chassis, is positive in respect of the true H.T. negative does not affect the bias applied to the M.H.4 valve. This is an indirectly-heated valve and derives its bias from the voltage drop across a resistance in the cathode circuit. The grid is taken to chassis and thus becomes more negative than the cathode by the amount of the voltage developed across the resistance. The fact that the chassis itself is more positive than H.T. negative does not affect the question of the grid-bias applied to this valve at all, but does result in a potential difference between the heater and cathode of the indirectly-heated valve by an amount equal to the voltage developed across the resistance in the H.T. negative lead. The insulation between the cathode and heater, however, is more than sufficient to withstand this, and there is no fear of breakdown in this direction.

The H.T. power supply is obtained from a Westinghouse metal rectifier type H.T.16 connected in the voltage-doubler circuit, with an A.C. voltage input of 205 volts. This gives an output of 310 volts at 52mA (the current of the P.X.4 and M.H.4. valves) and is smoothed by a choke of 250 ohms D.C. resistance and an 8 mfd. electrolytic condenser. The smoothed H.T. voltage is just over 290 volts. This arrangement allows of the use of a permanent-magnet type of loudspeaker.

Voltage Doubler

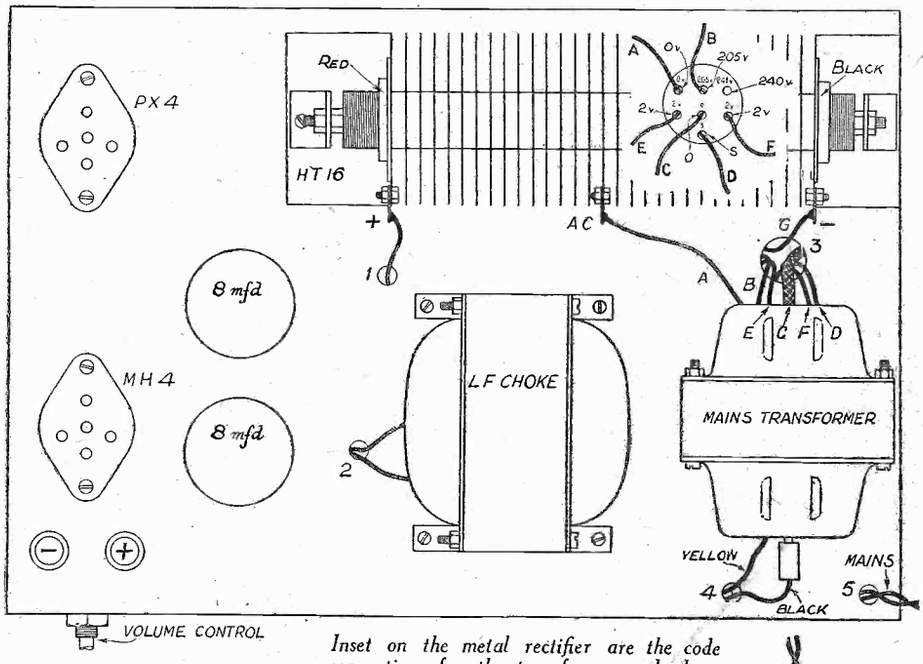
Note that the negative side of the voltage-doubler condensers is taken to H.T. negative and not chassis.

The voltage-doubler condensers are of the paper type, 500 v. D.C. working. Actually, the voltage they have to withstand never exceeds 400 volts, so that it is possible to substitute them with the cheaper electrolytic type. If it is desired to do this, it is advisable to obtain the condenser manufacturers' approval, when the type of rectifier in use, input voltage and load current, should be specified.

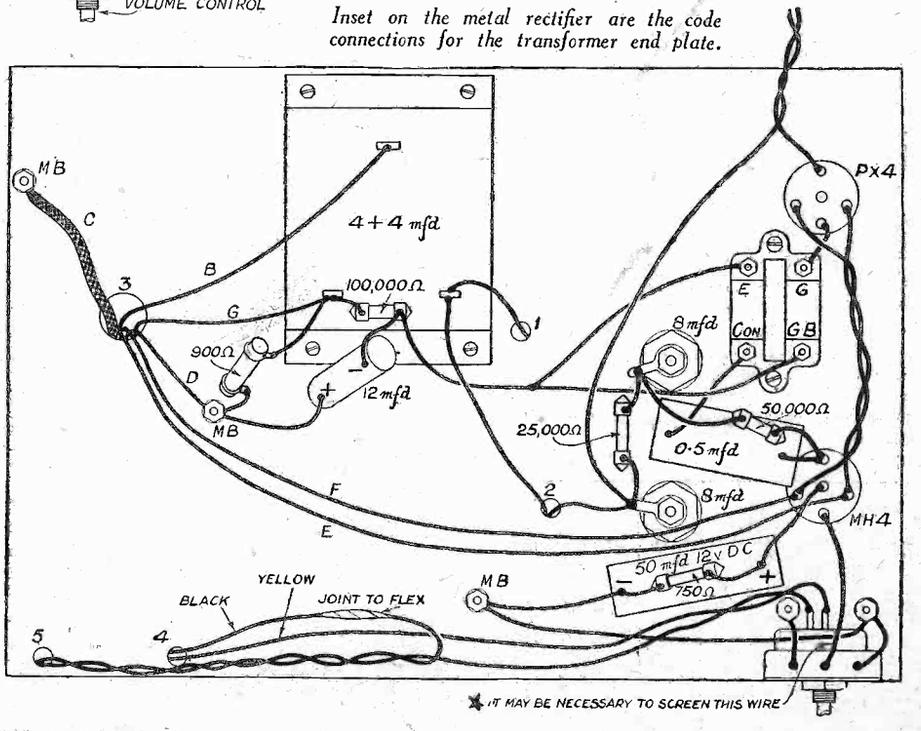
For those who wish to use a mains-energised loudspeaker, the input to the rectifier may be increased to 240 volts, and there is a tapping on the mains transformer to allow of this. In this case, the unsmoothed output of the rectifier at 52mA is some 390 volts, which, after being smoothed by a speaker field of 2,500 ohms D.C. resistance, leaves a voltage of approximately 265 volts for the amplifier valves.

(Continued on next page).

WIRING DIAGRAM OF THE AMPLIFIER



Inset on the metal rectifier are the code connections for the transformer end plate.



A SIMPLE QUALITY AMPLIFIER

(*Continued from previous page*).

As the action of the Westinghouse metal rectifier is instantaneous, a surge voltage of some 600 is produced when first switching on. The use of a directly-heated output valve limits this surge to matter of seconds only, but, even so, it is more than sufficient to break down the normal type of dry electrolytic smoothing condenser. For this reason, it is absolutely necessary to use surge-proof condensers such as the Dubilier type 0281 style A, or else to incorporate a thermal-delay switch to prevent the H.T. voltage reaching the condensers until the valves have had time to warm up, when the fact that they would take their full current immediately the H.T. was applied would prevent any large voltage surge.

Owing to the high mutual conductance of the two valves used in the amplifier, there may be some slight tendency to parasitic oscillation, which can be cured by the usual grid-stopper resistances. These were not found at all necessary in the experimental amplifier constructed.

When the volume control is turned full on, slight motor-boating may occur, depending on the "goodness" of the valves in use. This may be cured by reducing the value of the coupling condenser from 0.5 mfd. to 0.25 mfd., or by the inclusion of a stopper resistance in the grid circuit of the M.H.4, but it should seldom be necessary to have the set working full out, unless the amplifier is operating in a very large room.

Constructional Details

Construction is so simple as to need little comment. The set is constructed on an aluminium chassis, this being very substantial, easy to work, and providing good shielding and a convenient earth-return circuit, besides being very much nicer to look upon than the wooden baseboard type. The components are mounted as shown in the diagram (page 403). Make sure when mounting the rectifier that it does not rotate on its spindle and short to chassis through the cooling fins. Also, when the set is in use, take great care not to touch the rectifier at all, as the fins are connected to the actual rectifying washers, and are thus alive.

The rectifier, mains transformer, etc., are first mounted in position, the resistances and small condensers being suspended in the actual wiring, which is an extremely simple job. Once the chassis itself has been built, it should be possible to mount the components, wire up and have the amplifier ready for testing within the hour.

Having completed the wiring, there is little to be done beyond settling down to enjoy gramophone record reproduction.

There is no fuse in the amplifier, so it may be desirable, at least if you have any doubts at all as to the correctness of your wiring, to insert a 250 mA. fuse between the rectifier negative terminal and the bias resistance.

The simplest way to test the receiver is to connect a moving-coil voltmeter across the bias resistance (positive connection to chassis), switch on, and note whether or not a voltage is produced across the resistance. A reading should be obtained almost immediately.

Detector Unit

A simple detector unit for use with the amplifier is shown in Fig. 2, and consists of an AC/HL type valve tuned by an unscreened Bulgin coil type C.69, of which only the medium-wave windings are used. The long-wave grid winding is shorted out as indicated in Fig. 2, but don't connect terminal 4 of the reaction winding to earth, or you will short-circuit the H.T. supply. Leave this terminal free.

The usual 0.0001 mfd. grid condenser and 500,000 ohm grid leak are used, and the anode circuit is decoupled by a 25,000 ohm resistance and 8 mfd. condenser, and the usual load resistance of 50,000 ohms is also incorporated. The rectified voltages developed across this resistance are fed to the amplifier via the 0.05 mfd. condenser and 100,000 ohm H.F. filter resistance. H.F. filtering is completed by the two 0.0001 mfd. condensers. Reaction is also employed in the usual manner with the reaction condenser on the "earthy" side of the reaction condenser to avoid hand capacity effects.

Note that the detector valve is operated without any cathode bias.

The selectivity of such a unit is of course very low. Used near the transmitter it will allow of the best quality reproduction without any interference, nearby stations being "swamped" by the local. In more distant areas, however, it may be found necessary to use a 0.0001 mfd. pre-set condenser in the aerial lead and to adjust this, at the same time advancing the reaction control to a point just below oscillation, in order to increase selectivity. Used in this fashion, the unit is giving a good account of itself in the west of England.

The tuning condenser and the reaction control may conveniently be pre-set so that it is only necessary to switch on to receive the B.B.C. Home Service.

An efficient unscreened coil, such as the one suggested above, allows maximum stage gain to be employed, and it has been found possible, by careful adjustment of the aerial series and reaction condensers, to receive three or four foreign broadcasts with but very little interference. The unit is, however, intended for "home consumption" only.

NEW SERIES

RADIO ENGINEER'S POCKET-BOOK

No. 1

Frequency Formula

Formula for frequency is: $f=\frac{10^6}{2\pi\sqrt{LC}}$ where L = inductance in microhenrys and C = capacity in microfarads.

Wavelength of Tuned Circuit.

Formula for the wavelength of a tuned oscillatory circuit is: $1884.96\sqrt{LC}$, where L = inductance in microhenrys and C = capacity in microfarads.

Inductance

The formula for inductance in microhenrys is $L=\frac{9.86lD^2N^2K}{1000}$, where L = inductance, D = diameter of coil in centimetres, l = length of coil in centimetres, N = number of turns per centimetre, and K = a constant. See table.

Inductance Reactance

Calculated from the formula $2\pi fL$, where f = frequency and L = the inductance.

This Table shows the Value of K, which must be Calculated from $\frac{D}{l}$

$\frac{D}{l}$	K	$\frac{D}{l}$	K
4.00	.3654	1.25	.6381
3.75	.3743	1.00	.6884
3.5	.3944	.90	.7110
3.25	.4111	.80	.7351
3.00	.4292	.70	.7609
2.75	.4545	.60	.7885
2.5	.4719	.50	.8181
2.25	.4972	.40	.8499
2.0	.5255	.30	.8838
1.75	.5579	.20	.9201
1.5	.5950	.10	.9588

No. 2

Capacity of Variable Condensers

$$C=\frac{.0885NS}{1{,}000{,}000\ d.}$$

Where N = Number of moving vanes.
S = Area of one moving vane in square centimetres.
d = Air gap between moving vanes and fixed vanes in centimetres.

H.F. Transformer Ratio. (n) $n^2=\frac{R}{R_0}$

R being the dynamic resistance of the tuned circuit and R_0 the A.C. resistance of the valve.

Stability in Screen-Grid Stages.

One Stage.

Stable if $\frac{\omega\ g\ Co}{\sigma_1(\sigma_2+\sigma v)}$ is less than 2.

Co = residual anode-grid capacity in farads.
= .001 × 10—12 for Cossor S.G. Valves (all types).
= .0045—10—12 for Cossor MS/Pen A.

σ_1,σ_2 = conductance of grid and anode* circuits respectively.
= 1/R where R = dynamic resistance in ohms.

σv = anode filament conductance of valve.
= $1/R_0$.

Two Stages.

Assuming identical tuned circuits throughout, and ignoring damping effects of valves on tuned circuits.

Stable if $\frac{\omega\ Co\ g}{\sigma^2}$ is less than 1.14 (Tuned Anode).

or if $\frac{\omega\ Co\ g}{\sigma^2}$ less than $1.14n^2$ (Tuned Transformer).

where σ = conductance of tuned circuit (secondary) and n = transformer ratio.

* In the case of transformer coupling, or its equivalent, replace σ_2 by $n^2\sigma$, where n = transformer ratio, σ = conductance $\left(=\frac{1}{R}\right)$ of tuned secondary.

No. 3

Wavelength-Frequency Conversion Table.

Metres to Kilocycles.

Metres.	*Kilocycles.*	*Metres.*	*Kilocycles.*
5	60,000	370	810.8
6	50,000	380	789.5
7	42,857	390	769.2
8	37,500	400	750
9	33,333	410	731.7
10	30,000	420	714.3
25	12,000	430	697.7
50	6,000	440	681.8
100	3,000	450	666.7
150	2,000	460	652.2
200	1,500	470	638.3
205	1,463	480	625
210	1,429	490	612.2
215	1,395	500	600
220	1,364	510	588.2
225	1,333	520	576.9
230	1,304	530	566
235	1,277	540	555.6
240	1,250	550	545.4
245	1,225	560	535.7
250	1,200	570	526.3
255	1,177	580	517.2
260	1,154	590	508.5
265	1,132	600	500
270	1,111	650	461.5
275	1,091	700	428.6
280	1,071	750	400
290	1,034	800	375
295	1,017	850	352.9
300	1,000	900	333.3
310	967.7	950	315.9
320	937.5	1,000	300
330	909.1	1,250	240
340	882.3	1,500	200
350	857.1	1,750	171.4
360	833.3	2,000	150

Note.—To convert kilocycles to wavelengths in metres, divide 300,000 by the number of kilocycles.
To convert wavelengths in metres to kilocycles, divide 300,000 by the number of metres. One megacycle = 1,000,000 cycles or = 1,000 kilocycles. Thus, 30,000 kilocycles = 30 megacycles.