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HOME-MADE COILS

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ROUND THE WORLD OF WIRELESS

Short-wave Reception

The increasing interest in short-wave reception has led many amateur receivers, but unfortunately the present period seems very unsuitable for short-wave long-range reception. Conditions have been very bad on some of the short-wave bands and it would appear that these conditions will remain until later in the month. However, by the use of suitable apparatus it is possible to obtain good results, but do not be disheartened if, when you try to get a given station, you are unable to hear it. If you need to increase the H.F. of your receiver, a two-stage regenerative unit such as is described in this issue will be of great assistance, or if you wish to build a new receiver, the three-valve described in this issue will prove a very good general type of set. It should be remembered, in connection with short-wave reception, that very few amateurs can now be heard. Most countries have suspended amateur activities, and therefore there is very little to help in judging the performance of a receiver, other than the standard commercial broadcasts, and it is therefore necessary to listen at the correct times on the correct wavelengths, rather than to listen at any odd times in the hope of hearing something.

French Licence Increase

A has been made in the French wireless receiving licence fees. For crystal receivers the new rate is fr.15, and for valve receivers the new rate is fr. 90. A separate rate is charged for receivers used in places of public entertainment, and for this the rates are fr. 180 if the entertainment is free, and fr. 280 if a charge is made for admission.

Anniversary

This month marks the anniversary of the death of Professor Hertz (January 1st, 1894). On January 7th, 1927, the first transatlantic service was opened, and on the following day in 1929 the first outside broadcast was given by the B.C. This was a performance of the "Magic Flute" from Covent Garden.

Off to Hollywood

Luke Belle and Scotty, top-ranking rural entertainers at WLW, are to be starred in the movies. They left recently for Hollywood, and on arrival will start production on "The Village Barn Dance." Both have been under contract since August with Republic Pictures to be filmed in two shows this year, following the success of their first movie venture "Stone on, Harvest Moon," which starred Roy Rogers and Kidolmers. As soon as their work in Hollywood is completed, probably early this month, Luke Belle and Scotty will return to WLW, to appear again on the "Boone County Jamboree" and their own morning program.

Known in real life as Mr. and Mrs. Scott Wiseman, Lulu Belle and Scotty have been in radio six years. In 1930 Lulu Belle was selected radio's queen in a nation-wide listener poll.

Alternative Programmes

The B.B.C. announces that listeners who find difficulty in receiving the Home programme on either of the two wavelengths, 301 or 49.9 meters, are advised to try, after 6 p.m. any evening, the wavelength 342 meters. They may find that this wavelength, which is marked on most receivers "London Regional," will give them more satisfactory reception.

Symphony Orchestra

The B.B.C. announces that the B.B.C. Symphony Orchestra, leader Paul Beard, conducted by Sir Adrian Boult, will visit the Town Hall, Cheltenham, on Thursday, January 11th, to give two concerts, one in the afternoon and one in the evening. On Wednesday evening, January 17th, the Orchestra will visit the Central Hall, Newport, and on Wednesday evening, January 24th, the Orchestra will play at the Pavilion, Bath.

Extremes of Dance Music

Robinson Russell is to present on Saturday, January 6th, a programme called "Extremes," which will be played by the "Sweet Rhythm Quartet," known for their broadcasts from Costorphine, Edinburgh. "Extremes" will be of Cuban Rumba music and sweet rhythm. The players are Ronnie Austin (violin), Percy Pegg (piano), Ralph Smith (bass), Jack Collin (guitar), with Betty Roberts, vocalist.

Africa Flight

Val Gielgud's "Africa Flight," which was produced for the stage last year, has now been adapted for broadcasting and will be heard on January 4th. This is the story of a plane which makes a forced landing in the heart of Africa. The theme of the play is the way in which different members of the crew and the passengers face up to the hazardous situation in which they find themselves.
Home-made Coils

Essential Factors which Must Be Considered When Designing and Making Coils. If Unsatisfactory Results are to be Avoided

By L. O. SPARKS

CONSIDERABLE interest is now being shown by serious constructors in the winding of the coils required for their transmitters, or experiments, and it would appear that a few guiding remarks would not be amiss. For example, while coil design and construction can form a most interesting and fascinating subject, and, incidentally, save money, there are several considerations which, if not fully appreciated, can introduce very disappointing results.

Complete constructional details of coils for aerial and H.F. circuits, condensers, and transformers have been given more than once in past issues, and the present article deals with what might be termed practical considerations and simple formulae associated with tuning coils of normal design.

General Design

The object of winding any coil for radio purposes is to provide a certain value of inductance, and if the property of inductance is examined, it will be seen that there are certain unavoidable factors which must be avoided if the most efficient results are required. Without going into theoretical reasons too deeply, the following can be taken as those things which must be eliminated, as much as possible, when undertaking the winding of a coil. Self-capacitance, Resistance, Poor insulation. Large magnetic field and fragility.

Self-capacity

When any winding has a high value of self-capacitance, its effective inductance is reduced considerably or, in other words, part of the sole object of winding the coils is lost. A most striking example of this is a poorly-designed H.F. choke, the purpose of which is to stop the flow of high-frequency currents by presenting a barrier in the form of inductance. If the choke formed by connecting several puddle-wound coils, close together, on a slotted former of poor material, in series, then it is possible that the sections of the complete winding will act as the plates of a fixed condenser, and form, virtually, a condenser of measurable value. The resultant effect would be similar to connecting a small condenser across the choke; therefore, if one bears in mind that the reactance (this can be likened to resistance) of an inductor increases as the frequency increases, while that of a capacitor decreases, under the same conditions it will be appreciated that the H.F. choke will no longer possess an impassable barrier to the H.F. currents, owing to the fact that the condenser will offer to them a path of very much lower resistance, and thus kill the sole object of the inductance forming the choke.

With ordinary tuning coils, particularly those intended for use on the medium and short wave-bands, this property of self-capacity will not only directly affect the overall efficiency and characteristics of the tuned circuits, but it will also reveal its presence when one comes to check the wave-band width of any given coil with a pre-determined variable condenser. The self-capacity would, in effect, increase the total capacity across the circuit and thus increase the minimum tuning wavelength. On the short and ultra-short wavelengths, when the frequencies soar to very high figures, the matter becomes more serious, so much so, in fact, that, as an examination of any good short-wave coil will show, the necessary windings are built up with turns quite widely spaced from each other.

The simplest way of avoiding this self-capacity, therefore, is to use coil formers of reasonable diameter, say, a minimum of 1 in., and wind the coils in the simple single layer solenoid fashion. It can be noted, however, that the trouble is not so pronounced with coils designed for long-wave work, but this does not mean that it can be ignored completely, but only that the lower frequencies concerned and the fact that a certain capacity across the coils will help to bring their fundamental wavelength closer to the band width required for this section, a little more latitude in design is permissible. A solenoid single-layer coil to cover, say, 900 to 2,000 metres with a .006 mil.

Figs. 1 and 3.—Self-capacity can be likened to a small condenser across the winding, as shown on the left. A typical slotted former often used for the winding of the L.W. section is shown on the right. A variable condenser, would, unless very fine wire was employed, become rather clumsy for average set work, so one is forced to adopt some sectionalised winding method for this section.

Resistance

When speaking of resistance in relation to coil windings, it is not meant to infer the normal resistance to direct current, but that offered to the high-frequency alternating currents which are dealt with in the circuits preceding the detector valve.

The H.F. resistance of a condenser might be many times that which it would offer to a steady direct or low-frequency alternating current, and this is largely due to what is known as the "skin effect." This effect obtains in any conductor and the peculiar paths taken by H.F. currents which, unlike the more familiar.D.C., tends to avoid the heart of the conductor and seeks to flow on the outer surface or skin of the conducting material. In addition to the above, quite serious losses can be introduced into coil circuits carrying H.F. currents by poor insulation, and the presence of other conductors within the effective field of the winding under consideration. The losses can be caused by using formers of poor insulating material, poor dielectric strength of supporting insulation pillars or mountings holding the coil or any metal, such as other conductors or screens too close to the insulators; therefore, here a subject which, especially in that sphere of radio, must receive every consideration. Many a constructor, no doubt, have seen or used the S.W. coils wound with hollow copper tubing, such as those used in many amateur transmitting stations, and these can be taken as an example of the attempts to reduce the H.F. resistance of the circuit by providing the largest skin area possible, within, of course, reasonable limits.

So far as ordinary dual-range coils are concerned, the best one can do is to use formers of high insulating material, and wind the best material, consistent with available space. This must not be taken too literally; it is not intended to suggest that 18 or 12 S.W.G. wire should be used for medium and long-wave requirements. If space permits using, say, 26 S.W.G. instead of 30 S.W.G. for the medium-wave section, then the former would be the more satisfactory, but the ultimate choice is so often governed by the size of the coil former, so the best way to set about designing a coil, when one does not have to consider space to a fraction of an inch, is to decide on what wire you are going to use and then select a former which will carry the required number of turns, but more about that later.

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Some Old Circuits Revived

The Experimenters Describe Some Circuit Arrangements Which Have Almost Been Forgiven, But Which May Be Worth Trying by Those Readers Who Have Not Previously Seen Them

It is not always easy to think of new experiments which can be tried, but many readers will probably find interest in testing a few of the circuits used in the earliest days of broadcasting. In many cases it will be found that not only do the circuits provide interesting experiments, but that they are by no means inefficient. We were reminded of this recently when turning the pages of an old notebook in which a record of all experiments carried out were recorded.

Series Tuning

One of the earliest entries, made in 1922, was based on the theme that a tuning circuit is most efficient when it contains a maximum of inductance and a minimum of capacity. It went on to record that reception with a single valve (one of the old "R" valves, no doubt) receiver was appreciably better when using a series condenser for tuning, in place of the more customary parallel one. The connections to the aerial coil and tuning condenser were as shown in Fig. 1, where it will be seen that the series-tuning condenser is between the aerial and the top of the grid coil. Incidentally, however, it could be used equally well in the earth lead, as indicated by broken lines. Often, the earth connection is better, since there are then no high-capacity effects.

One fault with this arrangement is that selectivity is somewhat reduced by the series-tuning system. It is also evident that sensitivity must fall off at the minimum position of the tuning condenser is approached. The latter fault was less noticeable in 1922 than to-day, since the minimum capacity of a tuning condenser was much higher, in relation to the maximum, then than it is now. Still, you might consider it worth while to try this tuning circuit. The coil used in the 1922 tests was a number 75 plug-in, but a standard tuning coil can be employed.

"Tuned " Reaction

The old-fashioned "swinging-coil" method of reaction was used, where the reaction coil took the place of the H.F. choke used now, and was movably coupled to the aerial coil. Another form of reaction is shown in Fig. 2. However, this having formed the subject of another paragraph in the notebook. The underlying idea was that there is a certain amount of capacity between the grid and anode of a three-electrode valve, and that if the anode circuit were tuned to the same frequency as the aerial circuit, the capacity would serve for reaction coupling. As most readers are aware, a circuit tuned to a particular frequency has an infinite resistance to signal currents at that frequency.

According to the notebook, best results were obtained by employing a variometer for tuning the anode circuit, although reaction could be obtained with a coil-condenser circuit. The advantage of the variometer is that it is a variable-inductance device and is not shunted by a condenser. If you have an old variometer in the junk-box you can easily try this reaction arrangement, and draw your own conclusions. It should be mentioned that a variometer of the kind originally intended for tuning in the aerial circuit will not serve unless it is connected in series with a small coil consisting of about 20 turns on a 2n. diameter former. One of the type designed for tuned anode coupling will serve without the addition of a coil. The reason for the difference is that in the early days the aerial was always joined directly to the top of the aerial variometer, with the result that the inductance and capacity of the aerial were added to the corresponding properties of the tuning circuit.

The Original Reinhart

A modified form of Reinhart circuit is employed almost universally for reaction control to-day, but the original Reinhart, which was in use up to about 1923, was somewhat different from the modern version. A single-tapped winding was used for tuning and reaction, and the end of the reaction portion of the winding was connected to the aerial, as shown in Fig. 2. By this method of connection the reaction turns serve as both reaction and aerial-coupling winding. Reaction is controlled in the usual manner by means of a .0003-mfd. variable condenser, this being connected between the anode of the detector valve and the aerial.

An H.F. choke is shown in Fig. 2, and is desirable, although the circuit in our notebook does not include this; instead, the necessary H.F. impedance was supplied (or was supposed to be supplied) by the

phones. If you wish to try this circuit you can use any standard tuning coil, or you can wind 75 turns on a 3n. diameter former, and take the earth tapping at the fifteenth turn. It will also be better to insert a .0002-mfd. pre-set or fixed condenser in the aerial lead at the point marked X in Fig. 2.

One Valve for H.F. and L.F.

Prior to 1926, or thereabouts, so-called

Fig. 3.—A modern version of an old-type reflex circuit, using a triode detector.
A Modern Reflex

The reflex circuit which we found most successful was similar to that now given in H.P. It has been seen, however, that the Fig. 3 circuit has been brought fairly well up to date by the use of decoupling for the tuning shaft and the use of an H.F. (or L.F.) pentode for amplification. We have actually used a circuit of this kind during more recent years, and it is by no means unsatisfactory as might be imagined. The quality would not please the music critic, but it need not be bad. It will be seen from the circuit that the H.F. and detector stages are conventional, but that the secondary winding of the

L.F. transformer is fed back to the grid circuit of the H.F. valve, instead of being connected to a third, or ordinary L.F., valve. The secondary has a .002-mf. fixed condenser in parallel with it to by-pass H.F. currents in the tuning circuit, but it is often possible to reduce the value of this condenser to .001 mf. without upsetting the H.F. stage; there is then a certain improvement in the quality of reproduction. Standard components can be used throughout this circuit, and the voltage applied to the screening grid of the H.F. pentode should be as high as possible without impairing H.F. efficiency. The higher this voltage, the greater will be the L.F. output, although this can never be high when using an H.F. pentode. That is why it is worth while trying an economy output pentode, such as the Cosgro 220 H.P. With that valve, and when using a maximum of 300 volts H.F., the screening grid voltage can be about 90 and G.H. 3 or 4 volts.

Full-wave Detection

One of the aims of those experimenters who favour the crystal detector has always been to obtain full-wave rectification, with consequent increase in volume. It is one of those things which looks all right on paper, but which seldom works out in practice. The circuit shown in Fig. 4 brought back memories of many valiant struggles when it was found in a 1921 notebook; it is one of many arrangements which were tried, with indifferent results. Two crystal detectors were used, and the series connection from the two earpieces was brought to a center tap, which had been located on the winding of the coil. Despite all efforts to find the exact centre-tapping point, we were never successful in obtaining any better reception than could be obtained from a single crystal.

An Improved Unit for Use
in Conjunction with Motor-driven
Preset Tuning Apparatus

A COMMON form of station-selecting switch is a motor-driven preset-tuning apparatus consists of a rotor or commutator drum, which is mechanically coupled to a reversible electric motor and to the tuning shaft of the receiver, and a stator which supports a number of station-selecting contacts radially round the periphery of the rotor.

The rotor may consist of two commutator segments separated by narrow strips of insulating material; the stator usually consists of a semi-circular strip of metal formed with a longitudinal slot and mounted concentrically with respect to the rotor; station-selecting contacts are usually frictionally supported in the groove in the stator and may be slid in the groove and thus moved radially with respect to the rotor to vary the stations they select.

A disadvantage of this arrangement is that the angle through which anyone contact may be displaced in one direction is limited by the position of the adjacent contact in that direction: thus if a contact is set to select a station at one end of the wave-band, and it is desired to change the selection for a station at the other end of the wave-band it is usually necessary to move the station-selecting contact nearest to the desired position into that position, and move the remaining contacts up one.

This tedious and time-wasting proceeding may be avoided by constructing the station-selecting contacts so that they may be removed readily from the stator groove.

An improved station-selecting contact of this kind is illustrated in the accompanying illustration and consists of a hollow post 1 formed with a knurled head, 2, and provided at the opposite end with a substantially rectangular flange or plate 3. A strip, 4, of insulating material of similar shape is mounted in the upper surface of the plate, 3, and the dimensions of the plate and strip are such that their width is less than the width of the slot in the stator and their length is greater than the width of the slot. The stator is illustrated at 13, and the post 1 may be placed in the stator slot by holding it by the knurled head with the long edges of the plate parallel to the sides of the slot, and it is then rotated through 90 degrees to prevent withdrawal.

The upper surface of the strip 4 is preferably provided with a short, cylindrical projection, where by a projection is formed which lies between the side walls of the slot, and keys the station selector contact to the slot.

The post 1 is held in the slot by means of the insulating bush 5 which is urged by a spring 6, bearing against a washer 12, into engagement with the upper surface of the stator. The spring 6 also bears against a collar 7 on a sleeve 8 and the sleeve 8 is threaded internally and mounted on a screwed threaded section of the post 1. The sleeve is rotated in the correct direction to force the bush 6 into firm engagement with the upper surface of the stator 13, and locks the post in the selected position within the slot.

When it is necessary to alter the position of the post the pressure on bush 5 is reduced by rotating the bush 8 in the reverse direction, and the projection 4, which is a turn in the opposite direction, so that the relatively light pressure of the spring 6 serves to keep the bush 6 aligned along the groove. When it is desired to remove the post from the stator the sleeve 8 is rotated through 90 degrees to prevent axial movement of the post, and the post is depressed to withdraw the projecting portion of the plate 3 and strip 4 from the groove and then turned through 90 degrees and lifted out of the slot.

A plunger or contact-making member 9 is slidingly mounted in the bore of the post 1, and is urged by a spring 10 into engagement with the rotor indicated by the line 14. The spring 10 is secured to the plunger 9, and the post 1, in any suitable manner to prevent the plunger from being completely withdrawn from within the slot.

A terminal number 11 for a conducting lead may be riveted or otherwise secured to the heads of the post 1.

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Tone Control by Negative Feedback

Further Notes on How Negative Feedback can be Used for Controlling Tone Value

(Concluded from page 332, December 30th issue)

A further embodiment of the system is shown in Fig. 5. The A.C. output potential used for counter-coupling is connected to the series connection of the resistances $R_1$, $R_2$ and $R_3$. The sliding contact $S$, connected to the cathode of the valve $V_1$, is shown in Fig. 9. In this arrangement the counter coupling and, therefore, the amplification for the medium tone frequencies remains approximately equal, whereas the counter coupling for the high- and low-tone frequencies may be made small, whereby these frequencies are raised.

If in the circuit shown in Fig. 5, the parallel circuit is replaced by a series circuit, we obtain the control curves shown in Fig. 10, in which the high- and low-tone frequencies may be attenuated or raised as desired with respect to the mainly constant medium-tone frequencies.

Circuits with control curves according to Figs. 9 and 10, are suitably applied in such cases in which one can reckon with a constant medium input A.C. potential, when a constant medium output volume is desired, and a pure tone control is intended.

Circuit arrangements with parallel circuits will often be given preference because the self-capacity of the coil goes into the capacity $C$. In the ease of the series circuit the self-capacity of the coil $L$ has to be taken so small, that for the frequency range in question, the capacitive resistance of the coil is still sufficiently high.

(Continued on page 348.)
A Musical Taste
Our Music Critic, Maurice Reeve, Discusses Popular Melodies

O NE's taste, or fancy, is a most peculiar thing. Often it is quite unaccountable. And it is no more predictable in music than in anything else. Just as we meet on our travels with two of a kind—anything of the thousand-and-one things we handle during the course of our passage through this transitory life, two pieces of soap, maybe, or two kinds of cigarette, one of which, for no apparent reason, flourishes and luxuriates by the side of the other—so do we find with two pieces of music. An ordinarily musical man may hear two pieces of music of the same genre—anything from symphonies to swing—and both may appeal to him as being equally good in their own particular sphere. Yet one may be the public's favorite. And again, when a work like Schubert's Unfinished Symphony is taken to the people's hearts out of a collection of nine, of which most people are almost ignorant, except the ninth, we don't ask why. Because, in a case like that, one possesses such an unmistakable quality and exercises such an irresistible appeal on our thoughts and emotions that the reasons are obscure, even though we may not be able to give adequate expression to them.

But the most remarkable instances are of works in which the public insists on taking to its hearts and bestowing on them its signal favours, but which are, in the unanimous opinion of everyone who knows anything about the subject at all, inferior as works of art to their companions in the collection bound up within the same covers. Among such instances may be cited Rachmaninoff's famous Prelude in C Sharp from his 'Op. 1 No. 2' movement on Black Keys, Schubert's Ave Maria and Serenade, Elgar's 'Pomp and Circumstance' march, containing 'Land of Hope and Glory,' and there are scores of examples from opera, musical comedy and revue which are nothing but a collection of tunes and melodies. For some unaccountable reason the public takes one of them and crowns it favourite, when very often some of the others in the mauseleum are just as good, and better. It is passing strange, and defies analysis.

Popular Melodies
Up to a point, so far as a general type of music or mood in music is concerned, there is a remarkable fact, the reason for which could only be solved by passing right beyond the confines of music and on to psychology and the national character and temperament itself. I start my presentation of this fact (I shall not attempt to give reasons for it, here, at any rate) by appending a representative list of twelve compositions, the universal popularity of which, if any, readers would care to dispute.

1. Moonlight Sonata, first movement.
2. Rachmaninoff's Prelude.
3. Chopin's Funeral March.
5. "One Fine Day," from "Madame Butterfly."
8. "Annie Laurie."
9. "Lost Rose of SOMMER."
10. Schubert's Unfinished Symphony.
11. The Indian Love Lyrics, by Woodforde Finden.
12. "In a Monastery Garden."

Please note that I have not attempted to place these in any order of supposed popularity. I have merely put them down as the titles occurred to me.

Whilst admitting the enormous popularity of works like "Poet and Peasant" and "William Tell" (both of which are more or less abruptly divided into two parts, grave and gay), I doubt very much whether there would be a majority vote for their inclusion in my list to the exclusion of any two of my first choices. In any case, it wouldn't affect the propriety of my selection if we judge the popularity of a composition by the welcome given to it whenever it is performed, which must, after all, remain the final arbiter. Of course, I am quite prepared to admit that, at given moments, works like "The Lambeth Walk" or "Tea for Two" might elbow their way through to the front of the queue. But I feel that their presence is very ephemeral and transitory, whereas the others are permanent.

What is the extraordinary thing about this list? Why, that every piece in it is of a sad or contemplative character. There is not one single lively or jolly number in it from beginning to end. It is so remarkable, in fact, that you may think there is something "phony" about it. But that is not so, as a brief examination will show.

I set out to think of twelve tunes which I thought the vast majority of people would find most acceptable on all ordinary occasions, such as when visiting theatres or cinemas, restaurants or cafes, etc., and for the life of me I couldn't think of one lively one that I, personally, have heard played on such occasions. Turn on your radio and listen to the many salon combinations that broadcast so frequently; they play at least eleven of them more often than almost anything else. A small gramophone record makes which records have the largest daily-to-day sales. You may ask why Chopin's Funeral March? Why our Wedding March? Well, whilst neither are ever played as entertainment, the Funeral March stands by Chopin for its occasion, whilst the Mendelssohn at least shares the honours with Wagner's from "Lohengrin." I venture to suggest that a public funeral without Chopin's work would be talked about as something of a novelty (has it ever been known), whilst thousands of bridal couples are preparing for the day against music out of preference to Mendelssohn's.

A Surprising Encore
I will tell you of an experience I had a short while ago. Although I vouch for it, I shall forgive you if you choose to doubt it. It was remarkable, and surprised me and others at the time. The last occasion in which I gave a piano recital at one of the biggest girls' public schools in the north of England—Casterton, at Kirkby Lonsdale—I was awarded the customary encore. But instead of playing something of my own choice I invited my audience to make their own selection. I told them it was at my expense. I was, of course, a case of the biggest girls' public schools in the north of England—Casterton, at Kirkby Lonsdale—I was awarded the customary encore. Furthermore, the suggestion was welcomed with sounds of applause and the performance of it accorded with a public enthusiasm as that given to anything else on my programme! Although it greatly surprised me as well as the Head Mistress and everyone else, I felt it to be an indisputable proof of the trend of thought of a large body of people, and juveniles to boot, which think we interest thinkers in other branches of thought as well.

Strauss waltzes would be certain to gain a large number of votes on any occasion, and at any time, but I cannot think of any merry and bright work that I would consider as likely to hold the affections of the majority, and to be agreeable to them on all average occasions, as the type of piece which makes up my list. Try and form one for yourself, and I'll wager that sad, dreamy, contemplative music will gain the majority of places every time. Think of the pieces of this kind that I did not find a place for but whose popularity is unquestioned: Liszt's Liebestraum, Chopin's Nocturnes, Debussy's Clair de Lune, Schumann's Träumerei, Rubinstein's Melody in F, as well as all the famous ballads like "Little Grey Home in the West," "Bird Songs at Eventide," "Un Til," "Because," "Trees," and a myriad of others. You'll have had a lively one amongst the first hundred.

PERSONAL PARAGRAPHS
George Taylor, who used to be with Whiteley Electrical, is now fixed up as engineer for E. Lincoln and Company, the London printers. Mr. Taylor commenced his new duties on January 1st.

H. Mitchell is back again at the Burndoze and Vidor offices as publicity manager. He had been at Baird's for some time.

Sir Louis Sterling has been elected vice-chairman and managing director of A. C. Censor, Ltd., and Mr. Thomas has resigned his managing directorship. Mr. Thomas has also tendered his resignation as chairman of the R.M.A.

PRACTICAL MECHANICS HANDBOOK
By F. J. CAMM
6th or 6th by post from George Naeon, Ltd., Tower House, Southampton Street, W.C.2.
Back Issues Wanted

Mr. C. P., of Muswell Hill, urgently requires Practical Wireless dated January 19th, 1935, January 26th, 1935, and February 2nd, 1935. These issues are entirely out of print, so if any reader can oblige perhaps he will let me have them.

C. P. served in the last war, but is unfortunately not able to serve in this as he was invalided from the service. Wireless is his sole recreation, and the issues concerned will help him to complete a set.

The Battery Racket

REPORTS continue to reach me that dealers are splitting up H.T. batteries and selling the individual cells at 4d. each. In each case I have reported the matter to the appropriate authorities. In the meantime, I suggest that the Associated Radio Battery Manufacturers should investigate this matter at once.

You have observed that the Board of Trade have an eye on the matter, for their first order under the Prices of Goods Act includes electric torches and accessories, including batteries and bulbs. Unfortunately, this order did not come into force until January 1st. By that time manufacturers undoubtedly caught up with the delivery of price-maintained goods. The colossal demand has ceased, and the profiteers have vanished. I suggest that the Order should have been immediately operative. As from January 1st it was an offence to sell such goods at higher prices than those ruling on August 21st last, plus a permitted increase which must be calculated as defined in the Act. The hire purchase Trade Association has issued a bulletin on the matter in which it states that there is a duty on every supplier of goods during the continuance of the war to endeavour to keep prices down to the lowest possible level, as it is necessary that the cost of living shall not be needlessly inflated. The feeling in the country against profiteering is intense.

Presentation to Lt.-Col. Ozanne

About 60 members of the R.M.A. had their first wartime lunch at the Russell Hotel recently, with Mr. W. W. Burnham in the Chair. Mr. A. F. Bulgin presented Lt.-Col. G. D. Ozanne with a gold cigarette case, and a piece of jewellery for his wife, in appreciation of his efforts in organising Radiolymphia. Mr. Leslie McMichael also referred to Lt.-Col. Ozanne's work. I, too, should like to pay my tribute, for I know the enormous amount of work he put in to make this year's Radiolymphia a success. His efforts were only defeated by the war.

The Output Stage

It is a prevalent idea that an improvement follows the fitting of a new speaker. Most speakers will function with an efficient receiver provided that they are connected in a suitable manner. This is because any valve operates most efficiently when the impedance connected in its anode circuit is of a fairly critical and definite value; this value is called the "Optimum Load," and is measured in ohms.

The Transformer Ratio

It is evident that a speaker of different impedance could not be employed for each type of output valve, and therefore some simpler system must be devised. All listeners know that a transformer can be used to "step up" or "step down" A.C. voltages, and it is this instrument which is used for the purpose under discussion. If one knows the optimum load required by the valve and also the impedance of the speaker to be used with it, one can find a particular transformer ratio with which the valve and speaker will be matched. In the case of a moving-coil speaker the correct ratio is obtained by dividing the optimum load by the speaker impedance and taking the square root of the answer.

Readers' Change of Address Column

I am happy to comply with a request made that I include a regular column of readers' changes of address. Where these addresses relate to the Army, I am, of course, unable to publish them, but I can include the reader's name and district and offer to forward letters. Readers who wish to keep in touch with one another are offered the facilities of this column.

Coupling Condenser Values

A TECHNICAL question I frequently receive relates to the values of coupling condensers. The value of the coupling condenser depends upon the stage of the receiver in which it is employed, and the correct value of the condenser is best found by experiment. In the case of a detector valve, the value depends to some extent upon the constants of the valve and upon operating conditions. In a power grid detector, for example, where the coupling condenser usually is smaller than the conventional 0.003 mfd., say 0.001 mfd., and the valve is operated at a high anode voltage and current, a much smaller grid leak, generally of the order of a quarter megohm, is necessary. A fairly wide range of choice is usually given for the value of the coupling condenser in low-frequency resistance-capacity coupled amplifiers. A capacity value between 0.005 mfd. and 0.05 mfd. will be perfectly satisfactory, but the actual choice depends very much upon the band of frequencies it is desired to pass. If the set builder wishes for full round tone with plenty of bass, then the value of 0.05 mfd. or even greater should be chosen, while a lower value, by cutting off some of the bass, will give a higher pitched and perhaps more brilliant tone.

Physical Jokes

The B.B.C. has now good reason to believe that several million men and women listeners have settled down to the routine of the early morning broadcasts of physical exercises. It is the ambition of both instructors, as they move anonymously through the streets, to see in the carriage of men and women the difference that their instruction is making to the nation.
A Useful Addition to Any Receiver to Ensure Long-distance Short-wave Reception

By W. J. DELANEY

A two-stage Pre-selector

L ast week we dealt with the problem of improving a receiver of the short-wave type to ensure reliable long-distance reception, but only existing apparatus was dealt with. It has been pointed out in these pages, however, that the addition of an H.F. stage, or a pre-selector as it is often called, will enable much greater reliability to be obtained, not only so far as range is concerned but in relation to the removal of certain troubles which are often experienced in simple circuits lacking H.F. amplification. Even with a superhet of the communications type, if an H.F. stage is not included, the performance may lack certain of the effective handling properties met with in a receiver which is so fitted. It will therefore be gathered from the above remarks that a separate pre-selector is a worthwhile piece of apparatus.

Most units of this type which have been described employ a single H.F. valve, generally a pentode, and as such merely add a further tuned stage plus a certain degree of amplification. If, however, we intend to settle down to the building of such a unit there is no reason why, whilst still practical, we are about it, we should not make a two-stage unit, and in addition go to the trouble of incorporating some form of regeneration to add still further to its usefulness.

The Circuit

By using a variable-mu pentode this regeneration may very simply be obtained by the simple expedient of controlling the screen voltage, selecting the various voltages so that a smooth build-up may be obtained. A similar valve, suitably biased, may be used in the second stage, but without the control, adjusting the bias voltage so that a fairly good measure of amplification is obtained. The control on the first valve should be selected so that it will regulate the output from the unit in such a manner that overloading of the initial stages of the receiver with which it is used will not occur, and so that the maximum amplification may be obtained on distant stations. Fig. 1 shows a circuit on these lines, with, however, only one tapped circuit in each position giving a wave-range coverage according to the coils in use. There is, however, no reason why the unit should not be built, with a set of coils, selected by a suitably gauged switch unit so that three or even four multi-contact switch units which may be arranged any way, and thus the construction of the tuning sections of a unit of this type is simplified. For the screen voltage control a fixed pentode valve is suitable, and the construction of a separate coil, capable of carrying the total screen current. The tapping on the coils to which the cathode is connected to provide the reaction effect is not exactly critical, but should be about one-tenth of the total number of turns. The exact position should be found by experiment with the particular valves you intend to use, although the regulation of the screen voltage will be found to be so wide that a critical tapping point is not essential. Use non-inductive condensers for all bypass purposes, and keep wiring as short as possible. It is desirable, but not essential, to separate entirely the two stages, a vertical screen coil on top of a small chassis serving to separate the valves and two tuning condensers, whilst a similar screen below chassis may isolate the separate sections of the switch unit. If desired, the tuning condensers may be in the form of a special short-wave two-gang unit, such as is found in the Edystone or Raymart ranges.

How To Use the Unit

To enable the unit to be used the aerial must be removed from the aerial terminal of the receiver and transferred to the aerial terminal on the unit. A short lead, preferably screened, is then taken from the aerial terminal on the unit to the aerial terminal on the receiver, and the earth terminal on the unit is linked across to the earth terminal on the receiver. A lead is then taken from one of the maximum H.T. points in the receiver across to the H.T. terminal on the unit. As this is rated for the maximum H.T. which the valves will take it is preferable to take the lead from the L.S. positive terminal in the receiver. If it is found that any instability sets in it may be worth while to include a really good H.F. choke in the lead between the H.T. positive terminal on the receiver and on the unit, with a 0.01 mfd. micro-condenser between the unit H.T. terminal and earth. This choke must, however, have a fairly high current rating as it will have to carry not only the total anode current of both H.F. valves, but also the screen currents and that flowing through the screen potentiometer. The unit is not a short-wave converter, and therefore, it is necessary that the tuning ranges selected for the unit shall be the same as those covered by the receiver, and the main use of such a unit is on the short waves. In use, both receiver and unit should be switched to cover the same waveband, and then both unit and receiver are tuned together. The tuning of the unit will probably prove much sharper than that of the receiver, especially if the latter is only of the detector-L.F. type, and therefore some care is necessary to avoid passing stations by rapid tuning. Adjust the potentiometer so that the usual rushing sound denoting reaction is observed, and it should not need touching whilst the condenser is turned through its entire range on each band. With care it may be possible to find a value of resistance, or setting of the control, in conjunction with the tapping on the coils which will enable the control to be set and then the condenser turned from minimum to maximum on each coil terminal to suit the perfect control range.
Practical Hints

A Valveholder Modification for Tests

The principle illustrated in the accompanying sketch is simply that of interrupting the continuity of one or more valve socket connections, by introducing suitable contacts which engage with the valve pin or pins, due to the shortened valve socket.

A novel valveholder modification for testing purposes.

This scheme lends itself admirably for such conditions as interrupting screen-grid circuits for, say, the inclusion of headphones in oscillator circuits or output circuits, the temporary interruption of filament circuits, for cutting out pre-audio amplifier stages in gramophone pick-up reproduction, and in certain instances where single and double diode A.V.C. schemes are being experimented with.

It is advisable in fitting the contact members to use suitable soft rivets to prevent the possibility of the contact shifting into short-circuit with adjacent pins or sockets. The sketch is self-explanatory, and the inset theoretical diagram examples very simply one adaptation.—D. L. Easton (Buckley).

A Flash Unit for Morse Practice

In company with an enthusiastic friend, I have been trying to master the Morse code with both oscillator and torch bulb unit, but owing to the objections and lack of dexterity brought about by an unshielded bulb, it occurred to me that an improved flash unit could quite easily be made using a small shielded light aperture, the dots and dashes being carried out by a suitable shutter. To this end then, we both set about drawing up a few ideas on paper, the final choice being as illustrated. With a little patience we made two such units, dipping very frequently into the multitude of odds and ends which make up the proverbial wireless den.

It will be seen that the light aperture constitutes simply a slot in both the panel and the aluminium shutter, the shutter opening in such a way under the control of the spring loaded rocker arm of the Morse key that on each depression of the key the two slots are exactly in line, thus letting the light through, whilst on the key restoring, the shutter drops back governed by the spring bar “S” the shutter slot consequently sharply cutting out the light.

Various methods suggest themselves for the light source, so I have left details of this out of the sketch, which I think is self-explanatory.—R. W. Dennis (Stratford).

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 £1-0-0 for the best hint submitted, and for every other submitted, published on this page we will pay half-price. 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 item sent in must be original. Mark envelopes “Practical Hints” Do NOT enclose Queries with your hints.

SPECIAL NOTICE

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

A simple connecting panel for light components.

A Simple Connecting Panel

quite useful an efficient connecting panel for anchoring wires and light components from the set, and flexes from the set to the batteries, etc., can be quickly made up from pieces of bakelite or ebonite and short lengths of stout gauge tinned copper wire.

The sketches are self-explanatory, but briefly the method of construction is as follows: Small holes are drilled in the panel at the required distances, and through these are passed the short lengths of wire, these being bent from their centres, and the ends taken over the top of the panel, leaving two projections as shown. To these projecting ends, the external and internal connections can be soldered, and for neatness, the external ends can be bent down after the flex connections have been sold-dered to them, as shown in inset.

Perhaps it would be inadvisable to use this type of panel in short-wave receivers, owing to the possibility of coupling due to the loop effect, but for medium and long waves, no such trouble is likely to be experienced.—R. L. Graher (Chelmsford).

PRACTICAL WIRELESS ENCYCLOPAEDIA

By F. J. CAMM

(7th Edition 6/- net)

Wireless Construction, Terms, and Definitions explained and illustrated in concise, clear, language.

From all Booksellers, or by post 6/- from George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.
A Resolution

In a recent issue the indefatigable Ther- 
ior added his pleas to those of many others for the reinstatement of the B.B.C. 
television service. He pointed out what an 
admirable gesture that would be on the part of the Government, which is slowly but 
surely removing the restrictions on every-
day life which were imposed at the out-
tage of war. Without any exact know-
ledge of the turn of events which would 
occum should hostilities commenced, it is fair 
to say that the Government’s action was 
fully justified, but subsequent experience has 
shown where restrictions can be relaxed, at 
least partially, without in any way weakening 
the security of the nation. It is now learned that a 
leading city’s Chamber of Commerce has 
written a letter to the Associated 
British Chambers of Commerce asking that the Government should 
be urged to encourage the continu-
ance of research work in connection 
with television, which has brought a 
reply stating that the points raised in the 
letter would be considered by the Home Affairs Committee of the 
Associated British Chambers at their 
next meeting. This attitude is a most 
important one, for while the bulk of 
the nation’s resources in both man 
power and material must inevitably 
be directed towards non-productive 
work for war purposes when judged on 
a commercial basis, it would be 
fatal to think that every industry must suffer in consequence. Before the 
war the radio industry was both 
directly and indirectly employing 
hundreds of thousands of men, and a vast capital sum of English money 
was invested. The advent of tele-
vision, coupled with its promise of 
provincial extension, was destined to 
bring about a new wave of pros-
perity, and if all research in this 
science is allowed to lapse, then this 
country will lose the substantial lead 
which had established both in transmission 
and reception. No effort should be 
spared, therefore, to make the 
present Government realise the 
extraordinary importance of continuing 
research in such a field of tele-
nomy, even if only on a partial basis. 
This will enable the companies badly 
hit by this crisis to look for-
ward with a measure of hope to the 
time when they can re-enter the 
market with the minimum of delay.

America Taking Stock

Judging by the accounts which have 
reached this country from the United 
States, it would seem that after nine months of television transmisions which 
have improved steadily since their initiation at the beginning of April, 1939, the Americans have been taking careful stock of the 
public interest in such a new medium has 
steadily increased. It is well known that man’s natural instincts 
are such that he cannot live alone, he must be in touch constantly with his fellow 
creatures. Communication between in-
dividuals and nations has ever been fore-
mest in his thoughts. Telephonic, tele-
graphic and wireless devices have made 
distance no object, but whereas the ear has 
been served so well the appeal to the eye 
has been slight within a relatively narrow 
compass. Using the present high-definition 
service the public who have witnessed the results have been quick to realise that 
individual portrayal instead of a group 
scene has a great advantage. First of all, it 
can be undertaken with relatively 
simple apparatus and handled without any 
great difficulty, but there is also something of greater importance. If a public function 
is attended it is the central personality 
which is the attraction, and yet in tele-
vision only a fleeting glimpse is obtained. The 
new science has made people realise that it is best to watch this man or woman in the 
comfort of the home by means of television 
so that one can get the close-up and par-
ticipate in the intimacy denied to most 
theatre audiences. The new medium can be 
handled with the utmost of care so as to 
permit the eye to be suitably entertained with the 
whilst not being in any way bored. 

The form taken by a crystal dice unit of a modern high-powered television transmitter working on ultra-short waves.

Americans that when television becomes a vital factor in the field of entertainment, it will give fresh wings to the talents of 
creative and interpretive genius, and will furnish a new and greater outlet for artistic 
expression. Considering the matter 
carefully, the potential audience in television 
in its ultimate development may reason-
ably be expected to be limited only by the 
population of the earth itself. New forms of artistry will be encouraged and devel-
oped, while variety, and modern materials 
will be the order of the day. Whereas the ear 
might have been content with the oft-repeated song, the eye would be impatient with the 
twice-repeated scene. The service will 
demand, therefore, a constant succession of 
personalities, a vast array of talent, a trem-
endous store of material and a great 
variety of scenes and background. There 
is also evidence that American advertisers 
are preparing to grasp the television per-
formance as they have radio. It will, when 
Federal Communication Commission re-
strictions are released, result in a spate 
of advertisements which will have been displayed on cartoons and in the daily press. 
With television in the home, how-
ever, the advertiser would have to see 
that at no time was he an 
unannounced guest.

Using Crystal Control

There is no doubt that within 
recent years the increasing use 
of crystal control has contributed to 
no small measure to the accuracy and 
stability with which radio equipment 
operates, this being particularly 
true of the case in transmitters. For cer-
tain work it is absolutely essential that a wireless transmitter should only be 
operative on one or more frequencies 
with a particularly high degree of 
accuracy. This has been brought about in the television field, where the 
concern is the creation, and oper-
ening, of a high-powered station 
operating on a single ultra-high fre-
quency channel for the radiation of 
the picture modulation. Many do 
not realise how the design of the 
apparatus is more or less centred 
round this essential section of the 
transmitter, and the following 
illustration is therefore of particular 
interest, as it emphasises this 
point, and shows how it is being 
practised. First of all, in designing a high-powered transmitter for tele-
vision purposes special attention has 
been paid to the necessity for cover-
ing the maximum possible range at 
the carrier frequency, which has 
been done carefully to suit a given standard of 
definition for the picture. This frequency 
has to fall within the broadcast 
television services by international conven-
tion, while the high power chosen in 
comparison with sound broadcasting is 
especially because of the necessarily 
small hand of the modulation, coupled with the 
degree of interference experienced from 
certain well-established lines of electrical 
(Continued on page 14)
Loudspeaker Design

Further Data in Relation to the Design and Construction of Loudspeakers for Domestic Uses

(Concluded from page 332, December 30th issue)

While the stiffness of the centering devices and the construction of the casing exert the greatest control on the performance of the loudspeaker at low frequencies, it is on the characteristics of the diaphragm, or cone, that the performance at other frequencies depends.

Some previous experience with commercial loudspeakers had shown that the cone supplied with a certain individual made of loudspeaker was capable of producing an exceptionally uniform characteristic of the cone. It was discovered that this cone (hereinafter referred to as Type A1) had been manufactured abroad, but that the manufacturer of the loudspeaker (Manufacturer A) had installed plant for manufacturing cones and was willing to co-operate in producing an equivalent or, if possible, an improved type of cone.

Only a few examples selected from the very large number of frequency characteristics obtained with different diaphragms can be reproduced here. Each of these curves (Figs. 2 to 5) was taken on the axis of the diaphragm at a distance of 2 ft. from the front of the loudspeaker. In each case the diaphragm was assembled with an outer centering device of three tapes in an enclosed case. Since the curves were taken at different times throughout a long investigation the cases and mountings used were not always the same, but the differences involved would only affect the low frequencies (below about 300 c./sec.). On each chart is also shown for comparison a standard curve which represents the design objective for frequency-ranges, of which the range 0–2,000 c./sec. (Figs. 2 and 4) was often used since it covers the frequencies of greatest practical interest for the present purpose. The range of 0–9,000 c./sec. (Figs. 3 and 5) was also very generally used.

The curves in Figs. 2 to 5 are direct reproductions of the curves taken off the drum of the recorder; they, therefore, show all the minor irregularities in complete detail. A scale converting the linear law for the ordinates into relative values in decibels has been added to the curves.

Diaphragms Supplied by Manufacturer A

The full-line curve in Fig. 2 is typical of the performance of the A1 type of diaphragm. This is a molded paper cone, to all appearance of quite usual construction. The shape and dimensions of this cone are also shown on the same sheet, and these apply to the diaphragms to which Fig. 3 refers.

In attempting to obtain an equivalent performance the manufacturer first submitted a number of samples, all of which were true copies in size and shape but different in some details of manufacture. One of the worst of these samples was judged by comparison with the standard curve—is the one designated A2 and shown by the broken curve in Fig. 2. A curve of this general shape has been very frequently encountered during the investigation.

Based on these tests the manufacturer then submitted a second batch of samples made with further small modifications of manufacture; and the full-line curve, A5, of Fig. 3 is typical of samples submitted later as direct manufacturing copies of the best sample of this second experimental batch.

Further experiments were made, but no further improvement has so far been obtained. Work on these lines, involving a closer co-operation with manufacturers, could probably be continued. The broken curve, A6, in Fig. 3, is typical of more recent supplies, which have a different code number but are probably of very similar manufacture.

A few of the samples have been subjected to chemical analysis and mechanical examination. None of these tests, except perhaps a breaking test, gave any differentiation between cones which were comparatively good or bad as regards performance. There was a general tendency for the better cones to give lower breaking-load figures for samples in square cut from them, though such figures can be very variable as between samples from the same cone.

(Continued on next page.)
LOUDSPEAKER DESIGN
(Continued from previous page)

Some particulars relating to the cones to which Figs. 2 and 3 refer are given in the table. With regard to the manufacturer’s code number, the figure following the stroke (e.g. “65” in 9772/65”) gives the weight of the cone, in grams. This figure includes the weight of a flat surround extending to a diameter of 8.3 in., which is cut away for assembly by the 3-tape suspension.

<table>
<thead>
<tr>
<th>Cone No.</th>
<th>Manufacturer’s Code Number</th>
<th>Approx. thickness</th>
<th>Breaking load for 1 in. sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>9772/65</td>
<td>15</td>
<td>10.15</td>
</tr>
<tr>
<td>A2</td>
<td>9813/68</td>
<td>16</td>
<td>12.15</td>
</tr>
<tr>
<td>A3</td>
<td>9813/69</td>
<td>16</td>
<td>12.15</td>
</tr>
<tr>
<td>A4</td>
<td>9811/49</td>
<td>15</td>
<td>10.15</td>
</tr>
</tbody>
</table>

Diaphragms Supplied by Other Manufacturers

A considerable number of diaphragms from the stock of other manufacturers has been tested, but only those were selected which were of suitable size and shape for mounting in the experimental loudspeaker unit. Record is made here of only the few samples whose performance approximates to the standard considered above.

Diaphragm B1, shown in Fig. 4, is not moulded but formed from flat sheet paper into a straight cone, without corrugations. It is normally mounted with a cloth surround—in which condition it was tested. This cone is heavier than most moulded cones, and the main resonance is therefore at a somewhat lower frequency.

Diaphragm C1, also shown in Fig. 4, is the best example of the straight-sided cone diaphragms (moulded) obtained from Manufacturer C. A number of diaphragms obtained from this manufacturer were moulded with circumferential corrugations and the general characteristic of these diaphragms was an emphasis of the mid-frequency range, the greatest ordinate of the curve lying, in most cases, between 1,600 and 2,000 cycles per sec.

An interesting variation in shape is provided by forming the diaphragm with a flare. A diaphragm of such shape is represented by the curve C2 in Fig. 5, a feature of this curve being the relatively greater efficiency obtained at the higher frequencies, though the irregularities are more pronounced throughout the range than with the best of the straight cone diaphragms. An attempt was made to obtain the advantage of better response at high frequencies with less marked irregularities, and some samples of flared diaphragms were obtained from Manufacturer A. The performance of one of these is shown by Curve A7 in Fig. 3.

It was not considered that advantage was gained by the use of this type of diaphragm, and circumstances did not justify proceeding with the experiment. At the same time, the experiment shows that there is some promise of obtaining improvement of response at higher frequencies—without sacrifice of performance over the main frequency range—by a suitable shape and manufacture of flared diaphragm.

An Outline of the Specification Resulting from the Investigation

This section deals with the specification which was suggested as a result of the experiments. On this basis a commercial specification was issued to a number of interested contractors. Latitude is allowed to the contractor over details which are not considered likely to affect the performance, e.g. the shape and size of the magnet. An outline of the specification follows.

The loudspeaker may be considered to consist of two main parts, namely, the case and the loudspeaker unit.

Case

The construction of the case is illustrated in Fig. 6. The case consists of a box of 3 in. plywood, with an aperture 5 in. diameter in the front. The two sides and back are lined with each of the following:

- Felt (about 3/16 in. thick);
- Lead sheet (0.005 in. thick);
- Corrugated packing paper (with the corrugations inward).

The top and bottom are lined each with rectangles of the felt and corrugated paper, which serve to hold the linings on the sides and back into position. No adhesive should be used; two or three light tacks through the linings of the top and bottom only should be used to retain the linings in position.

Two layers of felt on the back of the front panel are held round the aperture to form a bag surrounding the back of the loudspeaker unit, when in position.

Loudspeaker Unit Magnet

Permanent magnet, not greater than about 250 cm³ total volume, developing at least 6,000 lines per cm³ in an air-gap of 1.013 mm. external and 0.988 mm. internal diameter and 0.25 mm. deep.

Frame

Suggested construction is illustrated in Fig. 7. The exact depth of the frame should be adjusted to position the coil correctly in the air-gap. Excessive obstruction behind the cone is to be avoided, for this reason the four bars connecting the outer ring to the inner part (which is secured to the magnet) are limited to 0.03 in. width.

Coil

Total of 53 turns in two layers of 53 turns each, of 0.005 in. diameter enamelled copper wire. Ends of winding secured to former and left sufficiently long connection to the binding posts (not illustrated) on the frame. The free lengths of these wires to be covered with cotton twine.

Spider

Stiffness imposed by the spider to axial movement of the cone should not be excessive. This can usually be achieved by the use of sufficiently thin material, irrespective of the shape and manner of fixing of the spider.

Conce

At present it is only possible to specify one make of cone, namely Type 8881/49, supplied by Manufacturer A.

In view of possibilities of variations of supplies, it will be required initially that 1 per cent. of cones obtained for use in the Post Office Engineering Department’s contracts shall be tested by the Department for acceptance.

Edge Suspension

The outside diameter of the cone is 6 in. The clearance from the inner edge of the outer ring of the frame (7 in. diameter) is free except at three points where strips of unstretched tape, 0.25 in. wide, cemented at their ends to the cone and to the outer part of the frame respectively, compose the suspension.

Stiffness of Suspension

The resonance frequency of the unit should be determined, before assembly in the case, by applying a constant p.d. of variable frequency to a circuit consisting of the coil of the loudspeaker unit and a resistance of 8 ohms, and by observing the

Continued on opposite page...
frequency at which the p.d. across this resistance of 8 ohms passes through a minimum. The frequency of resonance so determined should not be greater than 30 c/sec.

Conclusions

On the question of how to judge the quality of loudspeakers, the authors consider that the criterion of faithfulness to the original source is the one that determines the type of sound reproduced by the loudspeaker with the original sources, heard in the same room, cannot be immediately upon the room, should, of course, be of a kind similar to that for which the use of the loudspeaker is intended, and the types of sound should be restricted to those which might ordinarily be heard, as original sources, in such rooms. In any such comparison the influence of the acoustics of the microphone studio should be negligible.

The loudspeakers to be used in living-rooms, this criterion appears to be satisfactorily met when the total power radiated by the loudspeaker in free space is a function of the frequency. The requirement

**PRACTICAL TELEVISION**

(Continued from page 342)

The form taken by the whole transatlantic assembly will naturally vary in its particular details, but on general lines will comprise first of all the crystal controlled oscillator. The requirements here are very rigid and often demand a frequency-compensating variety of type, and such a one in the neighbourhood of one part in 50,000. This is only attainable by careful design, and in the apparatus featured in the drive sub-assembly the crystal oscillator is housed in a thermally-controlled double oven to ensure even temperatures.

**Projection of Television Pictures**

There is still intense activity both in Europe and America in connection with the projection of satisfactory television pictures whose size is comparable with that seen in the theatre or living-room. When it is not possible to appreciate the subtle effects in the control of the image in the apparatus itself, it is to be expected that certain modifications in the screen will be necessary to meet the requirements of the equipment. The view of the screen is affected by the received television signals, and quite good results have been claimed for this latter method of working. On the one hand, most of the more recent of these proposals use an interposing crystal screen made up from nature crystals, and it is important that the reception of the screen should be as perfect as possible. The resultant electronic field produced in the immediate neighborhood of the crystal screen causes the screen's optical polarising angle to rotate to a degree depending on the field strength, which may be in accordance with the degree of modulation applied to the electron beam by the received television signal. The beam of light from the projection lamp is polarised before it reaches the crystal screen face, and it is therefore subjected to further polarisation as it passes through. In this way it produces an enhanced image of the television picture by passing the light emerging from the back face of the crystal screen through a polarising filter and projection lens. The scanned sections of the crystal screen remain charged until they are neutralised by an auxiliary discharge electron beam, which works in synchronism with the main modulated electron beam, and which is timed to precede it by a very short distance.

As it can be seen, therefore, there is an important storage effect associated with an electronic device of this character and, if desired, this could be applied to bringing about a reduction in the line and frame frequency with the seriousness reducing picture detail or quality, and would help to solve the problem of flicker. The net result may be a reduction of the camera necessary to accommodate the radiated television picture, a factor, the importance of which, loco large scale schemes for increasing service coverage are considered in this or in any other country at some future date.
LATEST PATENT NEWS

Group Abstracts can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, either sheet by sheet at on payment of a subscription of 2s. per Group Volumes, or bound volumes price 2s. each.

Abstracts Published.


The sensitivity of a radio receiver is varied without substantial change in amplification by varying the coupling between two high-frequency circuits and simultaneously varying a reaction coupling coil K (Fig. 1). The circuit comprises a deflector plate 10 and a main circuit coil L1, L2, the movement of the lever L being controlled by the lever H. As K approaches L1 to increase coupling R recedes from L2 to reduce the feedback and vice versa. Coils K may be dispensed with by connecting L2 with respect to L1 and R which remain fixed in an alternative arrangement. The device may be operated manually or automatically. Specification 344031 (Group XL) is referred to.


In a moving coil loudspeaker comprising an electromagnet for producing the magnetic field and a speech coil transformer, the cores of the electromagnet and of the transformer are structurally combined so as to form an uninterrupted magnetic circuit. As shown in Fig. 2, the core of the electromagnet comprises E-shaped laminations 25 forming the core 28 of the transformer. The primary and secondary windings 29, 30 (Fig. 4) of the transformer are mounted on the core 28 and the magnetic circuit of the loudspeaker is completed by a cylindrical pole piece 22 and a pole piece 10. The core of the transformer which may be formed of U-shaped laminations may be a laminated case which does not form a part of the core of the electromagnet, but is magnetically connected thereto. The housing 1 for the diaphragm is connected to pole piece 10 screws 12 and the cores are enclosed by a cylindrical casing 26 and a disc 35 (Fig. 5), the terminals of the loudspeaker being mounted on the casing or on the disc. The core of the transformer may be closed by a member attached to, and magnetically insulated from, the core of the electromagnet, or the transformer may be mounted on the housing 1. The core of the electromagnet may be U-shaped and in a modification a transformer with a laminated core may be associated with a permanent magnet.

ELECTRIC TRANSFORMERS. — Kolster-Brandes, Ltd., and Newman, L. G. No. 507695.

A variable selectivity comprising two tuned circuits the coils L1, L2 (Fig. 6) of which are mounted in variable proximity to the inductance L of a third circuit and having different coefficients of coupling is decreased and vice versa; a detuning effect is thereby produced each circuit L1C1L2 being disconnected from the sides of the resonant frequency. According to the invention the inductance is constituted by the screening casing 6 of the coils L1L2 which are fixedly mounted with longitudinal and angular displacement on the spindle 5, as shown in Figs. 7 and 8.

PHOTO-ELECTRIC DEVICES

The principles governing the action of a photo-electric cell have been known for very many years, but it is only of more recent date that this electronic device has found so many applications in industrial and commercial life. Its functioning, in conjunction with various forms of auxiliary equipment has seemed so miraculous to the lay mind that it is only recently that the "Electric Eye," and yet it does not "see" in any sense of the term. Its capabilities are, of course, associated with the detection of various in the light to which the active electrode surfaces are exposed. Even if the reactions are not directly a matter of concern, the cell is able to take cognizance of them, and when connected up to a valve amplifier and multiplier, the light changes are converted to electrical changes which become amplified and may be used, for instance, to operate a motor or as a work as a useful signal. It is learned that experiments have been conducted in America whereby photo-electric cells could be employed to utilise solar energy, although the powers as yet generated have been very small. By reducing frictional loss to a minimum and the special type of electric motor, the incident light activating the electrode surfaces of a cascade of P.R. cells has been made to turn the motor at speeds depending on the quantity of light available. Sun rays and lamp rays have each been capable of generating up to fractions of a horsepower from the motor, and although at the moment the whole device seems little less than an ingenious toy, it may be developed to a commercial standard at a future date. In the same country several large manufacturing firms have been employing the photo-electric cell to act as a high-speed analyzer. In one case a firm engaged in the cleaning of paper are using the cell to move along a conveyor belt at the rapid rate of ninety per second. They made use of a beam of light which illuminated a "inspection beam" terminating in a certain color sensitive photo-electric cell, and it is assumed that if the colour of the light is in any pre-arranged standard a rapid action relay was brought into service which caused a jet of compressed air to blow each bad bean off the conveyor belt. In a similar way a machine was designed to incorporate a cell that rejected a packet of produce which had no label. Again, realising that when a packet of cigarettes is opened it is most impressive to see the printed name and weight, etc., on every cigarette in the packet, certain cigarette making firms use a machine which rotates the cigarette until the light ray, falling on the print, reduces the incident light on the cell and the cigarette rotation is thereby stopped, and in that position it is分级.

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 12s. 6d.).


31455.—Telefunken Ges. fur Drahltose Telegraphe.—Short-wave housing receiver. December 4.

Specifications Published.

51320.—Farnsworth Television, Inc. —Method of operating electron multipliers.
51302.—Pye, Ltd., Jones, W., and Edwards, B. J.—Television and like systems.
51304.—Scophony, Ltd., and Okolick—The Televisore receiving apparatus.
51320.—Electric and Musical Industries, Ltd., and White, E. L. C.—Television systems. (Addition to 491029.)
51518.—Rendall, A. R. A.—THERMIONIC valve amplifiers.
51311.—Chillingworth, J.—Sound-reproducing apparatus.
51360.—Bumlein, A. D.—Television or other signal transmission systems.
51377.—Marconis Wireless Telegraph Co. Ltd.—Microphone apparatus.

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.

WORKSHOP CALCULATIONS

TABLES AND FORMULAE

By F. J. CAMM

3/6, by post 3/9 from

George Newson, Ltd. (Book Dept.),
Tower House, Southampton St., Strand, W.C.2.
SHORT-WAVE SECTION

A BAND-SPREAD THREE-VALVER
Construcational Details of an Interesting Receiver for Amateur and Short-wave Broadcast D.X. by A. W. Mann

SHORT-WAVE enthusiasts may be divided into three distinct groups. Those who confine their activities to the short-wave broadcast channels, the amateur "phone" and C.W. enthusiasts, and the all-round D.X. listener.

Various aerial systems are used, some of which are efficient, and others which, due to space or other restrictions, are of comparatively low efficiency.

A receiver which is capable of providing good average performance on an efficient aerial, and some measure of satisfaction tonally to a particular transmitter, regardless as to frequency, and within the defined limits of receiver coverage, the effective signal gain is considerably greater than when alternative methods of coupling are used, all of which have been tried and tested when making comparisons.

Whilst it is possible to use an H.F. choke in the grid to earth line, the writer much prefers the non-inductive resistance of 250,000 ohms, as shown.

Whilst this applies generally, it applies more so in cases where resonance-tuned on the inefficient type or compromise kind of aerial, would appear to be a rather expensive proposition.

The receiver described in this article has been used by the writer for a number of years in conjunction with his rotary aerial system, and on test, in conjunction with the commonly used types, provided gratifying results. The super efficiency of the former system due to variable directional properties, however, obviously provides the best possible results.

Before entering into details I would stress the fact that the coils, tuning condensers, valveholders, coil base, and L.F. transformer as incorporated, are amongst the best of their types obtainable—this factor contributing towards the efficiency of the whole.

Circuit Details

Figure 1 shows the theoretical circuit in which a stage of untuned high-frequency is inductively coupled to the grid coil of the detector stage. The latter being a triode of the H.L. 210 type.

This form of coupling is as developed by Mosley, Eddystone, and is most efficient. Proof of this is found in the fact that when this form of coupling is used in conjunction with the rotary aerial system mentioned above, when the system is rotated directionally to a particular transmitter, regardless as to frequency, and within the defined limits of receiver coverage, the effective signal gain is considerably greater than when alternative methods of coupling are used, all of which have been tried and tested when making comparisons.

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**SHORT-WAVE SECTION**

In order to eliminate wiring between these components, the grid condenser is of the T.C.C. tag type.

**Band-spread Tuning**

Next for discussion is band-spread tuning, a feature used in this receiver.

Before going further I would refer readers to previous articles dealing with band-spread by the writer and others.

As previously stated the Edystone band-spread outfit is incorporated in this receiver. The band-setting, or tank, condenser, is fitted with a ten-stop catch plate and ten-division scale, complete with pointer, whilst the band-spread condenser has an integral slow-motion drive, a large diameter knob, and an hundred degree scale, the complete kit being designed for use with Edystone four- and six-pin coils.

A useful amount of spread is obtainable on the 14 mc. band covering 40 degrees, using the 6LB coil. With the 0Y coil 80 degrees spread is obtainable on the 7 mc. band. A commendable feature is the care fully worked out overlap between the band-setter positions which assures that nothing is missed. A point worthy of consideration with regard to this receiver concerns calibration. With the coils and band-spread kit installed, the operator can calibrate the band-spread condenser dial over the full scale, in association with the individual stop positions of the band-setting condenser, through the full range of coils, and if desired, can prepare separate or composite calibration charts for reference purposes.

Taking into account that accurate calibration is the key in part to successful DX, other things being equal, it will be appreciated that the degree of accuracy made possible by means of the definite stop positions provided by the band-setting condenser, and the fact that once logged a station’s frequency can, in conjunction with the band-spread dial, be spotted or recorded accurately at any time, as required, the DX possibilities appear rather attractive.

In order to get down to 10 mc., a special home-made coil is required, this coil being wound on a standard Edystone six-pin coil former as follows:

Ten-metres coil data.
- Grid coil:
  - Two turns 20 gauge copper enamelled wire.
- Aperiodic coil winding:
  - Two turns 20 D.C. wire interwound with grid coil.
- Reaction coil winding:
  - Two turns 20 gauge C.E. wire as per grid coil.
- Standard spacing between reaction turns, and double spacing between grid turns.
- Standard spacing also between grid and reaction windings.

There is no place for old valves in this receiver; an emission test is therefore advisable in cases of doubt, and the manufacturer’s instructions should be followed relative to plate and bias voltages, etc.

**Performance**

The original model was in two-valve form, the untuned stage being added at a later date, and on completion of over twelve months’ tests under all conditions used the performance in terms of results was remarkably good on all bands, including the U.H.F. band, various U.S. amateurs and others on the Canadian border being heard in the afternoons at volume comparable with that of British 40 m. amateurs.

'Tones'. The same applies to other amateur 10 m. stations in various parts of the world.

The addition of an untuned H.F. stage further improved the overall performance of the receiver on all bands, including S.W. broadcast channels and C.W. channels.

It is not claimed, however, that the untuned stage provides the signal gain to be obtained with a fully tuned T.R.F. stage, but should the latter be contemplated at some future date, the necessary

**TONE CONTROL BY NEGATIVE FEEDBACK**

(Continued from page 337)

**Single-stage Amplifier**

Control curves of a similar kind may also be obtained with condensers alone. Such an arrangement is shown in Fig. 11, in the form of a single-stage amplifier. Between the anode and the earthed return lead of the valve is the series connection of the resistances R1, R2, and R, and R. The resistance R is capacitively bridged by the condenser C for the high-tone frequencies. The output resistance R is connected across the condenser C with the cathode of the valve which is connected by the not capacitively-bridged resistance R, with the earthed return lead. The condenser C has such value that a considerable potential drop occurs for the low-tone frequencies, but not for the medium-tone frequencies which potential drop makes the counter coupling for the low-tone frequencies small. The resulting control curves are shown in Fig. 12. In the one extreme position (b) the amplification for the low tones is considerably less than for the high, and particularly for the low-tone frequencies (? WR). In the other extreme position the amplification for the medium-tone frequencies has risen considerably, so that it is now larger than for the high-tone frequencies, where degree of amplification has only increased very little. The degree of amplification for the low-tone frequencies has risen a little more so that it reaches almost the value for the amplification without counter coupling (dashed line). The circuit shown is recommended for receiving sets without complete fading compensation in which it is desired, for instance, because a loudspeaker of poorer quality is used, to achieve in any case a raising of the low-tone frequencies.

**PRACTICAL WIRELESS SERVICE MANUAL**

By J. CAMM.

From all Booksellers 5/- net, or by post 5/6 direct from the publishers, George Newnes, Ltd. (Book Dept.), Towner House, Southampton Street, Strand, London, W.C.2.
Readers' Dens

Sir,—As a regular reader of your excellent journal, I am sending you a photograph, together with a description of my station, which, until the beginning of September last, operated under the call of 2HNO.

The receivers used are a Halliater's "Sky Chief" (now pretty ancient, but still in good trim!) and a battery-operated home-built 0-1 used exclusively for 28 megacycles. This latter set has bandspread, and transformer coupling between the two triode valves (a D 210 detector, and an H L 2 L F.). Both of these sets are to be seen in the photograph. The antenna preferred here for reception is a simple half-wave 20 metre doubler.

Results with this apparatus have been most encouraging; 107 countries have been heard on 'phone and C.W. on 14 megacycles, and 45 States of the American Union have been "hooked." 1

The best verifications which I have received are: VR6AY 14 mc. 'phone; CJRAMM, ZL2QQ and K6BNR, 14 mc/c.w.; and C628X 28 mc/phone. First G reports have been confirmed by W2KXP 7 mc/c.w. and W4GTU (14 mc/c.w.).

Also in the photograph is to be seen a portion of the C.W. transmitter which was in course of construction when the war broke out. This is now safe in the hands of the G.P.O., but it is my firm intention to utilize Hitler, and see what can be done with QRP C.W.—LESLIE J. J. MORGAN (Bournemouth).

Sir,—I would like to correspond with any S.W.L. who is keen on logging C.W. DX on 7 mc/s. In addition, I am willing to exchange my S.W.L. card by return of post with any reader who may care to send me his. Here's with a log of 7 mc/s stations received recently on an O-1 valve S.W. Adapter: On 'phone: PW6; and PX9CT. On c.w.: L421; KADEZ, ERA; KD, FAI1; H K 8 H B; and KAK, AM; 28 in PYL 2, 3, 4, 5, and 7; all districts W. QSL's confirming 7 mc/s. reception have been received from VOIB; K5AM; BSSC; K6BNR; K62Q; and K65Q. A reader, Vincent Upton of Whitley, sends us this interesting photo of his den.

U.S.A., S. America, and the West Indies. I would also like to correspond with any young reader in U.S.A. or S. America, interested in S.W. reception. Wishing your paper every success.—KENNETH L. PROCTOR (63, Thackery's Lane, Woodthorpe, Nottingham).

Sir,—I would like to correspond with any S.W.L. who is keen on logging C.W. DX on 7 mc/s. In addition, I am willing to exchange my S.W.L. card by return of post with any reader who may care to send me his. Here's with a log of 7 mc/s stations received recently on an O-1 valve S.W. Adapter: On 'phone: PW6; and PX9CT. On c.w.: L421; KADEZ, ERA; KD, FAI1; H K 8 H B; and KAK, AM; 28 in PYL 2, 3, 4, 5, and 7; all districts W. QSL's confirming 7 mc/s. reception have been received from VOIB; K5AM; BSSC; K6BNR; K62Q; and K65Q. A reader, Vincent Upton of Whitley, sends us this interesting photo of his den.

"P.T.O."

Most of us these days have friends in the Forces, and most of them want something to read. Often billeted, or in training camps in the heart of the country, they find that, in the black-out, time drags interminably. Good reading matter is, for some odd reason, at a premium, and this is where every reader of this journal can help. A magazine that slips into the tunic pocket is a godsend, and a good example is P.T.O.—the British pocket "Digest" of the world's news and views. The February issue, for instance, contains an important article, "When We Have Won—What Then?" by Harold Nicolson, and another on Russia's startling claims for a gigantic new oilfield which is being developed a thousand miles from the nearest frontier. Many of us believe that the earth may not be the only planet to contain intelligent life, and this age-old problem is treated in "The Mars Inhabited?" by W. T. O. is obtainable through any newsagent or bookstall, price 7d.

Solution to Problem No. 380.

Arthurs had an exposed spigot-screw aerial lighting separator fitted to his aerial, and this had become very dirty and was leaking. The gradual short-circuiting of the cap by dirt increased the loss which it experienced.

The following three readers successfully solved Problem No. 379, and books have accordingly been awarded to them:—

(No Signature), 6, Rington Road, Walthamstow, E. 18.
G. A. Collings, 22, Lawfield Road, Acton, W. 2.}

LATHE WORK FOR AMATEURS

By F. J. CAMM

1/- or 1/2 by post from

PRACTICAL WIRELESS SERVICE

PRACTICAL WIRELESS

January 6th, 1940

BLUEPRINT SERVICE

No. of
Blueprints, 6d. each.

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PW14A

PW85A

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PW3

PW36B

PW76

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Universal Half-Mark (HF Penn, D, Push-Pull)
PRACTICAL WIRELESS No. of

PW17

PW18

PW40

PW42

PW19

Superhet, 2-valve (Three-valve)
Superhet, 2-valve (Three-valve)
Triple Superhet, 3-valve, 6d.
Superhet, 2-valve (Three-valve)
Universal Superhet, 3-valve, 6d.
"Qualitone" Universal Four
Superhet, 4-valve (2, 2 L.F. and RF)
"Double-valved" Bi-Directional

PW10

PW26

PW12

FJ's C.C. Superhet 4
FJ's C. C. Universal 4 Superhet 4

PW28A

PW13C

PW56

PW31

PW5b

PW12

Universal Crystal Four, 5, A.C. Main Model

PW29

S.W. Converter and Amplifier (1 valv)

PW88

AMATEUR DIODE AND TRiode WIRELESS AND CRYSTAL MAGAZINE

PW11

4-station Crystal Set

PW4

Electrogrammar (S, D, L. C.)

PW10

WM357

WM296

WM194

WM383

WM129

WM394

WM240

WM237

WM284

WM241

WM285

WM303

WM207

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WM204

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By-pass Condensers

"I enclose a circuit of an H.F. amplifier and detector stage which I am building and should like advice regarding the by-pass condensers which I have marked. I understand that non-inductive condensers are preferred to by-pass condensers. Now, what can you do in this type of tubular form? If so, I cannot find the 4 or 8 mfd. type of condenser in any list in my catalogues. Please send me any advice regarding suitable types."— J. H. (Perranporth).

All H.F. by-pass condensers should be non-inductive, but the tubular condenser is not the only condenser which is of this type. Mica condensers are non-inductive, and electrolytics are also of this type. In addition, certain of the paper types of condensers are non-inductive and this is generally indicated on the case by the letters N.I. In the case of the large capacities, therefore, the paper non-inductive condensers or the electrolytics may be used.

Contrast Expander

"I note that you have again referred to the Contrast Expander in your notes on the ideal set. I regret to say that I tried out a circuit of this type some time ago, having got the circuit from an American magazine, but it did not appear to make any difference to the reproduction from records. Have you found that it does really what is claimed for it, as I should certainly like to improve my results by using such a circuit if I could be assured that it does work?"— L. K. (N.W.5).

The circuit certainly does what is claimed for it when it is properly constructed. You may have used wrong values, wrong connections or unsuitable valves in your experimental tests. You can see for yourself, when such a unit is made, that it does actually modify the contrast, and in the special unit which we described we indicated how this could be done. A milliammeter is included in the anode circuit of the expander valve, and while listening to the reproduction you can see the current rise and fall with the volume of the music. Obviously some types of record need no expansion and the difference may be hardly noticeable, but a really good symphony record, or an organ, will reveal the effects, especially in the latter case, in the reproduction of the pedal notes.

All-wave Aerial

"Once again I must call on your assistance in designing part of my radio equipment. The aforesaid apparatus having the receiver has been followed and I am more than pleased with the result, but now wish to improve the aerial so that I can cope in all those distant stations. Unfortunately I am living on the second floor of a three-storey house and the garden is only 15ft. in length. I do not want to put up a long pole in the garden and yet the indoor aerial does not seem all that I could desire. What is there I can do to me now in this connection?"— K. D. (Bromley).

A vertical aerial of the type we have often described is undoubtedly your best solution. If you do not wish to erect the aerial itself, then a rigid aerial will have to be used. This should be a length of steel or copper tubing, depending upon what you can afford or obtain in these days, about 3m. in diameter. Paint it with two or three coats of good outdoor paint to prevent corrosion and mount it on a strong bracket which will hold it about 12 or 16ft. from the wall. The overall length of the tube should be not less than 6ft., longer if possible. To prevent swaying or bending, a length of wooden dowelling can be fixed down inside it. Solder a length of good covered stranded aerial wire to the lower end, and mount the bracket so that it will be clear of the wall outside your window as possible.

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.

REPLIES IN BRIEF

J. McI. (L.pperlands). The meter is not suitable for measuring the output from a mains unit. You must use a meter with a high resistance, preferably 1000 ohms per volt. H. G. (Birmingham). Oil-filled windings will be found in our handbook, "Cables, Cables and Transmitters" (P. D. B. D., London). J. W. W. (Parkstone). We do not supply blueprints of commercial receivers. The makers may be able to assist you. R. J. (Depenport). The condenser may be modified by extending the inner plate a distance usually kept for the exposed end of the metal section.

L. M. (Gloucester). The condenser is provided with an adjustable valve in parallel with the existing output valve, i.e., to obtain effective tuning, exactly the same as in your set. R. E. (Buckingham). The current is much too high and it is evident that the valve is not suitable for the application, and a longer form of the valve would be necessary. D. A. B. (Windsheep). The arrangement is definitely not recommended, and the valve-makers' instructions should be referred to.

L. V. C. (Shrewsbury). Use the 6-8 gauge wire and leave just enough windings. Insulation is not important in this case. N. T. (Abertywyn). A resistance of approximately 200 ohms could be used, but the current should not exceed 3 mA.

G. D. (Newport, Salop). Both components are insulated, and you should precede them with an up-to-date unit.

W. V. (Perth). Write to the Economic Electric Company, Ltd., 64, London Road, Twickenham. S. E. L. (N.W.3). Keep the envelope and test the coil in question.

H. E. T. (Begonia). Try a much smaller condenser, not larger than 0.001 mfd. Only the H.F. part of the wave would be preferable and would eliminate all of the troubles.

P. A. (Slough). Only one H.F. condenser is necessary. A band-pass detector in the detector stage will keep out the noise. S. W. (Maiden). A large horn-type speaker would be preferable, but remember to add the additional resistance taken up. The good tone, properly muffled, would probably be indistinguishable with the amplifier installed.

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

PRACTICAL WIRELESS
**PRACTICAL WIRELESS**

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Type HD24 replaces the HD23 with a reduction of 25% in filament current—only 0.10 amp.

OSRAM KT24
A High Slope Output Tetrode. This valve is a high-sensitivity power tetrode, particularly suitable for small battery sets in which economy of consumption is of greater importance than high-power output. Type KT24 consumes only 0.2 amp—a saving of 33% in filament current.

The above valves, together with the OSRAM W21 economy Variable-mu H.F. Pentode, enable a 4-valve battery receiver to be designed with a total filament current of only 0.62 amp. and with no decrease in overall sensitivity over a similar receiver with other valves normally taking 25% to 30% more current from the L.T. accumulator.

WRITE FOR TECHNICAL LEAFLETS
Switches and Switching

It has often been said that the component part which gives most trouble in a wireless receiver is the switch. Whilst this may be true, due to the fact that this component receives the most use, it is very often due to the use of the wrong type of switch, or an unsuitable type of switch for the purpose. There are many different patterns of switch on the market and the beginner often thinks that they all operate in the same manner, and in an endeavour to save money he obtains a low-price component which, whilst it may be ideal for one purpose, may be unsuitable for continued use in the position in which he intends to place it. Wave-changing is probably the most important part of the circuit from the switching point of view, as low resistance is essential and perfect switching must be carried out or the receiver will fail to function correctly. It is often found that the receiver seems to be working properly, but signals are weak, and much time may be spent in looking for a fault which is merely due to poor contact in the wave-change switch. In this issue we give brief details of the various types of switch which are available and indicate some of the positions and circuits for which they are most suited.

The B.B.C. Symphony Orchestra

The B.B.C. Symphony Orchestra, leader Paul Beard, conducted by Sir Adrian Boult, will visit the City Hall, Cheltenham, on Tuesday, January 11th, to give two programmes, one in the afternoon and one in the evening. On Wednesday evening, January 17th, the orchestra will visit the Central Hall, Newport, and on Wednesday evening, January 24th, the orchestra will play at the Pavilion, Bath. Full details will be announced later.

Expeditionary Force Programme

As from January 7th, the B.B.C. are including a special programme from 6 p.m. onwards, on a wavelength of 342 metres. This programme is designed especially to appeal to the forces in France, and consists mainly of dance and similar light music, variety, sporting items, and so on. If the programme proves successful it will probably be expanded into a full daily programme.

Will Shakespeare

TIMING restrictions have developed a new technique for dealing with one form of radio play production. An example of this was seen in the production of "Macbeth," which dealt in sequence with the deterioration of the character of "Macbeth." The same technique, stressing the character of the central figure, is to be used in Barbara Burnham's production of Clemence Dane's "Will Shakespeare," on January 13th. In this production scenes from different acts of the play are knit together to throw up the character of Shakespeare.

Wire-tapping machines at the Echo Works, adjustable to wires of all sizes, strips away the insulating covering, exposes just enough bare wire for soldering.

Songs from "A Country Girl"

One of the most popular of George Edwardes' many famous productions, "A Country Girl," was produced at Daly's on January 18th, 1902, with a cast containing many stars, among them being C. Hayden Coffin, Rutland Barrington, Wilfrid Ward, Bertram Walters, Huntley Wright, Harry Croom, Ethel Irving, Topsy Tudor, Nina Seyming, and Evie Green. It ran for 279 performances, and whilst the original production failed to catch on, it was revived at the Theatre Royal in 1903.

On January 12th, songs from "A Country Girl," composed by Lionel Monckton, with additional melodies by Charles Groves, and the B.B.C. Theatre Orchestra, conducted by Stanford Robinson, will be broadcast. The singers will be supported by the B.B.C. Chorus, headed by Charles Groves, and the B.B.C. Theatre Orchestra, conducted by Stanford Robinson. Production will be by Gordon McConnell and Stanford Robinson.

Talks for the Housewife

JANET GUILTY, who arranges the B.B.C.'s talks for women, has put together several interesting series for the new schedule from January onwards. These have necessarily a wartime atmosphere.

The Tuesday morning talks, for example, are entitled "Wartime in the Kitchen." The B.B.C. is in the closest possible touch with the Ministry of Food, and the talks have been designed to help housewives to solve the thousand and one new problems with which they are at present faced. If, for example, there is a glut in any commodity, listeners will hear of new and attractive methods of presenting this particular article of food. Speakers will include such familiar radio figures as Mrs. Arthur Webb, Mrs. Bosquet, Ann Beaton, and Ann Hardy. The early (Thursday) morning marketing talks will be continued. These are designed to assist in the planning of the day's menu.
An All-wave Frame Aerial System

Details of a Recently-developed Screened Anti-static Self-contained Aerial

In the latest General Electric receivers produced in the U.S.A. an interesting arrangement has been adopted in order to reduce "man-made static." The idea is to use a screened frame aerial inside the cabinet of the radio receiver for long waves, and to use the screen as the aerial on the short waves. The sensitivity of the Magic Eye tuning indicator is also varied on different wavebands.

Fig. 1 shows the circuit of a typical receiver in which the frame aerial 1 is shielded by the shield 2. An ordinary outside vertical aerial 3 is also shown, which may be employed, or not, as required by the user. These different aerials are arranged for connection to the input circuit of an R.F. amplifier 4. The output of the latter is supplied to the usual converter stage and I.P. stages of the receiver, which are indicated by the rectangle 6, feeding the diode detector 7. The rectified unidirectional signal potentials appear across a resistance 8 connected between its anode and cathode. This resistance is shunted by a potentiometer comprising condenser 9 and resistance 10, having a variable contact 11. The signal potentials appearing between contact 11 and earth are supplied to the A.F. stages and the loudspeaker.

Resistance 8 is, of course, by-passed for R.F. currents by the usual condenser 25, and it has connected in series with it an R.F. filter comprising resistance 27 and condenser 28.

The aerial transformer 13 consists of primary windings 14 and 16, and secondary windings 17 and 18, and is adapted to transfer energy received from aerials 2 and 3 to the control grid and cathode of the R.F. amplifier 4. The wave-change switch 19 has three positions. In position A, the first connecting the receiver for operation on the broadcast band, position B connecting it for operation on the next higher frequency band, and position C connecting it for operation on a still higher frequency band. A second switch 19 is also employed, and has two positions, one effecting certain circuit connections when the frame aerial is used, the other position effecting circuit connections when the frame shield is employed as an aerial.

Resonance Indicator

A visual resonance indicator 20 of the "Magic Eye" type, is shown in the lower portion of the diagram. Resonance is indicated by the fluorescence of a screen within the tube, which is controlled by the grid potential. The latter is varied by connecting the control grid through resistance 21 to the negative terminal of resistance 8. The potential of resistance 8 is also supplied to the control and suppressor grids of valve 4, and also through condenser 23 to any additional valves in the equipment, for A.V.C. purposes and an A.F. by-pass condenser is associated with resistance 22.

It will be noted that the switch 19 is in its B-position, the receiver thus being connected for broadcast band reception, while switch 19 is in its upper position, thus connecting the receiver for reception by the "Frame" 1, which may be oriented for minimum reception of noise or other undesired signals. The frame shield 2 aids very substantially in eliminating the latter, and, as will be described later, its construction is such as to avoid detrimental capacity and resistance effects upon the frame.

Condenser 18 and 25 of the converter input and local oscillator circuits are ganged with condenser 3, as indicated in the diagram. A trimmer condenser 33 is also connected across the "frame," and provides for initial adjustment. In this way the receiver may be tuned through the broadcast band of from 540 to 1575 kc/s with satisfactory alignment of the tuned circuits as if an outside aerial were used, with the added advantage that the "frame" can be installed out of sight in the cabinet. The frame shield 2 is carried through the upper blade of switch 19, and lower blade of switch 19, and lower blade of switch 19 to earth. Simultaneously the primary winding 14 of transformer 13 is short-circuited to prevent absorption effects due to stray capacity coupling and the circuits of the other transformer windings open-circuited by the switches 19 and 19 in the positions shown. At the same time the full potential of resistance 8 is supplied through resistance 21 to the control grid of the visual resonance indicator 20, resistance 29 being open-circuited at the lower contact of switch 19. In this condition maximum response of the indicator is obtained.

Using An Outside Aerial

If an outside aerial is available, it can be utilized merely by operating switch 19 in its lower position. The upper blade of switch 19 interrupts the short-circuit across the transformer primary winding 14, making it effective between aerial and earth. This winding may be of the usual type which (Continued on page 303.)
Which Switch?

The Importance of Using the Right Type of Switch, and the Differences in the Various Types are Described in this Article

By W. J. DELANEY

The beginner may be pardoned for expressing doubt as to the correct type of switch to use for a special purpose, as a perusal of a catalogue shows so many different types, yet many are described as of the same kind. For instance, one may see a wave-change switch and this may be of the push-pull type, or of the Q.M.B. type, and have two contacts or perhaps three. Similarly, the on/off switch

across the H.T., it is also necessary to break the H.T. lead, and in this case a three-point switch is required, the H.T.-lead being joined to the extra contact on the switch. The same simple type of two-contact or on/off switch may also be used in any position where it is necessary to open or break a circuit, provided that a high current is not being passed. A typical instance will serve to show what is needed, and this is illustrated in Fig. 5. As, however, this

Fig. 1.—Filament switching in a battery receiver, and the usual types of switch which are used.

generally found in a battery receiver is of the push-pull type, yet some receivers are fitted with a Q.M.B. switch. Finally, the latter type of switch may be found described as a 'toggle' switch, to add still further to the confusion of the beginner. Apart from the difficulties regarding the type of switch there is also the problem as to which switch to use in some receivers, in view of the fact that some current may be carried and thus the current rating of the switch has to be borne in mind. The simplest form of switch is the push-pull variety, and this may have two arms, with a moving plunger, or even four arms, and in some the plunger itself acts as one of the arms or contacts. This type of switch may be seen illustrated in Figs. 1, 2 and 3, which also show typical uses of the types illustrated. In addition, these illustrations also show alternative types which fulfil the same purpose.

L.T. Switching

In the simple battery receiver it is necessary to switch off when the receiver is not in use, and the usual procedure is to break one of the L.T. leads. Thus a simple two-pole short-circuiting switch is needed as shown in Fig. 1. But in the case of a battery receiver employing a potentiometer

Fig. 6.—A single-pole change-over switch of the Q.M.B. type, and a typical circuit in which it is used.

...
WHICH SWITCH? (Continued from previous page)

that on the right has exactly the same internal movement, but has a rotary control action, and this enables panel controls to be matched more satisfactorily. An interesting version of the toggle switch is shown in Fig. 6, where the internal connections permit a change-over effect so that a toggle charger and an H.T. eliminator may be brought into circuit with the mains as desired. When the set is switched off, the toggle charger is switched off. On D.C. mains it is very desirable to disconnect both mains leads when the set is switched off, and thus a double-pole Q.M.B. switch is needed, the circuit and a typical sample being shown in Fig. 7.

Coil Switching

Modern receivers utilise several coils, and if the receiver is of the all-wave type this introduces further difficulties. Special switch units have, however, been introduced for this purpose, and three examples are shown in Fig. 9. These switches have low losses and make reliable contact and furthermore may be ganged together, using one for each coil. Special lengths of rod are supplied so that the desired number of switch units may be used. It would be impossible to give circuit examples in view of the many different forms of switching which may be used. Recently a small form of this switch has been produced, although it cannot be ganged. It is illustrated in Fig. 10, and the various arrangements which are available with this switch are shown in Fig. 12.

Fig. 12. Connections available for the type of switch shown in Fig. 10.

Fig. 12. This indicates, by a heavy line, the contact point and the wiper and arm which are fitted. It will be seen that in one form a wiper arm may take selection on any one of 18 points, or two or more arms may be provided, and will select various contacts. This type of switch was used in our 30/All-Wave 3 receiver, and the only point to watch is that the correct arm

contact is selected for the appropriate contact points.

There is one final type of switch which, although not very well known yet, has many interesting applications. This is known as a "monostable action" toggle switch, and has only one permanent position. For instance, in one form the switch is permanently "on," and if the toggle is raised to the "off" position, it immediately flies back to the "on" position when the finger is removed from the switch. In a permanent "off" switch it will only be "on" whilst the toggle is held down. It is ideal for bringing into circuit a meter to measure angle current, for instance, the reading being noted whilst the switch is held "off," and the meter short-circuited in the normal position of the switch.

ELECTRON BOMBARDMENT

The bombardment of electrons against a surface, either in a narrow directed stream, or as a random impact, is a very important process in the science of television. The function of this process is really twofold, one being related to the transmitting end of the chain, and the other at the receiving end. In the case of the former, the brightness variations of the scene to be radiated are translated into electrical signals, and if consideration is given to the iconoscope type of camera, it is these electrons which are made to fall on a metal mosaic which is insulated and charged at varying potentials over its surface. Secondary emission is the medium which brings about the desired discharge, and in carrying this out, several other factors are brought into being, and these have to be considered carefully when design problems are tackled. For example, there is the question of the saturation effects of the mosaic, the space charge brought into being in the immediate vicinity, secondary electron redistribution and the rate at which these secondaries are collected, the electrical charges on the glass envelope, etc. All these items occur in practice, and have served to make the operation of the device a far more compli-
ON YOUR WAVELENGTH

A Midget Receiver

S. E. JAMES, of Croydon, Surrey, has sent me the details of a midget receiver which he has built in a gas-mask box. It is built on a baseboard 3½in. by 3 in., with a panel 3½in. by 5 in. This just fits in the end of the box, leaving enough space under the lid for the control, and the H.T. battery consisting of three 9-volt grid-bias batteries. On top of this battery, but carefully insulated from it, he has placed one of the old 6l cycle batteries as the L.T. This is used with a 3-ohm resistance for the P.M.2 DX, and H.L.2 valves, and brings the filament current down to the correct amount. The aerial is formed by a wire which passes over the shoulder, and my reader says he can walk about with it using one carriage. The appended photograph shows Mr. S. E. James's gear taken just before the war.

North Manchester Radio and Television Society

THE hon. sec. of the above club tells me that since the commencement of war their meeting place has been moved from Whitefields to the centre of the city, close to the main station, for the convenience of members. He invites other members around Manchester to co-operate. This club is keeping a watch on local rhaps in the wireless business, particularly in the battery line. The Consul for Finland has sent the club his sincere thanks for their sympathetic message to the radio listeners in Finland, which message had been passed on to the authorities in Helsinki.

Coniscation of Sets

THE Secretary of the same club sent a questionnaire to the Engineer-in-Chief of the Radio Section of the Post Office, relating to amateur radio transmitters. You will see from the appended reply the importance of the question:

"Relative to the confiscation of amateur radio transmitting apparatus, I have to inform you that it is the intention to return such apparatus to the owners after the war, and applications for restoration should be addressed to this Department on the cessation of hostilities. You can be assured that every reasonable precaution will be taken to ensure the safe custody of apparatus whilst held by the Post Office.

"This will apply also to call-signs previously held by licencees are cancelled simultaneously with the licence, and no claim to the use of a particular call sign in any future licence granted could be allowed. "If, and when experimental wireless facilities are restored, the question of an adjustment of fees and of the grant of fresh licences will be given consideration." (This was my answer to the following question: "When new licences for transmitting have to be taken out after the war, or will those holding them at the time of confiscation be able to carry on with the old licence until the number of months, etc., for which it was still available are ended?"

Another Battery Racket

E.S.1 of the North, exposes a racket in which is going on in that district. One dealer is selling "special" torch batteries consisting of a grid-bias battery cell neatly covered with pink-coloured paper containing the magic legend: "A.R.P. Anti-Dazzle Battery 4d."

Apparently, this dishonest profit-seeking will continue in spite of the Government.

Television in Germany

A COORDINATE recent newspaper report that television is proceeding in Germany in spite of war conditions. We should certainly reconsider the question over here.

The Short-wave Muddle

In my reference library I have several books which purport to give a list of short-wave stations, and their allotted wavelengths. I also have the list issued by the B.B.C. in connection with their publications. None of them agrees. Even the list issued by the B.B.C. from time to time differs as to important stations. The time has arrived when short-wave transmitters should be compelled to announce their wavelengths and stick to them. The present chaotic conditions merely indicate that the short-wave transmissions are run by mufflers. Quite often the sudden changing of a wavelength will cause severe interference with an adjacent one, making all those interested in listening on the short waves find it confusing to locate and to search around each night for a station which does not maintain its wavelength. This in itself causes further interference. Perhaps my readers would care to discuss this problem, and to give reasons why so many short-wave stations stray from their announced wavelengths. There cannot be any tenable reason for this. I should also welcome details of the worst offenders.

The 1940 Sets

I GATHER from manufacturers that they are not spending any considerable amounts of money in experimental designs for the 1940 receivers. Instead, they are directing their efforts to produce cheaper and simpler receivers so that they can market them without having to increase price. Many of the old constructors who deserted the pastime are now coming back to it and are finding that there is an interesting means of occupying the evenings they are now compelled to spend at home.

January 13th, 1940

PRACTICAL WIRELESS
Television Transmitting Aerials

All the work devoted to improving the efficiency of an ultra-short-wave radio transmitter used for a television service will be nullified if it is not used in conjunction with an aerial array having a very high performance factor. To increase the range of propagation this section of the whole installation must be so designed that the energy losses are reduced to the lowest, and considerable research has been applied to this side of the problem both in this country and abroad. For example, it is a well-established fact that a conductor one quarter of a wavelength long is an efficient aerial, but if this is erected at a great height, so as to increase the range of signal reception, then losses may occur in the feeder cable connecting the aerial to the output circuit of the radio transmitter proper. It has been demonstrated recently that one way to reduce these losses is to adopt a special form of earthing system for the feeder. This is done by using capacity wires which are less than a quarter wavelength long, and tuned to the carrier frequency, thereby giving a low impedance at the point to which they are connected. This simulates a low earth impedance, and forms a relationship to the capacity earth screens which were used with broadcast aerials some years ago, when real earthing facilities were not available. In some cases this capacity earth for television transmitting aerials is made up in the form of spokes radiating from the feeder located at the centre. These spokes and wires are adjustable in length if more than one carrier frequency is to be employed, but can be designed to a fixed length in the case of a single radiating carrier frequency which is usually the case. An actual design based on somewhat similar reasoning, that is improving the radiating efficiency of the television aerial, is illustrated in the accompanying photograph. This shows the corona aerial at the top of the chimney breast of one of the Crystal Palace towers. It was designed to give maximum horizontal radiation, and the eight spokes are clearly visible as an array of definite fraction of a wavelength below the vertical radiating conductor. Summarising this dipole is a small disc to give capacity tuning, and the whole installation was used in conjunction with a 10-kilowatt transmitter. Another method of reducing losses and improving horizontal radiation is to employ dipole aerials with reflectors and if the radiations are to be uniform in all directions, then this becomes a spaced array something like a spherical cylinder, as in the case of the B.B.C. station at Alexandra Palace.

Preventing Screen Damage

It is well known that if the beam of electrons in a cathode-ray tube is allowed to remain stationary, so that the image of the fluorescent screen is evidenced by a tiny brilliant area of fluorescence, then the screen will be burned at that point. That is why instructions are furnished stating that the beam must be kept on the move when patterns or pictures of brilliant intensity are being built up on the tube face. Even so, a measure of wear and tear is inevitable if the same section of the available screen area is used over and over again, while special precautions have to be adopted to offset the damage resulting from a failure of the time base generator to impart the combined horizontal and vertical motion to the electron beam. As an alternative to these methods another scheme has been suggested which has for its main object a prolongation of the life of the cathode-ray tube in terms of the retention of screen efficiency. For this purpose the tube employed has a much larger screen area than is necessary for the particular purpose for which it is to be employed. The screen, or screen and tube, according to the method of instruction, is then made to rotate about its central axis, while the area of screen is arranged to be eccentric to this axis. Fitted to the outer rim of the screen are vanes, and at predetermined intervals the electron beam is deflected so as to strike these vanes, and by this action rotate the screen in much the same way as the rotor of a turbine is rotated by the direction of stream jets against specially shaped vanes. The same principle could of course be applied to the photo electric or mosaic assembly screens used in the different forms of electron cameras, for here again the active life of the apparatus is very often a function of screen, and the damage that results from the continuous impact of the high velocity scanning beam of electrons.

The Attenuation of High Frequencies

The increasing use of the higher frequencies for all forms of communication, when long distances do not have to be considered, has extended very materially the amount of research which is being applied to the propagation characteristics of waves in that part of the spectrum. Obviously, the degree of signal attenuation will vary according to whether the transmissions are effected over water or land or a combination of both, while reflections from the various upper ionized layers of the atmosphere must be taken into account by those who are concerned with point to point working. Quite recently an investigation was carried out in America into the rate of attenuation up to distances of approximately 10 miles over land, the band of frequencies involved being from 20 to 1.5 megacycles, that is, the short and ultra-short spectrum. The results proved most interesting and showed that at 2.5 up to 4 megacycles there was an increasing attenuation with frequency, but that from 4 to 80 megacycles the degree of attenuation remained almost constant. On the other hand, with frequencies below 2.5 megacycles there was a greater attenuation measured during the hours of daylight than could be measured when the sun had set. By careful interpolation of the results it was shown that the variation of signal strength with distance could be expressed by an inverse power equation. In other words, between 80 and 4 megacycles the signal varied inversely as the square of the mean distance. It was also found that the variation of attenuation with respect to frequency could be predicted, but that in day-time the predicted results were always less than the measured values.
Remote Control of Radio Systems

Some Interesting Details of Speech-controlled Radio Transmitters in America

The location of aerials is generally controlled by factors affecting radio reception or transmission, and thus the most favourable site may very likely be at some distance from the central office through which the radio and land lines will be connected. The radio receivers and transmitters must be near the aerials, and in the past this has required the establishment of the station operating force at some distance from the switching centre. For the smaller radio links, where the equipment is simpler and the operating attention required is too small to justify the establishment of a permanent operating staff, the radio equipment has been designed for remote control, and all operating is done from the connecting central office. With this arrangement, periodical visits to the radio station are all that is required for ordinary maintenance. This method, which is fast used with aeroplane ground stations, has also proved effective for radio receivers in ship-shore or harbour craft service, and for both transmitters and receivers for such low-power radio links as that between Green Harbour and Provincetown.

Simple Control Circuit

The operating functions that must be remotely controlled vary for the most part, with each installation, so that standardisation has not been feasible. In all cases, however, a variety of control pulses transmitted over the voice line between the radio terminal and the central office are employed to actuate a suitable set of relays. An example of one of the simpler forms of control circuit is that used for the pole-mounted radio receivers and transmitters at Provincetown. Here it was necessary to be able to turn on either the receiver alone, or the receiver and transmitter together, or to add to the circuit an oscillator for test purposes.

As shown in Fig. 1, a simplex control circuit was used by a connection to the midpoint of the transformers, both at the telephone terminal and at the radio

![Fig. 1.—Simplex control circuit used to control radio receiver and transmitter at Provincetown.](image)

Operating the test relay to prevent operation of the test oscillator.

To bring in the transmitter in addition, the polarity of the control current is changed by operating the negative key. This releases the receiving and operates the transmitting relay. From the latter energises the transmitter through its front contact. During this transition the A relay remains released because of its slow-operate characteristic, and thus the receiver remains in operation and the test relay is held open to prevent the excitation of the test oscillator.

Testing Receiver Operation

To test the receiver operation, the receiver, transmitter and test oscillator must all be in operation at the same time. To bring about this condition, both keys at the telephone office are restored to the normal position, which allows the A relay to operate and the test relay to release and start the oscillator. The negative key is then operated, which actuates the transmitter relay, bringing in the transmitter, and opens the circuit to the A relay—thus allowing it to release and bring in the receiver.

With such a simplex control circuit there are three possible conditions of current flow—positive current, negative current and no current—and by employing various sequences of two or three of these conditions, and suitable relay combinations at the radio terminal, a number of operations may be secured. A few years ago a circuit of this type was employed to control frequency and aerial selection at a radio transmitter. A key at the central station connects a telephone dial to either an aerial change or frequency-change circuit, and the subsequent dialling selects the aerial or frequency desired.

The arrangement of apparatus for this is shown in Fig. 2. When the dial is pulled back, battery is connected to the line through the contacts of a pulsing relay and, depending on whether the battery is positive or negative, the A relay at the transmitting station will operate the aerial or frequency-selecting relay. If, in the case of the dial the battery is reversed a number of times equal to the digits dialled, and the selector at the transmitter will move ahead an equal number of steps to make the desired selection. Relay B remains operated throughout the pulsing, while relay A follows the pulses in order to actuate the selecting relay. Instead of using a simplex circuit, it is possible to send positive or negative pulses to ground over the two sides of the line separately, or a current may be circulated around the circuit in the usual manner.

Both of these latter methods were used recently to turn on and off a radio relay and to control its gain.

(Continued on next page)
Music Plans for 1940

The chief items in the B.B.C.'s broadcast music plans for the early part of 1940 are as follows:

The absence of an alternative programme has made it necessary for every concert to appeal to an infinitely wider audience than in pre-war days, and it is felt that the widening of appeal must come through the shortening of programmes where artistically possible and rigorous concentration on the highest standards of performance.

Special concerts will be given by the B.B.C. Symphony Orchestra at local centres in January and February, the first at the Town Hall in London on January 11th, and the second at the Opera House on January 14th.

A series of monthly concerts to be given in the presence of an invited audience is being planned. The first will take place at the Carnegie Hall on January 15th, and the second at the Empire Theatre on January 22nd.

The B.B.C. Music Productions Unit will continue to broadcast under the title of "Special Recitals," and the programmes will be of high quality and suitable for concert performance.

The B.B.C. Music Laboratories have produced several new programmes, including "The Baroque Era," "The Classical Period," and "The Romantic Era." These programmes will be broadcast under the title of "The History of Music."
A Motor-control Movement

I HAVE been trying to perfect a motor-control movement in which the condenser settings are governed by a cam action along the lines indicated in the article on "Improving and Stabilising Remote Control," which appeared a few years ago in Practical and Amateur Wireless. After pondering over a number of schemes, I finally hit upon the idea of using two nests of contacts obtained from a telephone relay which I purchased quite cheaply. I found that if properly aligned, the contacts (A to F) could be positioned or interchanged with the vanes of a condenser, that is to say, with the moving vanes (V).

On rotating the vanes, I noticed that owing to the thickness of the vanes (T) exceeding the width of the contact air gaps — as illustrated by the inset diagram — an even and definite contact sequence was obtainable. I immediately set about making a cam "unit" as a separate piece of apparatus to permit its adaptation under different conditions of operation during my experiments.

To this end, I constructed the cam unit in such a way that after assembly and clamping to the motor unit, the vanes could be lined up so that the cut-out portions would meet the contact sequence desired at the different settings. Ebonite was used for the cam assembly, an old variable condenser movement being commissioned for the same sequence. These vanes being cut, as depicted, and separated by the old method of brass washers on a square section shaft.

The method I adopted for rigidly mounting the contact nests consists of a reinforced aluminum bracket of 16 gauge, the two sections being clamped with 4BA bolts, as shown.

Owing to the slight protrusion of the nest fixing screws (B), it was necessary to slightly sink two holes (G) in each side of the bracket so that these protruding screws could recess neatly. In this way the nests are prevented from turning after assembly. Final fitment is secured by using a length of 8BA threaded brass rod (K), and nuts as depicted in the inset sketches. — E. V. Castle (Putney).

A Small Microphone

BEING in need of a small microphone, I hit on the idea of utilizing an old torch case for a hand or stand, as shown in the accompanying sketch. The torch case had a glass front, 2½in. diameter, and this I removed, together with the reflector. I next purchased a G.P.O. carbon microphone capsule, price Is. 6d., and fitted it in the end of the torch in place of the glass front. The adapter is made by taking an old pealamp and removing the bulb and cement. A lead from the bottom of the mike capsule is then soldered to the bottom contact of the adapter, which is then filled with sealing wax, or pitch. The bottom of the torch case is drilled with a 3in. hole in the centre to take a 4BA screw which is insulated with two bakelite washers. A piece of thin springy brass is bent, as shown, one end of which is drilled and clamped under the screw head, the other end making contact with the end of the adapter. The other connection is made to the metal case of the torch. — P. S. H. Matthews (Leicester).

A Safety Device for T.C. Connections

WHEN receiving a S.W.L., I had reason to remove the anode cap of a valve while the set was switched on, and although one deprecates such actions, I thought in this instance that with a little care, and as a common screen and anode circuit was in evidence, there would not be any trouble. But I accidentally short-circuited the cap to chassis, with the result that a feed resistance became overloaded, and, as could be anticipated, this resistance was located in a very awkward position in the wiring layout.

This little experience prompted the idea of a detachable fly lead connection, suitably insulated, as shown in the accompanying illustration.

The scheme consists simply of mounting another valve cap (obtained from an old valve) on an ebonite rod, being shrouded by adapting a brilliantine bottle cap as depicted in the inset diagram. To insulate the cap which, as will be noticed, is soldered to the lock nuts of a 2BA bolt (soldering being carried out by drilling a small hole in the top of the valve cap) three ebonite washers are fitted when the bolt passes through a metal chassis. A slot cut in one of the "flats" of the bottle cap permits the easy fitment of the valve cap connector. — S. A. Long (Letchworth).
More Composers’ Idioms

Our Music Critic, Maurice Reeve, Discusses the Outstanding Characteristics of the Music of Grieg and Wagner

WHAT is the definition of the quality or ingredient which goes to make one man’s music so different from another’s? What is that “something” that gives Grieg’s music, for instance, that peculiar tinge or flavour which makes it so characteristic of the man, and so different from any one else’s that, having once heard one single piece by the Norwegian master, whose father was a Scotishman, we could tell his stuff a mile off? And the same with Liszt or Wagner, and in more or less ways, Bach or Beethoven. We talk of this one’s or that one’s idiom in the same way that we talk of Johnnie Walker or something quite different from Haig, or Black and White. And in the same way that an inveterate smoker of cheroots always becomes way before smoking any other brand, so will the musician name one man’s music apart from another’s, even when he has never heard the current example of it before.

It is a most intriguing problem that has baffled and up against an almost insoluble problem. It is subconscious, like one’s personality. In fact, it is part of one’s personality. Having found the secret, I have no doubt that they afterwards exploit it for all they are worth. If we study the actual notation of different composers’ thematic and melodic material, we can be struck with certain characteristics that run through their works. It should not be overlooked, however, that this is only one of several departments, and not the most important at that. Their harmonisation, their treatment of form, their employment of rhythm; these are factors that must be carefully studied. In fact, it will be obvious to anyone that the union of all these ingredients makes the work itself—a melody or a theme is merely a part.

Grieg

Grieg is one of the most characteristic composers who ever lived, if not one of the deepest or most profound. His idiom stands out a mile, and we can easily have a look at his music, now, to illustrate this article, the more so as we have already mentioned him. Here is a short list of some of his most famous melodies, “Solveig’s Song”—the minor and major sections; Piano and Violin Sonata in C minor, first and last movements, and the first and second subjects in each—four themes in all; “Morning” and “In the Hall of the Mountain King,” from “Peer Gynt”; the theme from the beautiful Ballade for Piano; and the exquisite song, “Ich Liebe Dich.” This is a short list, but as it comprises some of the master’s very finest compositions, it can justly be called representative. In all these themes there is the striking recurrence of the drop of a third at some point or other. It is most often a drop, though in “Ich Liebe Dich” it becomes a rise. Also in the second subject of the sonata. Further, there may be more than one third in sequence. But the interval of a third is there, and it persists throughout a large number of Grieg’s works. So persistent and so forceful is it, that we are quite convinced in calling it a characteristic of Grieg’s music that largely contributes to making his music what it is—something quite different from anyone else’s, and a music that stands out a mile whenever we hear it.

Wagner

As Grieg confined himself to the smaller musical forms, his music would naturally be a very convenient medium for studying this question from a melodic point of view. It limits our research within convenient boundaries, whereas with Beethoven or Wagner we find ourselves, as we were, on the limitless tracts of some vast continent with enormous journeys to traverse between each two points. Wagner, I think, is the most characteristic and individual and personal of all the composers. Nobody has ever done anything remotely like his work before; he hammered it out from his own crucible and probably owed less to his predecessors than any of the other great masters (he was, however, a man of great erudition and vast learning). If you take the very first bar of his Prelude in Act I of “Tristan” the “love potion” theme—the first bars of the Prelude to Act III of “Die Meistersinger”--the Motif of “Poetic Illusion” and the divine Brunnhilde motif from “Götterdämmerung,” you will find one of Wagner’s most personal idioms—the big interval of a fifth or a sixth either preceded (ex. 1 and 3) or followed (ex. 2) by the small intervals of tones or semitones.

A COMPLETE LIBRARY OF STANDARD WORKS

By F. J. CAMM.

PRACTICAL WIRELESS ENCYCLOPEDIA 6/, by post 6/6.
EVERYMAN’S WIRELESS BOOK 5/, by post 5/6.
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PRACTICAL WIRELESS SERVICE MANUAL 5/, by post 5/6.
WORKSHOP CALCULATIONS, TABLES & FORMULAE 3/, by post 3/10.
PRACTICAL MECHANICS HANDBOOK 6/, by post 6/6.

All obtainable from or through Newsagents or from G. W. Newnes, Ltd., Tower House, Southampton St., Strand, W.C.2.
This is a two-valver for all the usual short-wave channels, working entirely from its self-contained mains power pack—suitable for all A.C. supplies from 20 to 250 volts, and frequencies from 40 to 100 cycles.

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

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

The Power Supply

This incorporates a mains transformer having a normal output of 280 volts—but the valve needs 250 volts. It operates quite well, however, on the output which is delivered. The only alternative would have been a much larger transformer than is actually needed.

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

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

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

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

A set of three coils is needed. These consist of 3 turns each of No. 20 gauge enamelled wire. This coil will tune quite well on 25.5 metres. The second-sized coil does the work from about 12 up to 25.5 metres. It is not intended that you should tune in 25-metre signals on that coil.

The third-sized coil tunes from 55 to 175 metres, and is quite suitable for reception of 160-metre band signals, the smallest coil tuning from about 50 up to 175 metres. Although this coil goes up to 25.5 metres it is not intended that you should tune in 25-metre signals on that coil.

The second-sized coil does the work from about 12 up to 25.5 metres. It is not intended that you should tune in 25-metre signals on that coil.

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School Broadcasting in War-time

We are informed by the B.B.C. that, despite necessary modifications imposed by war-time conditions, "Broadcasts to Schools" will, from January 8th onwards, occupy an important place in the programmes. Details of the broadcasts for the Spring Term, 1940, are now available.

In its main outlines, the programme follows along the lines laid down in peacetime. Mondays are devoted to Herbert Wiseman's "Singing Together." World History is the subject of the English Course, The Practice and Science of Gardening, Preparatory Concert broadcasts, and "Under-Works" (as usual stories and plays).

Herbert Wiseman has chosen his songs for their simplicity and they will be found in the main leaflet, most songs appear in well-known song books.

World History will be a continuation of last term's series by Rhodes Power, with the title "The Strange Adventures of John and Professor Wiseman." Simple and vivid stories from world history will introduce schools to such characters as Peter the Hermit, Akbar the Great, and Mahomet.

The Book Talks in the Senior English Course will again be given by S. B. Macl. He has chosen a varied list, including works by Dickens, John Buchan, Kipling and Daniel Defoe. Tuesday's programmes include a continuation of Edith Dowling's popular Physical Training broadcasts; Talks for Fifth Forms, which will again be entitled "Science and the Community," and have been planned by W. A. J. C.; and a series "For Rural Schools," entitled "The River." The centre of interest in this series is the story of an intelligent old tramp called Matthew Wherry, who has spent most of his life wandering by its banks. Senior English (Good Writing), also to be broadcast on Tuesday.

Secondly, across the loudspeaker tubes—virtually all stations are pleased to refer to as a static suppressor. Actually, this is our old friend, the high-note cutout, and the curious little gadget, sans suppressor, with a 0.1 mfd. fixed condenser. In series with these two components is a little on-off switch, so that the effect of the high-note cutout can be brought in at any time.

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

Under good conditions you will want to do away with the pentode insensitive quality—and then is the time to switch out the high-note cutout, enabling the pentode to reproduce speech with clarity, and music with great brilliance.

There is really nothing more to say about the circuit, except that it is a sound and reliable arrangement, which will get rid of that trouble when interpreted as a metal-chassis set.

Which brings us to one or two points in the construction you ought to know about before embarking on the assembly. The set is built on an all-metal chassis. A careful inspection of the parts will indicate what you can bend it into chassis shape yourself.

Do the bending on the edge of the bench with a pair of pliers, or better still, if you have a hammer, a stick or a screwdriver, you'll find the job.

No need for a sharp bend—the chassis must be nicely rounded for the topsides.

One of the modern tuning condensers with a very open scale dial has been specified. This is provided with fast and slow motions—the slow motion being a real short-wave asset. The scale is marked from 0 to 180 degrees—the only really satisfactory method of dividing on the short waves with a set of this type.

Reaction is applied in the usual way with a variable condenser which will find itself on the left of the tuning condenser. On the right of the tuning condenser will be the mains on-off switch. That completes the front controls—but don't overlook the switch at the back for the static suppressor.
AN ALL-WAVE FRAME AERIAL

(Continued from page 354)

resonates with the aerial capacity at a frequency lower than the lowest one to be received. At the same time, the lower coil in the system cannot resonate 29 ft. between the grid of the tuning indicator and earth, sufficient current then flowing through resistances 29 and 39 to give the sensitivity of the tuning device to give an equivalent response with the outside aerial by itself.

For operation in the next higher frequency band (i.e., the C band) switch 19 is moved to its middle position. On this band the middle position of switch 19 increases the sensitivity of the visual tuning indicator 29 by lowering amateur open-circuiting resistance 39. The external aerial 3 may be omitted entirely, frame aerial shield 2 being used in its place. This is effected by moving the switching switch 19 in its upper position, thus connecting the shield to the aerial terminal of the receiver, so that it operates as an aerial on the C.W. band, reception proving very satisfactory.

For operation in a still higher frequency band D the switch 19 is moved to its lowest position. The aerial circuit then extends from shield 2 through conductor 34 and the transformer primary winding 16 to earth.

Constructional Details

On the frame aerial and shield is shown in detail in Fig. 2, the frame comprising turns of conductor 43 wound upon cross pieces 50, 51, 52 and 53, fastened to supports 41, 45, 46 and 47 extending between end discs 48 and 49. The earth, or low potential end of the frame is connected to shield 24, and the high potential end to terminal 55, located within the insulated top bearing 56. An insulated bearing 57 connects the top bearing 56 so that the whole structure can be rotated.

The cross-pieces and uprights, together with the end disc form a structure of wood, but the latter are provided with conductive surfaces 57 and 58, of sheet copper, for example, which serve as shields for the top end and bottom end of the frame aerial. The sides of the latter are shielded by a screen 59—preferably of mesh form, containing vertical strands 58 of conductor, with horizontal strands 61 of wool, cotton or other non-conductive material. This screen is big enough to go round the end discs, and overlaps them slightly at the top and bottom, being stapled to the frame as illustrated at 62 and 63. The top ends only of the vertical conductors are joined together, as shown at 64, and also soldered to the copper end plate 57 at a number of points 65. The lower ends of the vertical conductors 60 are left free and insulated from the frame, to prevent the circulation of currents in them, but as it is desirable that the lower end shield 58 be connected to the upper one 57, and to the other parts of the shield, one vertical conductor is connected to it as shown at 66, thus maintaining all parts of the shield at the same potential.

It will be seen in Fig. 2 that the axis of the frame aerial is eccentrically placed in relation to the central perspex cylindrical shield. This arrangement is better illustrated in Fig. 3, showing the high potential and 55 of the frame aerial 43, fixed on a diameter of the shield, while the other end 54, normally earthed, and at low radio frequency potential, may be brought in closer proximity to the shield. The capacitive effect of the latter upon the "frame" is thus reduced.

In use the receiver will normally be placed in the most convenient position on the house, and the frame aerial rotated to the position giving maximum noise-free reception. This is done in that position, and it has been found that, in this way, and through action of the shield 59, reception conditions are further improved, noise currents being much reduced.
Valve Replacement Pointers

Receiver Performance can Often Be Improved by Replacing Worn-out Valves with Others of Newer Types, but Certain Precautions should be Taken when This is Done.

It is, apparently, a very simple matter to obtain and fit new valves to take the place of others which have failed, or which have been in use for so long that their emission has fallen. If in every instance the new valves were exact replicas of those previously in use, the matter would be perfectly straightforward, but it is often necessary or desirable to use different replacements. In the case of a set in which the valves are of fairly old types—possibly obsolete—even if still obtainable—far better results may be obtainable by using valves of newer and more efficient types.

On the other hand, the simple substitution of the more efficient valves might result in a more difficult operation for the general H.F. or L.F. instability. There are not many snags where a battery set is concerned. If the variable resistor is used to replace a fairly old type of screen-grid or screened-pentode, stability can nearly always be ensured by adjustment of the V.M. voltmeter. On the other hand, it will often be found that the receiver breaks into oscillation if the volume control is turned full on. Sometimes adjustment of the screen-grid voltage will overcome the trouble, but in other cases it may be necessary to provide better decoupling, and also to screen the anode lead if this is more than a few inches in length.

Stopper Chokes

Another method which is often successful, despite its simplicity, is to include a small H.F. choke in the anode circuit, between the H.T. line and the anode-coupling component (choke or tuning coil). Incidentally, this simple method of preventing instability can frequently be used with success in the frequency-changer stage of a superhet; in that case, a choke may be inserted between the primary of the I.F. transformer and H.T.—, and another between screening grids (inter- nal or external) and the dropping resistor in the screen circuit. The choke required is of extremely simple type, and can be made by winding about 100 turns of wire on a J inch diameter former. Screening is not always essential, but the effect of encasing the component in a small earthen metal cylindrical box may be tried.

Valve-base Type

If the detector valve is to be replaced, and it was originally a triode, we should favour the substitution of an H.F. pentode or screened-tetrode, which will give better reaction control and thus help to increase the range of the receiver. For preference, the screening grid should be supplied through a 100,000-ohm potentiometer, which will serve as an excellent additional reaction control.

In all cases there is something to be said for replacing existing four-pin and five-pin valves by their seven-pin counterparts. The reason is that seven-pin valves are being fitted increasingly by receiver manufacturers: this means that, in time, new valves of these types will probably be much more readily obtainable. Of course, there are some valve types not available with seven-pin bases, in which case the suggestion just made cannot be followed.

Where battery output pentodes of the four-pin type, with side terminal, were previously fitted they should certainly be replaced by five-pin types, for the side-terminal valves are not now readily obtainable in many instances.

by The Experimenters

Economy Tetrodes

Another point in connection with pentode replacement is that it is generally better to fit a new valve of the tetrode type. The connections are precisely the same as those for a corresponding pentode, but the

Valve Replacement Pointers

It is sometimes satisfactory to replace a large output valve by two similar smaller valves in parallel. They should be decoupled, and this diagram shows how this can be done adequately.

Valve Replacement Pointers

by a 220 OT. The former is a power pentode taking .3 amp. on the filament, and having a maximum anode and screen current of 17 mA; the latter has a filament taking 2 amp., with a maximum H.T. current of about 11 mA. The "economy" tetrode will not handle as great an input, and has a smaller maximum undistorted output, but it is actually more efficient if the input is cut down—by a reduction in H.T. voltage, for instance.

Most of the points mentioned above in relation to battery valves are similarly applicable to mains types. There is, however, an additional point to be watched, which is that the correct value of bias resistor for the new valve might be different from that specified for the original one. If that is so, the bias resistor should be changed before installing the new valve, even for test purposes.

Output Valves

When fitting a new output valve in a mains set of the more powerful type a new difficulty will sometimes arise nowadays. This is due to the recently introduced regulations against the sale, purchase or possession without special permission of valves which could be used for transmission. The regulations, details of which were given on page 285 of PRACTICAL WIRELESS dated December 10th, refer to "electron valves capable of anode dissipation exceeding 10 watts." This figure, it should be noted, is not the maximum undistorted output of the valve, for that is only about one-third of the anode dissipation, on the average.

It is not yet quite clear exactly how the regulation will work out in practice, for it is hardly likely that we shall be entirely prevented from obtaining replacement valves for a receiver, but some difficulty might be experienced. One way out of this is to use the most suitable of the new valves. Another would be to put two valves in parallel, inserting a 10,000-ohm stopper resistor in the grid lead to each, and using a bias resistor of half the resistance and twice the wattage normally required for a single valve. A better method is to connect the anodes together, feed the two grids through the stopper resistors, wire the heaters in parallel and "return" the cathodes separately through their own bias resistors—which should then be of normal rating. Sometimes it is also a good plan to include a 100-ohm resistor in each anode lead, taking both of these to the H.T. line—this ensures ample decoupling, which is desirable if the valves have slightly differing characteristics. Actually, it is far better in every way, of course, to modify the output stage itself. Two tetrodes or triodes in push-pull will give rise to a half and half times the output of one of the valves.

Valve Replacement Pointers

Heater Supply

There will seldom be any difficulty with regard to the heater current, since the previous valve would probably have been of the directly-heated type with a filament current of two amps, as against the one amp each for the heaters of the new valves.

(Continued on page 369.)
DURING the last war, while Europe was otherwise engaged, the United States captured the film market world-wide, probably by a hundred million pounds passed largely under the control of Wall Street financiers and Hollywood studio moguls. There is no grave danger that the same will happen to television, an industry which over the next few years in this country alone will probably be worth one hundred and fifty million pounds.

In this industry any aircraft should not be able to take bearings by picking up the ultra-short wave signals radiated from Alexanders Palace, television transmissions were stopped on the outbreak of war. As a result the young television industry, which was emerging successfully from the laboratory, had to be commercialised, as the production of television apparatus was required to finance it. On the contrary it would provide a considerable additional source of revenue to the Government. The plan would therefore over come one of the greatest of the pre-war obstacles to the growth of television, namely, the difficulty of providing adequate finance for attractive programmes and for the expansion of the service. Indeed, just before the war had been reached when the million or so listeners to the sound programme had a valid criterion to make that the B.B.C. were utilising part of the licence money in order to provide television programmes for the benefit of a few.

Co-operation Ensured

I am assured by leaders of the entertainment industry that they would co-operate wholeheartedly in the provision of wired television. Indeed, without the aid of the experts in the art of visual entertainment, namely, the film industry, it is impossible to provide an adequate visual service.

A wired television system would really be the ideal method of making television accessible to the hulk of the population. In its earliest days a rental system for television sets. After all, no one owns a telephone or does anyone buy an electric meter. A television set, which is a complicated piece of apparatus, will always be much more costly in the first place than an ordinary radio set. A certain amount of maintenance may also be required. All the public are interested in (a) adequate entertainment, and (b) a trouble-free service. If the public were satisfied that these two essentials were being fulfilled the majority of householders and flat-dwellers would be prepared to pay, say, a sum of 5s. a week or the like for the rental of the set, the rental to include a contribution towards the provision of the programme. The "plug-in and view" service, would therefore, pay its way without placing an undue burden upon the resources of the B.B.C. or upon the taxpayers' money.

What a boost it would be to the community if during the long winter evenings when the glooms of midwinter prevail and the hard work of the day is done, the residents from going the normal sources of entertainment, they were able to sit at home and have their entertainment provided by television. At all, co-operation and a wired production of television would enable Britain to maintain her lead in the field gained as the result of years of patient research work.

THE FUTURE OF TELEVISION

The Following Notes Have Been Received from Mr. S. Sagall, the Managing Director of Scophony Limited.
ONE of the most essential items in the equipment of those interested in coil construction is a reliable wire table or, to avoid confusion, a table giving all the necessary data connected with conducting wires of standard gauges. Such tables can be found in most electrical handbooks and in many of the small booklets issued by wire manufacturers, but for the benefit of those who are without such valuable information, it should be noted that a very comprehensive table is contained in "Wireless Coils, Chokes and Transformers," a book which can be obtained from these offices.

So prevents a copy of the table being given in these pages, therefore, it can only be said that it forms a most useful reference book for one is concerned, as when undertaking any winding work, with such things as the diameter, the number of turns per inch, the resistance per yard or the current carrying capacity of any one particular gauge of wire. For example, it was suggested last week that one could select a wire of a certain gauge and then, knowing the number of turns required, determine the size of former required for the work under consideration. A glance at the wire table will indicate the length of former necessary to carry any number of turns, and this alone will save a considerable amount of time and possibly labour. This is hardly the correct procedure to adopt when designing a coil, as there are other things to be considered first, but it is mentioned to show how simple application of a wire table will indicate how valuable it can be if used wisely.

Poor Insulation

The insulation between adjacent turns and layers is of prime importance, especially when dealing with high-frequency and high voltages, and the constructor cannot pay too much attention to this item which in many instances appears to be neglected with scant consideration.

With coils used in pre-detector stages quite serious losses can be introduced by using wire having a low insulation factor, and the average constructor does not appreciate sufficiently the effect of the atmosphere on cotton or silk-covered wires. If such windings are allowed to become damp, and this does not mean sufficiently damp to be felt, due to moisture in the atmosphere, the whole efficiency of the winding will be affected, and therefore it should be realised that some means must be provided to protect the winding from such possible source of trouble. Faulny or encrusted enamel or enamel wire must be watched for, and care should be taken when winding to avoid perspiration or grease from the hands coming in contact with such wires when carrying out the actual winding. This applies in particular to wires of very fine gauges.

When considering such windings as those required for L.F. chokes or mains transformers, where the winding has to be built up in layers, the importance of insulation becomes two-fold, as there is not only the danger of loss of efficiency but of short-circuits and burn-outs which, when bearing in mind the high voltages sometimes associated with such components, can become a very objectionable and costly business. Great care, therefore, must be taken to see that the wire itself is suitable in all respects for the voltage and current concerned, and that each layer is adequately insulated from each other by means of 'envelope cloth,' or other suitable insulating material. With mains transformers in particular, it is always wise to take all precautions as regards insulation.

Magnetic Fields

By virtue of the properties of inductance, an electro-magnetic field is created around any normal winding when it is carrying a current. There are certain forms of windings which tended to reduce the external field, but in this article we are only concerned with the more simple and straightforward types of windings, so the following points should be noted.

The effective area or range of the magnetic field around any given winding is governed by the strength of the current flowing through it, but in view of the fact that a field does exist under operating conditions, it becomes necessary to use sufficient care when placing inductances to see that such fields do not introduce losses or interaction between two or more components. In this respect, therefore, coils of large diameter are likely to call for more attention than those which are wound on a former having a small radius of curvature. It is a rule for all coils, when completed, that the inductance value is likely to vary in view of the movement of the winding, while if it is a choke or a transformer, the winding will, without doubt, collapse just as the last layer is being put on.

Always select a former or bobbin with sufficient rigidity for the work in hand, and, with the latter, see that the checks are securely fixed to the body of the bobbin.

Formulæ

Unless a hit and miss method is employed, one is forced to use certain calculations to determine the value of the inductance required for a given circuit with which it is desired to tune through a given waveband. Use can be made, if they are to hand, of charts which give the relationship between capacity (the tuning condenser) and the inductance (the coil) required for a given waveband, but if these are not available, then the formula wavelength = \( \frac{1,885}{\sqrt{L}} \) may be used, where the wavelength is in metres, \( L \) the inductance in microhertzs, and \( C \), the capacity in microfarads.

Knowing the value of \( L \) required, the following formulæ are fundamental factors for the construction of the desired coil.

\[
L = \frac{2A^2}{3} + 9B + 3A + 9B
\]

when \( A \) is the mean diameter of the coil in inches, \( B \) is the length of the winding of the coil in inches, and \( N \) is the number of turns. By twisting this around, the number of turns required can be determined from

\[
N = \sqrt{\frac{3A + 9B + 3A + 9B}{2A^2}}
\]

The above holds good for \( L \) for single layer coils of the solenoid type mentioned and shown last week, but if a coil having more than one layer has to be made, then the lower line of the formulæ for \( L \) becomes

\[
3A + 9B + 10C
\]

where \( C \) equals the radial depth of the winding in inches.
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).

Feature DX Broadcasts

SIR,—The listed appendix of short-wave transmissions will, no doubt, be of interest to some of your readers:

Short-wave Transmissions.—Jan. 21st, 22.00-23.00 G.M.T., ZAA, Ethiopia, 9,650 kc/s.

Broadcast Band.—Jan. 8th, 08.00-09.00 G.M.T., CKW, Moncton, Canada, 1,270 kc/s; Jan. 13th, 08.00-09.00 G.M.T., CHLT, Sherbrooke, Canada, 1,210 kc/s; Jan. 19th, 08.00-09.00 G.M.T., CFAK, Flin, Flin, Canada, 1,370 kc/s; Jan. 14th, 05.30-06.00 G.M.T., KOB, New Mexico, U.S.A., 1,180 kc/s; Jan. 14th, 06.00-07.30 G.M.T., WTAM, Cleveland, Ohio, U.S.A., 1,070 kc/s.

This DX programme promises to be one of the hifists shows ever put on the air for DX'ers! Jan. 14th, 07.00-08.00 G.M.T., CMHJ, Cienfuegos, Cuba, 1,160 kc/s; Feb. 18th, 07.00-08.00 G.M.T., CMHJ, Cienfuegos, Cuba, 1,160 kc/s.—N. Burton, Assistant European Representative, International DX'ers Alliance (London, E.8).

The "Kestrel S.W. 4"?

SIR,—In reference to my query in regard to "The Kestrel S.W. 4," I am glad to say that the set is now working perfectly, and I am more than pleased with its performance.

My experience should be a warning to other constructors. In order to economise I made alterations to the design: wood chassis, different components (which necessitated altering the layout), etc. Result: poor performance, blind spots, excessive reaction, and in the end I spent more money than I should have done if I had stuck to the original design.

I have now constructed an aluminium chassis, followed the layout, and now have a set that I am proud of.

I have learnt my lesson, and it will do me a lot of good. Wishing you every success in your work.—B. Howards, (Howlands Castle, Hants).

P.W.2 Short-wave Sets

SIR,—I thank you for sending me my B.L.D.L.C. enrolment card. I have been studying for an exam, so have had very little time to get any work done. The first set I built was the Simple Short-wave in the beginning of 1938. Last year I made the two-valve Simple Short-wave. I have had remarkable success with the above receivers. I have logged 500 Hams and had DX on B.C. bands were V.L.R. Ching-kung and Tokyo. I use six-pin plug-in coils and a 15ft. indoor antenna. I built the above receivers in Scotland, where I was at school, but over the years I did not return. I find that reception results here are much better than in Scotland. Incidentally I was up at Fort Augustus in the Highlands. Of course, the fact that there are many mountain ranges about up there may make a difference to reception. But, anyhow, not as satisfied with the above-mentioned receivers. In Scotland, when I was using the one-valve, I had a medium-wave plug-in coil, which worked very well. We are very unfortunate over here as to the price of parts. There is a 33½ cent. duty on all wireless parts, which is no joke when one wants to build a set.—Morgan O'Connell (Kilharny).

The "Pocket Two": Correspondent Wanted

SIR,—I should like to correspond with any of your readers who are building or anticipating building your "Pocket Two." I should also be pleased to correspond with any inequity of the B.L.D.L.C. or the W.F.S.R.A.

I have been experimenting with short-wave wirelessness for several years, but now I want to be more mobile and I have found your journal of great assistance.—L. D. Jeffery (Railway Transport Office, Central Ordnance Depot, Weeton, Northants).

Correspondents Wanted

SIR,—Through the medium of your excellent weekly I should like to ask any short-wave enthusiasts about the best way of sending near my address to please communicate with me. I have only recently moved to the address given below, and through doing so have lost touch with my S.W.L. friends at my old QRA; therefore, if any listeners living near me would care to call or write I shall be greatly obliged.

I am very keen on short-wave listening and transmitting, and I have about 30 QSL cards from various parts of the world. May I take this opportunity of asking you for such a fine weekly as Practical Wireless. I have been taking it for the past three years and have found it even better every month.—Leslie Browning (5, Charles Street, Gloucester).

Exchanging S.W.L. Cards

SIR,—I have been a keen reader of your most excellent journal for nearly three years now, and have found it most helpful in solving problems which arise in short-wave experimenting. I shall be very pleased indeed if any short-wave listener in any part of the world would exchange S.W.L. cards with me, and all cards will be answered direct, if possible. Here's wishing your paper long life and success in the future.—D. W. Surman (1, Brent Road, Dad's Lane, Strelley, Birmingham).

DX on the Medium Waves

SIR,—Please add my name to Mr. Burton's, regarding DX on medium waves. A set of the superhet type would be greatly appreciated. I have no doubt you agree, since the selectivity needed in present-day sets makes all other types, in my opinion, out of date. In my district, at any rate, it would have to be a battery type.—H. Mitchell (Cawthorne).

Valve Replacement Pointers

(Continued from page 166)

The centre-tap of the heater winding must, however, be joined to the earth line when changing to I.H. valves. If a centre tap is not provided, the same result can be obtained by using the potentiometer which was previously wired across the winding and earth-connected through the bias resistor.

If a new output valve is used singly, and this requires an L.T. current appreciably less than that taken by the valve employed originally, it might sometimes be desirable to connect a "four-ohm" resistor in series with the winding, this being designed to "absorb" the difference in current. Thus, if the winding is designed for two anode currents at four volts and the new valve takes only one amp, a four-ohm resistor could be used. With most transformers having good regulation this complication is not necessary.

A Transformer Point

When two L.T. windings were used originally—one for the I.H. valves and a separate one for a D.H. output valve—and an L.H. valve is to be used for output, it may be thought desirable to connect the two windings in parallel. This should not be attempted, for the D.H. valve may be more satisfactorily driven from the separate winding. If the two windings are joined together, and they should be wired in such a way that they are out of phase, the effect is similar to that of short-circuiting the transformer. This is because, if a transformer has a single primary winding, and the two windings are driven from one end, the windings would be connected to the negative of the other, and vice versa. Not only would the output voltage be practically nil, but the transformer would overheat and damage might result. Apart from this, paralleling of two windings, which have probably different characteristics, is not good practice.
Push-pull Transformer

I am going to build a set with push-pull output and should be glad if you would inform me as to the correct ratio which the transformer should have. I wish to obtain the best possible quality and expense is not a consideration."—F. S. P. (Edinburgh).

We are unable to answer this question direct, as there are several forms of push-pull, each of which calls for special requirements. The standard form of Push-pull known as Class A, utilises two power or super-power valves biased to the centre point and the standard push-pull transformer for this circuit is generally about 4:1 or 4:1. The Class B push-pull circuit calls for a special transformer with a low-recoil coil, this being generally about 1:1 to 1:2. The Quincent push-pull circuit utilises pentode valves and the ratio of the transformer is generally about 1:1 to 1:2.

Light Switch Fault

"I find that a lot of interference is caused by the light switches on the walls of my house. When these are operated they sometimes work properly, but other times there is a buzzing in the set if this is switched on, and it can only be stopped by operating the light switch once or twice. Can you explain the reason and cure for this trouble?"—R. J. (Steeleford).

This trouble is probably caused by a faulty switch. If the switches are old, they may have weakened and fall to make good contact at every operation. On the other hand, they may be of the type which is not spring loaded and when operated the contacts may not be firmly pressed home. Finally, they may merely need cleaning, but we suggest that you call in an electrician to inspect the switches and carry out the necessary adjustments.

Modern Coils

I have found a number of old circuits of various types of receivers which I would like to try, but unfortunately the coils which we recommend are not now on the market. Is it possible in all circuits merely to substitute modern coils and adopt the connections recommended by the makers? I should be glad if you could answer this query as I am sure it will interest many other readers who are also keen constructors and experimenters."—G. H. (Highbury).

Unfortunately it is not always possible to substitute coils without making changes in the circuits, or changes in the wiring. For instance, in its simplest form, such modification would consist in the re-winding of the reaction condenser, as this may be on either side of the reaction winding, and in some coils this winding is internally joined to the secondary winding. There is also the possibility that the circuit you wish to build incorporated some special feature which necessitated special coils. Modern coils may be totally unsuitable. It is therefore necessary to study carefully each circuit and if necessary inquire from the makers of the new coil whether it will be suitable for the circuit it is intended to try.

Winding a Resistor

I wish to wind one or two resistors for a power amplifier. The total current carried is about 1 amp and I should like to know if there is a gauge of resistance wire which has some even value of resistance to facilitate the working out of my various items. What wire do you recommend, and what is its price?"—F. R. B. (Highbury).

Ordinary nickel-chrome, 24 S.W.G, will carry 1.3 amps. in a solenoid winding and has a resistance of approximately 4 ohms per yard. This should be quite suitable for your requirements. We do not know the exact value of the resistors, but the fact that a simple solenoid of wire in the anode circuit of the detector valve, a fixed condenser feeding the phones direct from the detector anode circuit, and the other side of the telephone connected to earth. A simple on-off switch between the phones and earth would enable you to switch out the phones when using the loudspeaker.

Musical Instruments

"Did you give in any of your back numbers instructions for making a musical instrument with valves, probably two years ago? I should be very grateful if you would let me have the back numbers which I will pay for."—A. C. G. (Northwood).

We are not clear as to the exact type of instrument you require. It is possible to fit a microphone to any musical instrument and feed the microphone through a standard valve amplifier in order to amplify the sound. Alternatively, a stringed instrument may have the bridge carrying the strings in contact with the diaphragm of a microphone or gramophone拾-up to provide amplification. A more up-to-date idea is to fit small electro-magnets near the strings and to feed the output from these to an amplifier. Another instrument which you may refer, utilises the oscillation produced by valves as the medium for producing a sound from them, and by varying the pitch of the oscillation you alter the tone of the note produced. A very satisfactory valve circuit followed by an L.F. amplifier may be employed, with a metal rod connected to the grid terminal of the detector valve. By placing the hand near the rod the note will be varied and tunes may be played. This is the fundamental principle of the Theremin instrument.

Stepping Down A.C. Mains

"I have a commercial receiver operated by a mains section rated at 120 volts A.C. I have now moved to a house where the mains are 250 volts. Could I step down the voltage to 120, and if so could you give me details of a transformer which would be suitable for my purpose?"—W. W. (Gillingham).

It is possible to step down the mains voltage and this is a common practice. Unfortunately, however, it is necessary to use a transformer designed to deliver an output wattage suitable for the receiver. Therefore, we cannot give you winding details of a suitable component without knowing the load of your set. A suitable component could be obtained ready made from Messrs. Heysyberd, and you should write to them, giving them details of the receiver, and they will supply a suitable transformer.

REPLIES IN BRIEF

The following replies to queries are given in abbreviated form either because of non-cooperation with our rules, or because the postcard_tosubmit satisfactory results.

R. F. E. (Aberdeen). Must you use the extra valve? Apart from the increased consumption of H.V. and L.T. there will be very little gain and it would be uncommercial.

L. S. A. (Birmingham). We think the idea excellent, but the valves give very unsatisfactory results.

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

There are still many receivers in use in which engraved elonite dials are being used. Generally these have deep cuts for the degree markings and these are filled with white enamel or paint. After some time they may become discoloured and difficult to read. They may be re enamelled however, and made almost as good as new by dipping them in ordinary turps for a short time and wiping with a rough cloth, so that all the old paint is cleaned out. If necessary they may be scratched, taking care to avoid over-running the original markings, and then the dial should be wiped carefully with a piece of rag carrying a small quantity of good white paint or enamel. This will fill the markings, and a clean rag should then be wiped over to remove excess from the dial itself. When dry the dial should be as good as new.

Terminal Connections

When making a short-wave or similar receiver, where fairly heavy-gauge wire is used for connection purposes, some constructors experience difficulty in making connection to the shack of a terminal. Owing to the small space available the connection is not usually made soundly, and an idea worth remembering is that which was employed in old-pattern Government apparatus. The shack of the terminal was drilled down for a short distance, and the wire used for connection was of such a gauge that it just fitted inside the hole down the terminal itself. If the space is too small it is bored, and flux is inserted inside the terminal hole, and the wire then inserted, upon the application of the soldering iron carrying a good "blob" of solder, it will run down into the hole and the connecting wire will then be firmly attached to the terminal and be, in effect, an extension of the terminal shack. Ordinary terminals may be drilled by clamping them in a vise, first running a nut down the shank, which may afterwards be removed to take off any burr which may be made on the end threads.

PRACTICAL MECHANICS HANDBOOK

By F. J. CAMM.

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ROUND THE WORLD OF WIRELESS

Valve Characteristics

There are many listeners to whom valve characteristics still appear to be mysterious figures issued by a manufacturer specially for commercial set-designers. Actually, of course, these characteristics are essential for everyone who uses the valve and are just as important and easy to understand as the data issued by the maker of a car. When purchasing a car you want to know its petrol and oil consumption per mile, its acceleration, and other factors, and in just the same way the performance of the valve should be studied when selecting a valve for a receiver. It is quite a simple matter to take the valve data and draw up the characteristic curves, and all that is required is a volt- meter and milliammeter, in addition to the filament, H.T. and G.B. battery supplies. All the facts such as amplification factor, impedance slope, etc., may then be obtained and the process will not take long. By making up a small test unit it is then possible to test a valve from time to time in order to ascertain whether or not it is becoming worn out or otherwise in need of replacement. An interesting article on this subject will be found on page 374.

“Babes in Arms”

A radio version of the new Metro-Goldwyn film, “Babes in Arms,” will be broadcast on January 19th. This film, featuring Mickey Rooney and Judy Garland, has its London premiere this month. Douglas Moir, who is preparing the radio version, promises, “I have provided dialogue, with microphone versions of many famous films, including “Top Hat,” “Congress Dances,” and “One Night of Love.”

“Babes in Arms” is founded on the Broadway success by Richard Rodgers, with music by Lorenz and Hart. It tells the story of old-time variety performers who have fallen on hard times, but whose children, determined to save the family fortunes, start a new show on their own with overwhelming success.

Appointed to Governor’s Staff

Powel Crosley, Jr., president of the Crosley Corporation, operators of WLV, WNL, and the international station WLW, of Cincinnati, has been appointed to a colonelcy by Governor John E. Miller. Mr. Crosley will serve as aide-de-camp on the Governor’s staff.

Rationing

One of the main topics of the day wherever women meet is rationing. Joan Littlewood, who has done a great deal of feature work in the North, has been out and about in the Manchester district finding out what people are thinking and talking about on this subject. With a recording van Joan has been making a round of shops, ranging from some of the big city stores down to the shops of small back-street tradesmen and has recorded the impressions both of shopkeepers and shoppers. In another sphere she has tapped both ends of the social scale, giving the views of a manager in one of the city’s big hotels and, by way of contrast, what a tram has to say on the subject.

The Stuff to Give The Troops!

Harold Forrester, an Edinburgh bookbinder, who has wide experience in satisfying the tastes of different kinds of readers, gives advice on the “stuff to give the troops” to listeners who may think of buying books to send to friends who are with the services. His talk will be heard in the forenoon of Saturday, January 29th.

A Popular Wodehouse Character

With many Wodehouse fans Ukridge is quite as popular as Bertie Wooster or Jeeves. Ukridge stories are now being adapted for broadcasting by Anthony Dale, and will be given in programmes from time to time. The first is to be produced by Peter Creswell on January 29th. This is the very amusing Dog College story.

Radio Sales in U.S.

The year-end amount of radio sets sold during 1939 is expected to total 9,000,000, a high spot for the industry. Receiver sales are stated to be currently running about 26 per cent. of 1938, when the total was 7,100,000. The radio sales for 1939 being the number of sets in use by American listeners to a total of 45,200,000 as 1940 opens, taking into consideration that about half of the sales made in 1939 were replacements. It is also announced that in conjunction with the increased sales there has also increased very considerably the dollar volume of all sets sold in 1939 running at 30 to 33 per cent. ahead of 1938.

General Sir Edmund Ironside to Broadcast

General Sir Edmund Ironside, Chief of the Imperial General Staff, will come to the microphone on January 21st to make an appeal on behalf of serving men and their dependents. Contributions will be gratefully acknowledged and should be addressed to General Sir Edmund Ironside, at 23, Queen Anne’s Gate, London, S.W.1.

“The Way of an Angel”

One of the best known Yorkshire dialect playwrights is James B. Gregson, the Huddersfield dramatist, whose play, “The Way of an Angel,” is to be produced by Edward Wilkinson, on January 27th. This play, which is one of the Yorkshire drama series, has three characters and was originally presented by the Huddersfield Thespian Society.
Valve Testing

How to Determine the Characteristic Curve, the Amplification Factor, and the Impedance of Valves is Explained in This Article by L. O. SPARKS

The majority of constructors with a valve tester requires a reliable milliammeter and two voltmeters. If a dual range voltmeter is used, reading, say, 0 to 10 volts and 0 to 120 volts, that can, of course, be used instead of the two separate voltmeters. A potentiometer, some valve-holders, one or two switches, and a suitable piece of material for a panel, plus a small box or cabinet in which to house the unit, form the main requirements. It is highly probable that most constructors have the majority of these items amongst their equipment.

Essential Requirements

As will be seen later, the simplest of voltage testers requires a reliable milliammeter and two voltmeters. If a dual range voltmeter is to hand, reading, say, 0 to 10 volts and 0 to 120 volts, that can, of course, be used instead of the two separate voltmeters. A potentiometer, some valve-holders, one or two switches, and a suitable piece of material for a panel, plus a small box or cabinet in which to house the unit, form the main requirements. It is highly probable that most constructors have the majority of these items amongst their equipment.

Testing Procedure

The simplest test to apply to a valve is to determine its emission which, in turn, will allow its anode current/grid voltage curve to be plotted and give a visual indication of one of the valve's characteristics.

Most valve makers publish sufficient details about their various types to enable one to check results and thus see if the one under test is normal. For example, it will be noted that current values are specified against certain anode, screen and grid voltages, so when comparisons are being made the voltages mentioned should be applied.

Assuming that a simple triode valve is being tested, the following procedure should be adopted. With the valve in the holder and its filament and anode circuit connected, connect the grid to the negative side of the filament supply and plug in the H.T. supply, adjusting it until its voltmeter indicates 120 volts. Note the anode current, i.e., Ia, and plot it on squared paper as shown by the point x in Fig. 1. Now adjust the grid battery potentiometer until the grid voltmeter shows 1 volt, and then read off Ia again and mark its position (y) on the graph (Fig. 2). Repeat this procedure, increasing Vg by 1 volt each time a reading is taken, until the point x is reached, which denotes what is known as the cut-off point of the valve under test. When all readings have been taken, connect all points with a line, thus forming the completed curve, as shown by the solid line in Fig. 2. From this, the value of Ia can be read off for any value of Vg between zero and that required to produce cut-off.

With S.G., H.F. and L.F. pentode valves, a constant H.T. voltage must, of course, be applied to the screening-grid during the above operations. The value of this voltage will depend on the type of valve and the maker's specifications.

Amplification Factor

The amplification factor or, as it is more often called, the Mu of a valve, is a very important item as it indicates what gain or signal amplification we might expect from it when it is operated under ideal conditions. A glance at any valve maker's booklet will reveal that the Mu of a valve varies over a very wide range, according to the numerous types, but whatever type is under consideration, its amplification factor can be determined quite easily.

Assuming that the valve used for the previous test is being examined, the following readings must be taken. With Vg at zero, i.e., the arm of the potentiometer making contact with the negative filament/H.T. line, adjust the Va to 100 volts and then note Ia. Now increase Va to 120 volts, and when the meters are steady adjust the grid potentiometer until the value of Ia—which increased when Va was increased—returns to its initial value. Measure accurately Vg and then carry out the following simple calculation.

\[
\text{Vg} = \frac{\text{Va}}{\text{Ia}}
\]

If, in other words, divide the Vg difference in the two anode voltages applied, i.e., 120-100 = 20, by the grid voltage applied to restore anode current reading back to its value when 100 volts was applied to the anode. Supposing that Vg was 2 volts, then the amplification factor, or the Mu, of the valve equals

20 \frac{\text{Vg}}{\text{Ia}}

The Mu is simply denoted by a number which is an arbitrary term.

When carrying out this and any other tests connected with valve characteristics, it is absolutely essential to make frequent checks to see that all applied voltages are remaining constant, including the filament or heater voltage, as any fluctuations or inaccurate readings will upset all calculations.

Impedance

Another vital characteristic of a valve is its impedance or input resistance as the value of this plays a very important part in the design and selection of suitable inter-valve couplings. The impedance of a valve, as is expressed in ohms, can be determined by applying the following tests. With Vg at zero, apply 100 volts to Va and note the current reading Ia. Now increase the value of Va by a definite amount, say, 20 volts, and note the new reading of Ia. The impedance can now be calculated from the formula:

\[
\text{Impedance} = \frac{\text{Ia} \times 20}{\text{Va} - \text{Ia}}
\]

Assuming that the change in anode current for the above example is 4 mA's, then the impedance would equal

\[
\frac{4 \times 20}{5,000} = \frac{80}{5,000} = 0.016 \text{ ohms}
\]
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Receiving English News from Abroad

This Article Explains Methods of Obtaining Good Reception of News Transmissions from Various Parts of the World

By FRANK PRESTON

A Tuning Modification

In the case of a "straight" set, bandspread can most easily be added by fitting a 25 mfd condenser, with good low-oscillation drive, and providing a switch so that it can be put in parallel with the single tuning condenser of a Det.-L.F. set, or in parallel with the detector-circuit tuning condenser of an H.F.-Det.-L.F. set. The connections are indicated in Fig. 1.

where it will be seen that a simple on/off switch—any reliable pattern will serve—is placed between the moving vases of the condenser and earth. If desired, the switch can be omitted and the condenser left in circuit continually, but that would necessitate retuning in a selective receiver.

For preference, the re-alignment should be carried out with the tuning condenser set to its midway position, but this may not be possible because of the low capacity of the trimmer.

In any event, it is important that the lead to the fixed vases of the condenser should be kept short, and that the new condenser should be placed as near as convenient to the tuning condenser to which it is connected. If there is insufficient room for the extra condenser on the panel, or if placing it would spoil the symmetry of the controls, it might be satisfactory to mount it on the end or top of the cabinet, or even on an inclined sub-case, underneath the lid, so that it can easily be reached by opening the lid.

Modifying a Superhet

When using a superhet, the same general idea can be used successfully. This time the condenser should be wired in parallel with the section of the gang tuning condenser connected to the oscillator coil. In most cases it is better to fit the switch previously mentioned, and sometimes it is found desirable to fit the condenser in an empty screening box. Even when these precautions have been taken it may be found that slight readjustment of the trimmer of the oscillator section is required, this adjustment being made when the fine-tuning condenser is out of circuit and the set tuned to medium waves.

We never recommend that alterations should be made to commercial receivers, but those referred to above can generally be made without great difficulty by an experienced constructor. Before making any permanent connections and before mounting the new condenser, however, it would be wise to test the alteration to make sure that no harm will be done. It is also important that the circuit of the set should be carefully studied to ensure that even temporary alterations are made.

Calibration

Once the new condenser has been installed, it should be possible to calibrate its scale on the different short-wave bands, by carefully setting the main tuning condenser to exactly 19, 25 and 31 metres, for example. Accurate calibration is not, unfortunately, always possible because of the rather "open" marking of the original tuning scale. Sometimes it is possible to arrange an accurate guide by gluing on to the edge of the scale a strip of white card with a fine ink line across it. The advantage

...
Sir John Reith's New Job

Sir John Reith returns, although in an indirect way, to broadcasting. In his new job as Minister of Information he will, of course, control news. Sir John is not, of course, a journalist. Whilst he was Director-General of the B.B.C. he did in fact on a number of occasions, and, of course, facetiously, refer to journalists in somewhat slighting terms. There are many who do not understand the qualifications and the particular work of a journalist. They think his life is one round of social functions, and that he is permanently under the influence of inkoil. They think that an Editor’s job is to dot’s and crosses. Although a journalist, I have no hesitation in saying that journalism demands a higher degree of education, knowledge and the experiences gained in the university of life than any of the other professions. Sir John has in his time met all of the important journalists—including me—and thus he will be able to bring to bear on his new job a knowledge of the requirements of the Press and the public. He will know how to prevent the whispering campaigns, which the undue suppression of news or the publication of half-truths encourage. His best wishes for his success in his new job.

Our New Sister Journal

My congratulations also to the dynamic Editor of this journal who, I see, is founding yet another important weekly publication—Practical Engineering—the first issue of which will be published on Thursday, January 29th. The new journal is a weekly, thousand 4d. It is planned to appeal to all engaged in the engineering trades. Designers and draughtsmen, works managers, shop foremen, fitters and turners, millers, planners and shapers, welders and sheet-metal workers, tool makers and gauge makers, electricians and maintenance engineers, inspectors and viewers, in fact, everyone associated with mechanical engineering and its kindred trades, as plastics, should read Practical Engineering—the new and modern engineering weekly. Make a note of the date, Thursday, January 29th, and order a copy from your newsagent to-day.

The Torch Battery Ramp

I have stirred up a hornets' nest in my exposure of the ramp which is going on in connection with batteries. Perhaps I should have used the word vampires instead of hornets, for what can be said of people who in a time of emergency will stoop to the filthy low trick of breaking up high-tension batteries made for a maximum discharge of about 15 m. a, and sell them for use in torches? Inquiring at the least over a quarter of an ampere, and usually about half an ampere. One of my Midland readers saw an advertisement in one of the Midlands papers which said: “Thousands of batteries in stock, bring your case; all sizes." This advertisement was inserted at a time when the battery manufacturers could not deliver. Our reader investigated the case and found that some enterprising gentleman had taken over the shop and was selling 11-volt H.T. cells in series of two at 6d. each. They were wrapped in white paper, and were printed in blue with the magic words “Double Life Battery—British Make.” One of the difficulties in the battery trade has been the enormous number of different kinds of batteries for which the manufacturers are expected to supply batteries. The time has come when the battery manufacturer should standardize on no more than three sizes of torch battery, and thus force the stupid people who manufacture ridiculous battery cases to go out of business. Some of the torches which are sold are too tiny to give more than a few minutes’ life from the midget battery they can accommodate. The public must be encouraged to buy a proper size of torch.

A Quaint Request

One of our readers, Mr. J. A. C. of Forfar, sent us recently a letter which said: “I enclosed are six QSL cards as verifications of reception report. Please send B.I.D.L.C. A.C.R. certificate for your earliest. His verifications were from British house stations, and so we replied, pointing out that we could not accept cards of British home stations for an A.C.R. certificate. I should have thought that this would have been obvious to any amateur radio enthusiast, for anyone would be entitled to a certificate under such an arrangement. Not so our reader, however, for he replied: “I wish to draw attention to the fact that I fulfilled all the conditions as published. Your non-acceptance of a British card to represent the European zone is just silly. Where is Britain if not in Europe? Besides, anyone in Britain can receive European stations at any old time, using any old set, in any half-efficient conditions. I could send you a dozen or so European cards from countries other than Great Britain. Having clearly carried out the conditions as published I demand a certificate and will not be satisfied until I get it.”

The Editor replied: “According to you we should award a certificate to anyone who receives any sort of station, even though the station is his own station.”

Our reader should have sent the verifications from the European stations which he says he receives for investigation, and in spite of his demand he will not receive an A.C.R. certificate. Moreover, he has not clearly carried out the conditions.

The sole object of granting the A.C.R. certificate is to give some encouragement to those short-wave enthusiasts who are capable of building and operating a receiver which will receive the more distant transmissions which owing to their geographical positions and atmospheric conditions, and, in many cases, low power, necessitate a reasonable amount of skill, patience and efficiency on the part of the receiving station.

It has always been a rule that a station operating in Great Britain shall not be accepted for the European class, as it is perfectly obvious to anyone with the slightest experience of short-wave work that reception of a Q station is in no way a criterion of the efficiency of either the operator or his equipment.

Wireless for the Blind

I am pleased to note the announcement by the National Institute for the Blind that more than £10,000 has already been received in response to the broadcast appeal for funds to purchase wireless sets for the blind. Mr. Reith's appeal, made on Christmas Day, was for funds which would provide and maintain wireless sets in the homes of blind people.

Several children have answered the blind man's call by raising their money-boxes, and many old-age pensioners have sent contributions. Quite a number of the sets are from the B.E.F., one being described as "the result of a whirl-round in our dig-out." A Viennese musician, now a fugitive from the Nazis and living on a small allowance given by the Christian Council for Refugees, sent the pennies he had been saving for the purchase of a wireless set. "I find I can no longer write without music these days," he wrote. "I have my sight. My shadows are transitory, but those of the blind remain."

B.B.C. Symphony Orchestra

Those of my readers who follow the activities of the B.B.C. Symphony Orchestra should listen, on January 17th, to the broadcast from Newport, where the orchestra is giving the Tenth Hall. This broadcast opens with a great string work, the Introduction and Allegro for Orchestra by Elgar. Parry Jones will sing a big scene from "Tannhauser," denoted in the programme as "Zaehnhauser's Pilgrimage," which gives the orchestra an opportunity of rendering the brilliant Venetian music of the opera. The broadcast ends with Tchaikovsky's symphonic poem, "Romeo and Juliet." It is interesting to recall that this was first suggested to Tchaikovsky by his elder colleague Balakirev, who felt that Tchaikovsky was the very man to write such a work successfully. His idea was to have a programme of Russian music in the style of a chorale—presenting Friar Lawrence; then a hunting section would tell of the hunt between the two cities; and the grand melody would represent the loving lovers; the coda would represent the tragic end of the story. The piece was composed much on these lines, but it is safe to say that since music is so much less musical and the orchestral conditions of that time, the majority of those who know it now probably have a thought to the original script which inspired it.
The effectiveness of the method of interference suppression which involves reducing the output of the receiver while the interference is present has now been proved, and schemes of this character are consequently of interest. A circuit arrangement of this type has recently been developed in the R.C.A. Laboratories, and is shown in Fig. 1. The system includes a tuned input circuit including a capacitor 10 and an inductor 11 through which the modulated carrier impulses are applied to the cathode and anode electrodes of a detector 12. This input circuit also includes a radio frequency filter network 13-14-15 and a resistor 16. The detected modulation impulses produced in the resistor 16 are applied to the control grid 17 of an electron discharge device 18 through an input circuit which includes the grid 17, the resistor 16, the control grid 19, the lower section 20 of a bleeder resistor 21, and the cathode of the device 18.

The cathode-anode or output circuit of the device 18 includes a resistor 22 and a section 23 of the resistor 21. With these connections, the received impulses are amplified by the device 18 and applied to the control grid 24 of the limiter 25.

The limiter 25 is provided with an anode to which is applied a relatively low potential, a screen grid 27 to which a relatively high potential is applied from the upper terminal of the resistor 28. A cathode 29 which is connected to ground through a resistor 30, and a resistor 31 which is connected between the anode 26 and a grid 32 to afford a screening action, whereby greater output of the limiter is facilitated.

Fig. 2 illustrates the control grid potential-anode current characteristic of the limiter 25, grid potential being plotted as abscissa, and anode currents as ordinates. It will be observed that A and B are voltages of the control grid 24, which produce equal output current of the limiter 25. If the cathode-anode voltage of the device 18 (the potential of the resistor section 23) is so adjusted that B volts are applied to the control grid 24 when the cathode-anode current of the device 18 is cut off and, with zero signal at the detector 12, the voltage of the cathode of the device 18 is so adjusted that C volts are applied to the limiter control grid 24, the limiter input characteristic illustrated by Fig. 3 results in excessive level also drives the grid 17 sufficiently negative to intercept the output current of the device 18, and (3) that interruption of output current of the device results in the application to the limiter control grid 24 of a potential by which the limiter output is caused to assume the D potential (Fig. 3), this potential being applied through an input circuit including the grid 24, the resistor 22, sections 23 and 20 of the resistor 21, the ground terminal 19, the resistor 30, and the cathode 29.

The voltage of the carrier applied to the detector 12 should be maintained by A.V.C. or other suitable means at the value A in the centre portion of the positive slope of the curve of Fig. 2. The modulating impulses then move up and down this portion of the curve and excessive input produces operation in the D region of the curve, resulting in a limiter output current equal to that for zero modulation. It is desirable, although not essential, that the radio-frequency channel ahead of the detector 12 be relatively broadly tuned. Following the limiter 25, of course, a normal audio amplifier may be provided.

The limiter which has been described may be applied to the R.F. side of the receiver. Certain minor modifications are, however, desirable to ensure best results. The resistance load 31 in the anode circuit of the valve 25 should, of course, be replaced by a suitable R.F. impedance such as a choke or tuned circuit, and the cathode resistance 30 is preferably shunted by an inductance with a blocking condenser in series so as to reduce the lag in the voltage drop across the resistance due to stray shunt capacity. If it is desired to reduce the output from the limiter to zero for high amplitudes of interference, the voltage developed at the cathode may be fed over a high resistance to the anode, thus neutralising the residual output of the limiter. A suitable circuit arrangement incorporating these modifications is shown in Fig. 4.

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A Fine Book For The Beginner!

Everyman's Wireless Book

By F. J. Camm

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Fig. 4.—A circuit arrangement incorporating the modifications described.
WHILST short-wave signals may be received at all times of the day, it is an undoubted fact that the most interesting signals are picked up after dark, and many of the better types of American programmes are only available in the early hours of the morning. The keen short-wave listener is thus generally listening when the other members of the household are in bed and asleep and this means that in the ordinary way head-phones have to be worn. If a loudspeaker is fitted and reception is being carried out on the speaker, then a volume control is absolutely essential in order to avoid disturbing the other members of the household, whilst if head-phones are fitted in place of a speaker, the volume control must be cut down in order to avoid blasting in the ’phone. A good receiver will, of course, be provided with a volume control, but there are many cases where such a function is not provided and the problem is then how to apply such a device—preferably with the minimum of alteration to the receiver. There are many schemes available, and each possesses some merit which makes it ideal for one listener, whilst it may not perhaps suit another receiver or another listener.

H.F. or L.F. Control?

The control of signal voltage may be carried out on the H.F. side or on the L.F. side of the receiver, and with the usual L.F. controls are familiar to most listeners. These are of a type found in standard broadcast receivers, the usual scheme being a variable grid leak in an R.C. coupled stage, or a similar component connected across the secondary of the L.F. transformer, preferably in the first stage, if there are two or more L.F. stages. The circuits of both of these are shown in Figs. 1 and 2, and if you are now using an ordinary R.C. arrangement all that is necessary is to replace the fixed grid leak by a potentiometer having a similar value, whilst if transformer coupling is fitted, the component is joined across the secondary terminals of the transformer. In both cases the grid connection is taken from its present position and joined to the arm or centre terminal of the volume control. So much for the simplest scheme. If it is desired to apply control without altering any wiring, and L.F. control is desired, a variable resistance may be joined across the primary of the first transformer as shown in Fig. 3. There is, however, one drawback to this arrangement, to be found in the fact that the anode current of the following valve will flow through the resistance as well as through the transformer primary. It will be seen that the effect is gradually to short-circuit the transformer primary, and as this is part of the L.F. coupling, any noise present in the primary circuit will be transferred to the secondary, amplified and heard on the output. Thus, a noisy control will prove very troublesome in use, but there is a simple way of avoiding this, and that is by connecting a fixed condenser across the arm of the control and the "live" end. The value of the condenser may prove critical, as it may affect tone, or even the smoothness of the reaction control. A general value is 1 mfd, but you may care to experiment to find a more suitable capacity. The value of the resistance is not so critical, and either 10,000 or 25,000 ohms should prove useful, or some value between these extremes.

H.F. Controls

On the H.F. side there is not a great deal which can be done. If the receiver employs an R.G. or H.F. pentode valve a variation in the screen voltage will enable volume control to be carried out, or if a variable-mu valve is employed the usual bias variation will prove effective. Unfortunately, however, these valves are not very popular for normal H.F. circuits on short waves, and thus the scheme is not of wide application. There are, however, dozens of receivers which employ an aperiodic H.F. stage. This usually consists of an H.F. choke or fixed resistance in the aerial circuit in place of a tuning coil. In most receivers the choke, if this is used, may be replaced by a fixed resistance; but this must be non-inductive, remember. By replacing the resistance by a variable component, there is an ideal way of controlling volume—the circuit is shown in Fig. 4. It will be seen that when the arm of the resistance is at the lower end, we have the standard resistance arrangement. As it is turned towards the "top", the resistance is successively short-circuited and this not only reduces the signal voltage present across the resistance, but at the same time gradually short-circuits the aerial to earth, and thus it acts very well as an input control. It is, in fact, often regarded as the only really effective short-wave volume control. The value of the resistance until a suitable value has been found you may experience difficulty. Either erratic volume-control effects, or noises, or even sudden jumps in volume may be obtained, especially if a "swash" plate type of resistance is used. As it rotates it may make uneven variations in the resistance and this may result in difficulty in controlling the volume. If a wire-wound component is used it may give rise to noises or prove jumpy due to short-circuited turns or uneven windings on the resistance element. One of the carbonised or graphite controls having a wiping contact which is really best and the value should be between 1 and 5 megohms—again a trial being necessary to find which is most suitable for the particular receiver in use.

PRACTICAL WIRELESS SERVICE MANUAL

By F. J. CAMM

From all Booksellers 5s.; net, or by post 5s.6 direct from the Publishers,
George Newnes, Ltd. (Book Dept.), Tower House, Southampton Street, Strand, London, W.C.2.
Composers' Idioms Further Considered

Their Style and Characteristics are Discussed in This Article by Our Music Critic, Maurice Reeve

LAST time I touched upon this subject I did not unintentionally enlarged upon a melodic characteristic of two of the most individual and personal of all composers, Wagner and Grieg. So persistent and oft-recurring were these two features in their melodies and themes that we naturally concluded that their musical minds worked, even sub-consciously, in some groove or to some pattern, the reason for which can, partially, or at any rate, be traced back to their musical antecedents (see article on "Nationalism in Music"). It is obvious that we should begin a study of this subject with an examination of melodies and themes, because they were used up in the themes. Each of them begins with a theme of some sort or other; it is, in fact, the raison d'être for the work — that is, the theme, which their life is nothing but themes or melodies. A good theme, like Schubert's in the Unfinished Symphony and, although just as beautiful, they do not satisfy. They lead nowhere, for nothing has to follow — they do not end on a full stop.

As mentioned in my article on Chopin, that master's persistent use of his native dance rhythms, even in his bigger works in the classical forms, is a great characteristic, and stamps him as an individual in the study of any other ingredient in his music. It also, of course, stamps him as a Pole of unmistakable complexity. Liszt's torrents of embellished seventh— the like of which had never previously been heard, nor have since been heard— were one of his most conspicuous traits. Unlike Chopin, however, he seldom employed his native Hungarian music outside works which, like the famous Hungarian Rhapsodies, were composed to specifically exploit them. Brahms' fondness for twelve-note harmonies for the hands far apart at the extreme ends of the keyboard (I refer to his piano music, of course), are the foreshadowings of the embracing of the latter one he followed in the steps of his great predecessor, Beethoven (see WAGNER AND GRIEG). Hence, it is not surprising that Beethoven's authority is itself a more obvious influence on the style of two other nineteenth century composers, Richard Strauss and Edvard Grieg, than that of Chopin, whose influence, of course, is more obvious in the work of the two composers.

Arrangement

But how exactly one must arrange the notes and build up a movement in order to arrive at, say, Handel's vigorous masculinity or Elgar's English-ness, is a great subject requiring many tunes. Therein lies the real formula, of course. That is why you would have to study if you wanted to faithfully copy Handel or Elgar, that is, you would have to procure the recipe of a dish you had tasted somewhere and which you wanted to cook for yourself. You would have to ask whether a composer's idiom could be condensed into a recipe for others to imitate and reproduce, and even the strongest individual "such as Liszt or Grieg. The master's handling would always be conspicuous by its absence. But although Liszt himself might give us his formula for his nectar or ambrosia, we would ourselves have to be Lisztic to reproduce so that we could regard it as which from another. That is the inscription says on Beethoven's tomb, "I am Beethoven who makes the nectar for Man's delight."

Musical Form

Then comes a master's handling of the musical form on which he is going to plan and build up his work. From the musician's point of view this must come first in importance; nothing else depends upon it. The proportions and design of the building and the influence it is going to exercise on future writers. Beethoven is universally considered to be the world's greatest musician on two counts — the mastery of his handling of the large musical forms, and the reforms and innovations he made in them which have all been accepted and acknowledged. He was also a pattern-giver of all the nobility and loftiness of the character of his music. But that first of these qualities (although the second, largely dependent on the first, is the supreme quality in all art) would be sufficient to keep Beethoven on his throne may be proved by a comparison with other musicians of the same school. Brahms, for instance, wrote magnificent music, and of the loftiest and most altruistic character, but he made few innovations.

He accepted Beethoven's legacy gratefully and dutifully, and fashioned it, leaving little new so far as the constructive pattern is concerned. He didn't divert the historical river bed of music into a new channel; it continued to flow along its course clearly and beautifully, till we see him and in spite of him. He greatly beautified its banks and ornamented its islands with new stones, and in doing so he made some improvements, as well as reduced this unfruitful characteristic of struggle, strife and seeking. What is, however, unique amongst all musicians, which and cannot be reduced to a formula of "gaps of a third," or this, or that. It stamps the music with an indivisible personality, which is the deepest profundity, and in a manner that no mere harmonic trick or device can hope to rival. And when we do realise that, for his day, Beethoven's music was just as original in this respect (the flattened ninths in the Eroica Symphony and the Moonlight Sonata made the world jump out of its lethargy, and still make us gasp to-day) as it was architecturally, we get some measure of its mighty proportions.

Melody, Harmony and Rhythm

It might be serviceable to conclude this week's notes with an enumeration of the items which are necessary for the composing of a satisfactory piece of music. Unquestionably the first need is a plan. What form is it going to be written in? If one of the large forms—a symphony or sonata, with movements, then more than the conventional "first movement" is required. What is the composer's idea going to be? The third or sixth Beethoven Symphony, the op. 53 or the op. 57 Sonata? Then come melody, harmony and rhythm. These, of course, are largely governed by the mood—the state of the composer's mind. Melody is obviously first because, all is considered, had our composers less important to the finished work, it is difficult to imagine a composer getting his idea on paper and pen and paper without a "tune" or other idea come into his mind. It is that "tune" which is the focal point round which the work is built, its very essence.

In the case of a short work it becomes melody; in a symphonic work, a theme. Then, according to the manner of development decided upon, enter the extremely important questions of the employment of a coda, the length of the development section, and many more. All of this bears the imprint of the composer's individuality — a Beethoven coda is as strongly stamped as a Beethoven melody, and all the larger integral parts of that most mysterious and enigmatic thing—a work of music.
A Holder for Solder

BEING a service engineer I am constantly using solder, and have evolved a holder which is quite easily made and very handy in use. It is made from the case of an old electrolytic condenser. The first step is to remove the threaded base and all the inside material. A coil of solder is wound round a pencil about as long as the case, and with two or three layers. The pencil is removed and the coil is put in the case. The end from the inside of the coil is put through the hole in the base, which is then replaced.—E. Stevens (Middlebrough).

Adapting Headphones as Piano Mikes

WHEN carrying out some experiments on piano reproduction through my radio set, I decided, in view of the fact that the piano is situated at an angle to one corner of the room, to obtain an accentuated treble and bass response leaving the middle register to the differential reproduction of the two headphones.

This scheme called for a suitable means of anchoring for each headphone, and in order that resonance effects would not influence reproduction, I carried out various tests to determine the most suitable location for each phone.

Apart from the location of the headphones, it was necessary in each instance to glue a pad of brixon on to the piano fabric, as indicated in the sketch. I found that with the simple angle brackets depicted, a rigid and vibration-proof fixture to each piano carrying handle was obtained, using twisted mild steel extension arms, and sprung brass clips, for the headphone attachments.

The rest of the assembly detailing is clearly defined in the illustration, which also indicates briefly the wiring to a mixer and fader control unit.—S. P. Storey (Forest Gate).

Small Condenser Construction

WHILST experimenting with small condensers and resistances, I hit upon the idea illustrated. It will be seen that the only requirements for the construction of a number of condensers of different values are as follow:

1. A few short lengths of different gauge bare copper wire.
2. A length of glass tubing (internal diameter, one-sixteenth inch approx.).
3. Some silver paper, and a few flat wood screws.

When the silver paper has been compressed—by the head of a nail or strand of 16-gauge wire—heat the tube and silver paper until red hot, care being taken to see that it does not bend or warp, allow it to cool and complete by winding the wire and soldering same—short all the turns together. The screw constitutes one method of contacting with the solidified silver paper.

Great care should be exercised when compressing the paper to ensure that no cut fingers are sustained through slipping.

—W. R. Hons (Hiford).

SPECIAL NOTICE

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

PRACTICAL MECHANICS HANDBOOK

By F. J. CAMM

6/- or 6/- by post from George Newnes, Ltd., Tower House, Southampton Street, W.C.2.
A QUESTION which nearly every listener asks himself from time to time is whether or not the receiver in use is a faithful one. A good output of course is not enough; so far as quality is concerned. The question of fidelity is one which concerns every amateur, and nearly every listener claims that his set gives the best reproduction which he has heard—on a home-broadcast receiver as distinct from a demonstration of laboratory type of apparatus. The faults which are most likely to occur in a receiver are poor reproduction of very low notes and of the very high notes, together with undue prominence of certain notes at various parts of the scale. These are generally due to unbalanced transformers and hums and false hums, which are due to frequencies of the order of 1,000 cycles per second, which corresponds to notes about two octaves above middle C on the piano.

The Accommodating Ear

For the lower frequencies (below 100 cycles) and for the extreme upper register (above 5,000 cycles) the response of the ear is much more feeble. Now, unfortunately, it is just those frequencies to which the ear is the least sensitive that some loudspeakers reproduce the worst, so that the natural deficiency of the ear is aggravated by the defective responses of some loudspeakers. The human ear, on the other hand, is notoriously accommodating and is more easily deceived than any other human organ. It therefore recognises and accepts for reasonably life-like reproduction sounds which vary considerably from the original produced in the studio, and it is a fact that listeners may be so accommodated that they very poorly reproduce what they do not realise the extent to which the sounds produced by their loudspeaker fall short of perfection.

It is, however, not a difficult matter to carry out one or two practical tests which will indicate roughly what kind of response curve a speaker has. To carry out really accurate tests, expensive and very accurately designed apparatus is required, and this is generally outside the means of the average listener.

Apparatus Needed

To commence with, the simplest and clearest test is to ascertain easily whether a speaker has a reasonable bass response by applying a 50-cycle note only to the speaker and the A.C. electric light mains. Connect a fairly long length of flex, say, 5 or 6 yards, to the grid and cathode terminals of one of the low-frequency valves, and run this flex as close as possible to some wires carrying the alternating current house supply, such as the mains lead to your receiver or the flex connecting a standard lamp, for instance. No connection, of course, should be made to the light itself. The result will be that the appreciable alternating voltage at a frequency of 50 cycles will be picked up by the trailing flex and will be amplified by the valves and applied as a strong 50-cycle signal to the speaker. If this component has a reasonable bass response, a good quality of deep bass should be heard. Unfortunately, this test only gives an indication for one particular frequency, but if a good performance is obtained at 50 cycles it is fairly safe to say that there is nothing wrong with its bass response.

Gramophone Records

A far more accurate series of tests can be carried out with the aid of special gramophone records giving constant frequency notes. These constant frequency records are not usually stocked by gramophone dealers, but they can be obtained, or it may be possible to borrow them from a progressive firm, if necessary, and they are issued by the H.M.V. company and are numbered and grouped as follows:

<table>
<thead>
<tr>
<th>Frequency (cycles)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>500-500</td>
</tr>
<tr>
<td>750</td>
<td>750-750</td>
</tr>
<tr>
<td>1000</td>
<td>1000-1000</td>
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<td>1500</td>
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<td>2500</td>
<td>2500-2500</td>
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<tr>
<td>4000</td>
<td>4000-4000</td>
</tr>
<tr>
<td>6000</td>
<td>6000-6000</td>
</tr>
</tbody>
</table>

These records are of the 12in. type and cost 6s. each.

In addition, there is a special Sound Evaluation record, No. DB4032 (6s.) which has on one side Frequency—Amplitude—Interference—Modulation, and on the other, Harmonies—Response—Characteristics—Sounds—Music and Speech. A five-pocket album to hold the above records (No. 252) is available and includes a Stroboscopic Speed Indicator, and the new Automatic Record Groove Indicator, as well as a full description of the records and suggestions for their use.

Each record produces a practically constant volume at given frequencies. The last record, which has a 'sliding' note will probably prove most useful to the amateur who is not concerned with elaborate frequency tests at different parts of the musical spectrum.

A Simpler Method

There are other less accurate devices which anyone can try at home if he possesses a fairly sensitive microphone. The microphone should be installed in a room a few yards from the speaker, and sounds, as near as can be judged, of equal intensity should be produced, running right up and down the scale. This can be done by means of a piano or by means of other stringed instruments. If you possess a cello, this will be excellent for the upper frequencies, but a 'cello will be required to give a good test in the lower notes (25—50—75—100 cycles). Of course, it is difficult to judge when the sounds performed at the microphone are of equal intensity, but it will give a fair indication of performance.

A Moulded Iron Core for High-frequency Coils

WHEN moulded cores are used for high-frequency coils, the core itself is not reversed not only by magnetic field lines but also by electrical field lines. The accompanying illustration, in which the coil and iron core are shown, shows how such electrical field lines are broken. Since the dielectric constant of the moulded core is very high, and moreover, may have a very high temperature co-efficient, the behaviour of the core as a dielectric may become unpleasantly obscure when the core is used as a dielectrically determining element, especially on short waves. It would, of course, be possible to screen the core by means of an electrically conductive shield, but this would obviously involve the use of an additional component, namely, the shield.

Semi-conductive Bending

An alternative method, which avoids this disadvantage, is to use a semi-conductive medium including a finely divided iron powder of which the core is composed, a suitable material being carbon in an extremely finely divided state. It is true that this gives rise to a conductance appreciably higher than the capacitance of the material formed by the iron core as dielectric—but the advantage is that the behaviour of the dielectric is no longer an important factor. The upper limit to this conductance is set by the additional attenuation brought about in the core as a result of eddy currents and depends on the frequency in question and the dielectric constant of the material. The best compromise is therefore obtained by making the conductance of the whole core just so high that the eddy current losses are still supportable and the dielectric losses are low in consequence of the semi-conductive shunt. Theoretically, it would be sufficient to have only the outer layer of the core formed in the manner suggested, but unfortunately this would lead to production difficulties.

Section of an H.F. coil.
Adequate Protection

With all the various forms of equipment which together make up the plant for providing a high-definition television service, it will be appreciated that every precaution must be taken to ensure that the possibility of a breakdown is reduced to the lowest minimum. In many cases this entails the complete duplication of certain sections of the equipment, particularly the ultra-short-wave radio transmitter, cameras and portions of the amplifier chain. Schemes have to be worked out to enable a rapid changeover to be effected in cases of emergency, for it is realised that where a service to the public is involved, this has to be maintained at 100 per cent. efficiency with every means at the disposal of the authorities charged with providing that service. Coupled with this are the methods adopted to give adequate protection to the apparatus and assist in every possible way that the chance of breakdown is remote, or, alternatively, if some part of the apparatus fails, then remedies or repairs can be undertaken expeditiously without involving the whole of the equipment and extending the damage. In this connection it is interesting to see how one company responsible for the supply of machines for televising standard talking films introduced protective measures. This will be made clear by a reference to the accompanying illustration, which shows the bedplate on which was mounted the arc lamp, shutter mechanism, film gate, lens, etc., which projected the film pictures frame by frame on to the device converting the degrees of light and shade into the electrical television signals. Inside this bedplate were housed the driving motors for the mechanism, the take-up spool box and pumps. These pumps caused water to circulate through tubes to the film gate so as to keep it operating at a low temperature. If the pumps failed for any reason then before the gate had a chance to heat up, the plant was shut down automatically. If the film became jammed in the gate then a shutter was released to cut off the intense beam of light from the arc lamp, thereby preventing the film from igniting and causing wholesale damage to the unit. The same form of shut-down occurred if the film broke and the relay, pumps and piping employed for these protective purposes are readily visible inside the massive casing which normally has a pair of doors kept closed during running periods.

Television by Wire

In spite of continued representations from many quarters asking for a reconsideration of the television broadcasting position in this country, the authorities for a variety of reasons, still maintain that it is impossible to renew the ultra-short-wave radio service on a basis similar to that ruling before the war started. Active wards have therefore, turned their attention to alternative schemes for providing the public with entertaining pictures in their homes during the long hours of black-out. Naturally, this can only be effected by some form of wired television, using either special cables of the coaxial type or employing short runs of telephone cable with amplifiers and correctors in much the same way as the B.B.C. were doing for some of their outside broadcast relays a few months ago. Where the money is to be found to pay for really entertaining programmes has not yet been settled, but problems of television signal distribution should not prove too difficult now that knowledge on this subject has advanced so rapidly during the last two or three years. The best situations are obviously blocks of flats, indeed, before the war it was not unusual to find that one of the amenities put forward to entice tenants to a new block of flats was the knowledge that a wired television service had been arranged for during building, so that it was available for use as required in much the same way as the common services of electricity, water and gas. To busy people this was a tremendous advantage, for it relieved the tenant of any worries concerning aerial erection and landlord’s permission for feeder cable runs, with the result that special departments were being formed by some manufacturers to treat this side of the television work as a separate sales outlet.

Various Schemes

There are several ways in which the local distribution of television signals could be undertaken within a small radius, such as one or two blocks of flats, once the essential plant has been installed by some elaborate form of wire rediffusion. Both in America and on the Continent experiments have already been made to test for measure of success whereby the signals are handled at modulation frequencies as distinct from working at carrier frequencies. The original idea was to have in the subscriber’s room a cathode-ray tube as the picture reproducer without any auxiliary equipment in much the same way as a broadcast relay subscriber at the present day has a loudspeaker for which he pays a nominal rental fee. This entails the use of a cable capable of passing the vision signals together with the signals to the C.R. tube, while separate provision has to be made for the sound. While the rental may prove high in a scheme of this character during the initial development period, there is no doubt that with expansion the sum involved for a subscriber to enjoy amenities in this form would be quite economic. Another alternative would be to distribute at modulation frequencies by having a time-base generator producing the cathode-ray beam deflection as part of the subscriber’s unit and synchronise this with the transmission by pulses fed over the same line. Actual demonstrations of both these forms of working have already been given, so it is only a case of commercialising the plan on a proper basis, in order to fit it in with any fundamental scheme that may be proposed as an alternative to straightforward radio reception, as normally undertaken.

Carrier Frequency Distribution

A somewhat easier method and one which has already been used with success in flat installations in this country is to distribute the signals at carrier frequency. At the termination of the line in this case there is a available signal which is exactly the same as would be secured if reception was undertaken direct from the dipole aerial’s feeder cable. Distribution amplifiers for this purpose are readily available, capable of feeding up to a few hundred television sets direct. One of the problems involved is the design of satisfactory junction boxes so that at each point where a receiver is plugged in, the line is terminated with its own characteristic impedance so as to secure the maximum transfer of energy and prevent reflections.

(Continued on page 383)
Many months ago it was suggested to us by the executives of important engineering firms that there existed a need for a modern weekly periodical covering authoritatively and extensively the whole field of modern mechanical engineering processes. Support was given to this suggestion by our inquiries among many of the leaders of the engineering trades.

**Practical Engineering**, the first issue of which will be published on January 25th, is intended to fill this gap in engineering periodicals. Entirely modern in its selection of subjects, it will be published weekly with every workshop process, and the use of every type of machine employed in this country. The leading authorities on special subjects have been retained to serve the new journal, which will be published every Thursday at 48. The staff are practical engineers, having the highest qualifications.

**Practical Engineering** will be read by all the key executives in the metal working industry, by the designers, the shop stewards, by the production and plant engineers; in fact, by all those who are in a position to influence the purchase of machinery and equipment. The powerful resource and invaluable source of inside knowledge and direct views of the latest developments, the leaders in their respective trades, will be written by engineers in every factory, works, and machine shop throughout the country.

We shall not only deal with modern processes of manufacture and machine tools, but also with works layout, time-saving methods, the drawing office, finishing processes, test equipment and inspection; in fact, with every subdivision of the mechanical engineering industry. We shall review new machines and equipment and explain by practical articles, illustrated by first-class drawings, the latest methods of manufacture.

We have been encouraged to publish **Practical Engineering** because we feel that such a journal is even more vital today than it was several months ago when the idea was first mooted. It will perform a national service, and, we hope, encourage an even livelier interest in mechanical engineering. The news and other features will keep the reader fully informed of the latest developments in this and other countries. The Advice Bureau, consisting of a panel of experts, exists to advise engineers on all matters relating to their business. An important feature will be the informed criticism of matters affecting the engineering trade.
RECEIVING ENGLISH NEWS FROM ABROAD
(Continued from page 376)

of this is that the face of the condenser can be made almost to touch the pointer, whereupon the pointer itself is not only visible as a small scale, parallax is generally avoided, and a calibration line for each of the wavebands can be marked directly on the scale.

Using 'Phones

Even with a moderately sensitive all-wave receiver reception will vary considerably with changing conditions. But regular reception can often be ensured by connecting up a pair of

CONDEدس LIST OF NEWS BROADCASTS IN ENGLISH

12 (midnight) Moscow, 40.56, 31.25, 25, 19.9 mc.,

13.20 a.m. Budapest, 22.88 w.; B.B.C. Generators,

1.55 W.R.L. London, 40.56 m. (Mon., Wed., Sat.),

3.00 W.R.L. 21.02 w.; Paris-Montreal,

4.00 W.P.T.T., 40.56 w. (Mon. - Sat.); B.B.C. Generators, 21.02, 25.25 m.,

4.30 Paris-Montreal, 30.59, 25.25 m.,

6.00 W.R.L. 22.88 w.,

10.00 Moscow, 17.56 m.,

11.00 Minsk, 21.02, 15.36 m. (also on Sat.),

14.00 Kiev, 19.64 m.,

15.00 B.B.C. Generators, 24.88 m.,

17.00 B.B.C. Generators, 18.29, 33.48 m.,

17.30 Moscow, 22.88 m.,

18.00 W.R.L. 17.56 m.,

19.30 Valentine City, 25.56 m. (Tues.),

20.00 W.R.L. 17.56 w.,

20.30 W.R.L. 17.56 m.,

21.00 W.R.L. 17.56 m.,

21.30 B.B.C. Generators, 18.29, 33.48 m.,

22.00 Valentine City, 25.56 m. (Tues.),

22.30 W.R.L. 17.56 m.,

23.00 Winning (Japanese), 23.48 m.,

23.30 B.B.C. Generators, 18.29, 33.48 m.,

3.00 W.R.L. 17.56 m.,

3.30 W.R.L. 17.56 m.,

6.00 Valentine City, 19.54 m. (Sun.),

6.30 Helsinki, 25.48 m.,

8.00 Dubrovnik, 31.56 w. (ex. Sus.),

7.00 Patton City, 45.47 m. (Tues. Fri.),

8.00 Mantua, 40.75, 37.211, 31.25, 25.25 m.,

9.00 Tokyo, 24.1, 25.42 m.,

8.30 W.R.L. 31.56 w. (ex. Sus.),

8.45 Methen, 25.56 w. (ex. Sus.),

9.00 Belgrade, 40.18, 25.36, 25.09 m.,

9.10 Rome, 24.08, 21.53 m.,

9.30 Leids, 17.56, 17.51, 17.75 m.,

9.45 Radio Petersburg, 1,616 w. (Radio-S. 360 w.),

10.00 W.R.L. 31.56 w. (ex. Sus.); W.R.L. 13.57 m. (Amo.-Fri.),

10.15 W.R.L. 19.73 m. (Sat., Sum.),

10.30 Cluj, 31.56 m. (ex. Sus.),

10.35 W.R.L. 31.56 w. (ex. Sus.),

11.00 B.B.C. Generators, 31.25, 25.25 m.,

11.45 W.R.L. 40.96 w. (Tues.-Wed., Fri.),

11.50 W.R.L. 31.25 w. (Mon., Thurs., Sat.),

phones. These should be connected between the anode of the output valve and earth—through a fixed condenser—as shown in Fig. 2. By this means the speaker transformer continues to carry the anode current to the output valve, and the correct output matching is retained. If provision is made for connecting an external speaker it is usually quite safe to use the terminals or sockets provided for making the phone connections. Should there be any doubt about the method of wiring these terminals, insert a .01 mfd. fixed condenser in each 'phone lead. This is to make sure that the 'phones are completely insulated from the H.T. supply.

On certain commercial receivers the extra 'phone plug terminals are so wired that a low-resistance speaker is required. In that case it would be necessary to employ a separate transformer to step down the transformer output to the required value; that is, with the secondary winding connected to the set and the primary to the ordinary loud-speaker circuits. Isolating condensers are not then required, for the transformer prevents any direct connection being made with the H.T. circuit.

One of the difficulties often met when using headphones with a set not originally intended for them, is that background noises (usually called "sizzling") are very pronounced. This can be minimised by turning the tone control towards the bass position or by connecting a .02 mfd. condenser and a 10,000 ohm fixed resistor in series across the headphone terminals.

Switching On the Speaker

Signal strength on the headphones is increased if the built-in speaker is put out of action, and if there is no switch for this purpose an arrangement similar to that may be included in the speech-circuit, as also shown in Fig. 2. The switch is inserted between one secondary terminal of the output transformer and the speech winding. The switch must be of a reliable type or else there will be cracking noises when the speaker is in use—and must be mounted close to the speaker. If necessary, it can be operated by means of an extension cord. Should it be found necessary for any reason to place the switch more than a few inches from the speaker, see that the connecting leads are of good gauge, as for the secondary circuit there is a very low resistance and an extra 4 ohm might affect the available output.

RADIO CLUBS & SOCIETIES

SLough and District Short-wave Club

Rud. Sec.: A. K. A. S. (G4ABE), 16, Backland Avenue, Slough, Bucks.

Headquarters: Toot H grundhall, William Street, Slough

Meetings: Alternate Thursdays at 7:30 p.m.

This meeting was held on December 21st, 1949, proved very interesting, the chief being a further talk by Mr. Monks-Thompson on the Fundamentals of Radio, this time the speaker dealt with the principles of the oscillator and excited wave of the oscillators found in most of the transmitters which he had examined. He then described the fundamental principles which he hoped would be embodied in members’ transmitters when they could more soon act on it. The last meeting, held on January 4th, 1940, was the annual general meeting. The agenda was very full: the first item being the election of new officers. Mr. Pinte (G4EP) was re-elected chairman, Mr. Monks-Thompson (G4AOC) vice-chairman, Mr. A. H. S. (G1HEE) secretary, Mr. F. J. Tuckfield-Freeman, and Messrs. Gilbert, Halley, and Hine were elected to the Committee. The secretary then read an account of the past year’s activities followed by the production of the balance sheet by the treasurer. More procedures followed, the meeting being brought to a close.

Members are still required, and anyone who comes to one of our meetings will be welcomed. Members of Mr. Monks-Thompson’s Forces will be made honorary members.

PRACTICAL TELEVISION

(Continued from page 391)

Furthermore, it is necessary to ensure that there is no possibility of interaction between the receivers in a family to prevent one another. This is usually done by arranging attenuator pad boxes which give an attenuation in signal of the order of 40 to 50 decibels. Spurious signals fed back from the receiver due to defects in design are usually reduced to a very low level when compared with the television signal input. At the main distribution amplifier position, provision is usually made for a monitor picture to be observed by the visiting engineer, for as a rule the amplifier is not under continuous observation. Time-switches ensure that the complete circuits are made alive for operational purposes during the pre-arranged periods of transmission. This is the resident engineer’s job in the block of flats then warning-signals of a visual or aural form can be provided to allow for the few occasions when breakdowns arise. Should the proposals which are now on foot materialise, then it is certain that centres will be set up and local distribution schemes which have been described briefly will be used, and it will be interesting to see which one proves the most satisfactory.

STANDARD L.F. CHOKES

These clamp-shunted L.F. chokes are all of high efficiency and induction, flexible leads for connexion are fitted. Shunts finished matt grey enamel, and prevent "tannination buzz." 2.65 in. by 2 in. by 3 in. High.

SMALL L.F. CHOKES

This new range of L.F. Chokes comprises economy types at extreme utility. With usual joint, these chokes are true to rating and are tested at 1500 V to earth. Fitted with cramped high-permeability iron core fitted with grey celluloid shroud, with testing label. Supplied with 6 in. bakelite. Size 2 in. by 1 in. by 1.5 in. high.

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**A Neon-tube Test Unit**

A Simple Piece of Test Apparatus for the Experiment

The apparatus described in this article is a very economical and versatile tester and audio-frequency oscillator which should prove useful to any radio amateur. The component parts will usually be found in the junk box.

This unit may be used as a sensitive continuity tester for point-to-point testing, and also for the testing of the component parts of a receiver or transmitter such as condensers (mica, paper or electrolytic), transformers, coils, resistances, chokes, etc.

The oscillator may be used as a code practice set, keying monitor or audio-oscillator. The frequency of the oscillator is variable from 50 to 10,000 cycles/second.

**The Component Parts are Connected as Shown in the Diagram, Fig. 1.**

Either batteries or external power pack may be applied.

**Operation**

For point-to-point testing, and as a continuity tester, a 90v, D.C. supply is connected to the terminals marked “D.C. Input.” Sw. 1 is thrown to the “Off” position. The apparatus to be tested is connected to the terminals marked “Key” by means of test prods.

In testing chokes (both audio and radio frequency), transformer windings, resistors, up to 1megohm, coils, etc., a steady glow indicates a continuous circuit; an intermittent flash indicates poor connection or intermittent circuit; and failure of the Neon lamp to glow indicates an open circuit or no connection.

In testing condensers (papier or mica type) a good condenser will cause one flash of the Neon lamp when the condenser is connected to the test prods. A condenser that causes the Neon to glow faintly and does not flash has poor insulation and should be discarded. Failure of the Neon lamp to glow indicates an open condenser and a continuous glow indicates a shorted condenser.

**Testing Electrolytic Condensers**

In testing electrolytic condensers, be sure the correct polarity is applied to the condenser under test, and also do not apply more than the rated voltage. The majority of electrolytics for condensers withstand 90 volts, but some of the bypass variety are designed only for use at lower voltage, and must not be tested with 90 volts. These low-voltage condensers may be tested by measuring the resistance of the condenser, and any that do not have a fairly high resistance should be rejected. (Note: In using a resistance meter in this test reverse the test prods if a low reading results, as the polarity of the resistance tests may be causing the low reading.)

Electrolytic condensers may be tested at their rated voltage by increasing the voltage at the terminals marked “D.C. Input” to the proper value. Electrolytic condensers will cause the Neon lamp to flash once when connected or at regular intervals; if the rate of flash is not over 15 times per second the condenser is satisfactory. Condensers which flash often are leaky, and will cause trouble sooner or later. Condensers which do not flash intermittently but cause a partial glow of the Neon lamp are leaky and should not be used. A shorted condenser will cause a bright glow of the Neon lamp, and failure of the lamp to glow indicates an open condenser.

**As a Keying Monitor**

In the unit as a code practice set, or keying monitor, connect a 90v, D.C. supply to terminals marked “D.C. Input,” throw switch Sw. 2 to the “On” position, connect the headphones to terminals marked Key. Close the circuit by applying the key and adjust resistance R1 until a steady note is obtained, then adjust “OT” and “Sw. 2” until desired tone is obtained.

**As a Modulator : Signal Generator**

The unit could also be used as a modulator for a radio-frequency oscillator or "signal generator," and as such would furnish a modulated signal of any frequency within the limits of the audio-oscillator. In connection with a valve voltmeter a fairly accurate frequency could be run on a radio receiver. The audio-frequency should be compared with a known standard or estimated by ear in each case, and the voltage at input and output for each frequency measured with the valve voltmeter.

The Neon tube circuit would oscillate more uniformly if allowed to run for several hours, previous to the test, at twice its rated voltage.

---

**Details**

- **N.T.S. New Year Offers You Must Not Miss. Lists Free**
- **FREE VALVES, S.G.S. kit for all-wave operation of A.W.E. Portable Receiver.** A fine line of new condensers and large assortment of reliable parts. Write today for complete list. Note: Only genuine-issued parts are included. Postage extra. Ask for a list of all valves used.
- **Single unit coils. Easiest to install and an amazing performer for all hands. Two B.S. and Pentode output stages. Complete kit with metal chassis, transformer, etc. and 3 PHAK valves and building instructions, B.R.U. and C.R.S. 350.**
- **COMMUNICATION RECEIVER. We cannot possibly list all our models with continuing wave-range 15-20 m. (see coil list) built for World War and B.R.U. Immediate. A.V.C. and B.P.O., twirler. Built-in high-fidelity speaker, easy use, hand-screw tuning. Supplied complete in cabinet and ready for instant use on A.C. (unless in E.C.S.) 3300/- to 76s. New 3300/- special to 50s.**
- **CLASS B. 4-VALVE CHASSIS. New trebled output complete of all valves used.**
- **ARMSTRONG ILLUSTRATED CHASSIS SENT FREE.**
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**Fig. 1.—Wiring diagram of the simple Neon-tube test unit.**

Either batteries or external power pack may be applied.

**Fig. 2.—Panel layout for the test unit.**

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**PRACTICAL WIRELESS**

January 20th, 1940

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**Fig. 2.—Panel layout for the test unit.**

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**As a Keying Monitor : Signal Generator**

The unit could also be used as a modulator for a radio-frequency oscillator or "signal generator," and as such would furnish a modulated signal of any frequency, within the limits of the audio-oscillator. In connection with a valve voltmeter a fairly accurate frequency could be run on a radio receiver. The audio-frequency should be compared with a known standard or estimated by ear in each case, and the voltage at input and output for each frequency measured with the valve voltmeter.

The Neon tube circuit would oscillate more uniformly if allowed to run for several hours, previous to the test, at twice its rated voltage.
A Moving Scale with Magnetic Cursor

A Novel Arrangement which will Appeal to the Experimenter

When contemplating the design of a new scale for a reconditioned receiver, a rather attractive scheme suggested itself when the writer idly experimented with one of the "Eclipse" midget high-density magnets of the horse-shoe pattern.

There must be few people who are not familiar with the more obvious characteristics of the common magnet, such as the principle of influencing steel or iron objects through the medium of a sheet of paper, and it is this simple method which is the basic function of the cursor in this arrangement.

A fine sewing needle (N), and one which is as straight as possible, is vertically positioned by the paper weight being held by the influence of the strong midget magnet (M) referred to above.

The paper scale only is governed by the control of the tuning condenser movement, whilst the needle simply rolls over the moving paper scale.

Magnet and Needle

To permit the stable position of the needle during the scale movement, it is, however, necessary to break away the eye of the needle as is depicted in the inset illustration, which shows the use of a vice for a clean and safe method of breaking, using, of course, a pair of pliers.

The magnet is mounted directly on to the receiver chassis, being clamped by two 10-gauge aluminium or brass brackets, as shown, careful centring in relation to the scale being carried out. The scale movement is reasonably compact, and entails work which the majority of constructors will find little difficulty in executing neatly. It consists of a series of three wooden rollers, A, B and C, assembled in triangular formation on the chassis, and mounted on a shaped 10-gauge aluminium chassis.

The tension of the paper scale is maintained by spring loading the rear roller (B) at both ends.

Condenser Drive

The condenser drive is carried out by chain coupling, but reduction is left to a conventional drive head of epicyclic pattern, the chain wheels having a 1:1 ratio. To mount the rollers, the bearing shafts in each case pass right through the wooden doweling, being cleated by grub-screws let into countersunk holes, and securing by one or two threads in tapped holes previously made in these jin, shafts.

To retain the paper scale consistently on the vertical rollers, a number of wire nails (E) are equally spaced and driven into the bottom of each roller.

The mechanism of the moving scale is shown in the model illustrated in the first line of the Consideration portion of the scale, superimposed on the paper scale.
ELECTRADIX
Signal Work and Training Aids For Navy, Army and A.F.
L.t. SOLO PHONES. For use with tuners and oscilloscopes. Has a circuit breaker with a pocket coil. Single stage, metal box, scale, and scale of which the handle shows the value when the meter is connected. With flex. £1 9 6. 200 ohms, £1 8 6. 250 ohms, £1 7 6. 300 ohms, £1 6 6. 500 ohms.

RESISTANCE AND RADIO PHONES. The finish on the adjustable resistors varies from the best to the most satisfactory. Their resistance ranges from 5 ohms to 600 ohms, headband 460 ohms.

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CATHODE-RAY TUBES.—Baird Television, Ltd., and Nuttall, T. C. No. 50132.

In a tube where a wedge 4 is produced on an electrostatic image reproduced by a scanning beam controls a flooding electron beam to form a luminous image, the flooding beam is produced only during those times when the scanning beam is not incident upon the control electrode to produce charges thereon.

In television systems, the scanning time may be reduced to 50 per cent. of the line period by making the line for the flooding beam. When the scanning beam is not in operation, other signals, e.g., corresponding to other images, may be transmitted and reproduced in further tubes more especially in colour and stereoscopic systems. The luminous images may be projected on to a screen. The image signals are supplied to the control grid 3 from an amplifier 2. The line frequency component of scanning is affected by means of an oscillator 5, from which pulses are supplied through a shaping circuit 6 to the electrode 3 to change the scanning beam into a scanning beam.

Cathode-ray tubes; light valves.—Bosch, F. J. G. Van Den. No. 50116.

A cathode-ray produced by a gun 11 (Fig. 5) scans a screen 12 capable of developing under the bombardment of the scanning beam localized static charges which affect the orientation of a multitude of soft iron particles or filings suspended in a clear liquid so as to permit the passage of light through the particles on a larger screen. The screen 12 may be the ordinary zinc sulphide screen and the liquid, preferably a light oil such as paraffin, fills a disc-like container 15 clipped on to the end of the tube. Light from a powerful source 14 projects on to a further screen an enlarged and intensified replica of the charge image built up on the screen 12 by the modulated scanning ray.

NEW PATENTS
These particulars of New Patents of interest to readers have been selected from the Official Journal of Patents and are published by permision of the Controller of H.M. Stationery Office and the Official Journal of Patents can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. weekly (annual subscription 22 10s.).

Specification Published.

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
January 20th, 1940

LATEST PATENT NEWS

Group Abstractions 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 annum Volume, or in bound volumes price 2s. each.

改善了电路图

当使用金属或单一单极的节流器时，在其中的节流器连接是取出来的一端，它就被用来提供一个屏幕之间线的组合和节流连接在以减少反馈。这样就可很方便的找到不同位置。在本电路中，电流被分配到不同的信号。信号和电压信号的原始信号被用来驱动电子管的信号。图1和2显示了并网的电路，它被设计出来的意图。图3和4显示了并网的电路，它被设计出来的意图。
“Practical Wireless” with the B.E.F.

Sir,—Not only do I find your paper of great interest, I also have found for years one page of great importance to me, and that is the "In Reply to Your Letter" page. These replies gave me my first urge to have a try at dabling with wireless. As I am now serving with the B.E.F. I greatly miss listening to DX, etc., on my old two-valver which I built myself. Nevertheless, I am pleased to say that my wife sends on her fine paper to me each week while I lie in hospital. Although we have plenty of reading matter Practical Wireless is sought after by all the patients here.—A. Eder (No. 2 General Hospital, B.E.F.).

Correspondent Wanted

Sir,—I have been a reader of your fine publication for the past four years, and have read all its articles very helpful to me. I shall be glad to get in touch with any short-wave fans in my district.—R. Fairley (36, Westdale Road, Hulme, S.E.18).

DX on Medium Waves

Sir,—With reference to your recent article on medium-wave DX, I have decided to add my sentiments. Having been a reader of your journal since its inception, and, prior to that, of Amateur Wireless, since 1924-25, I think that I claim to have seen quite a few changes in the world of radio. Consuming my activities with a hulme crystal set in 1924, I graduated to a single valve (Bright Emitter?) three to simple (Det. L.F.) two and three valvers, venturing in 1926 to tuned anode (H.F.) and sundry neutralised circuits. My first S.W. set came in 1927, which was a lucky year for DX. In that year I managed to receive W2XAF (then a remarkable feat!). It was not, however, until some years later, 1931-2, to be exact, that I succeeded in receiving any medium-wave DX. I then successfully received W7Y (Schenectady) on a straight (1—2) battery set, using an indoor aerial! My interest in B.C.L. radio seemed to wane about that time, and I turned my attention to short-wave DXing; this time to the transmitting side, and in 1935 I was issued with my first A.A. permit. The following year, 1936, I was granted a full ticket, with the call sign G6JY. Since that time, right up to the commencement of hostilities, I have been conducting various experiments, and have had the utmost pleasure out of my hobby. Now, unfortunately, owing to the war, I am banned from this particular side of my activities, and naturally incline towards the other end of the scale, i.e., medium-wave (B.C.L.) DX, etc., as a hobby. Many ex-chums will, I am sure, turn their attention in this direction sooner or later. Your paper had a great appeal to me, and I hope that you will include this class of experiment, therefore I would suggest, if possible, a short series of suitable circuits, or sets, which could be built up from the usual assortment of gear, etc., usually to be found in the ardent experimenter's workshops. The more finished sets, and demanding expensive late wound coils, and sundry, and complicated, tuned circuits.

Surely such a set would be possible of design and construction, even should it fail to give the super selectivity of the more advanced affairs. Again thanking you for the splendid articles, circuits, etc., and not forgetting our old friend "Themis," with his weekly contributions which go so far to make your paper always worth reading. I trust 1940 may prove a "trumper" year for your endeavours, and that you may continue in publication right through hostilities, until peace is once more established, and many years beyond that.—S. Geoffrey Doon (Rotherham).

A 7 mc's Log from Scotland

Sir,—Noticing the increasing interest of your readers in 7 mc's logs I here submit mine. The RX here is a 1-2 w from an eliminator (home-built), and the time is from 23.00 M.T. onwards.

7 mc's Phone: PY1FX, PY2LN, PY4CB, PY7YE, PYDI, L42E, L5KVR, P43AW.
7 mc's CW: PY1FD, PY2HM, PY30E, PY2IIH, PY3K, W9D7G, and L52BD.

Latest QSL's received are: VQ8BH (Mauritius), 001 (I.C.W.), but I have stopped sending reports since the beginning of hostilities.

Like many other readers I was troubled with very bad fading on the "Home Service" stations, but discovered I could cure it by removing the earth wire from the antenna. Wishing them all the best in Wireless the very best in 1940.—J. Stewart (Bonhill, Dumfriesshire).

Pure Problems

PROBLEM No. 383.

A F.T.E.R. using his three-valve battery set A. For several times Artie searched for a short-wave listening set, and eventually purchased a well-known make of short-wave converter. He tried this with little success, adopting the connections recommended by the makers, but it failed to function. He had both the converter and the receiver tested and they were both found to be in order. What was the trouble? Three books will be awarded the first three correct solutions quoted. Entries should be addressed to The Editor, Practical Wireless, George Newby, Ltd., Tower House, Superintendent Street, Strand, London, W.C.1. Envelopes must be marked Problem No. 383 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, January 26th.

Solution to Problem No. 382.

Where Jackson mounted his tone-holder he overlooked the fact that his metal chassis would short-circuit the terminal leads, as they were level on the underside. He should have placed a layer of insulating material under the holder and then wired the leads down to earth. Only two readers correctly solved Problem No. 381, and both books have accordingly been forwarded to J. Dixon, 7, Clarence Place, off Castle Road, Searleby Road, J. Lyall, "The Swift," 29, Victoria Park, Kirkdale.

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).

PRACTICAL WIRELESS

January 20th, 1940

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Practical Wireless

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Speaker Matching

"I have a receiver with a valve in the output stage, which, according to the manufacturer's list, requires a load for proper matching of 4,000 ohms. The speaker which I wish to use, and which has given me very good service for a long time, is rated at 1,250 ohms, and so that I can get the best from it I should like to know what ratio of transformer must be used. The speaker has in transformer for decoupling the output terminals giving different ratios, but on test I do not seem to notice a great deal of difference. But I should like to use the proper ratio and should, therefore, be glad if you could give this."—S. G. (Bolton).

For the speaker and valve load in question the ratio of transformer required is approximately 2.7 to 1. Your tests were probably made with the low ratio taps, and these may have been around about 3 to 1, and thus you would fail to notice a great deal of difference in the results. The formula for obtaining transformer ratio for speaker matching is:

\[ \text{Ratio} = \sqrt{\frac{2 \times \text{Total valve impedance}}{\text{Speaker impedance}}} \]

This formula applies to moving-coil speakers, and it is usual in the case of the old-pattern horn orreed type of speaker to use the total valve impedance only, and not double the impedance as in the above formula.

Double Decoupling

"Is there any objection in the arrangement where I use a coupling transformer at the detector stage? I have used a 50,000-ohm anode resistor, with two 25,000-ohm decouplers, having 2 mfd. fixed condensers from each side of the decouplers to earth. It seems to have cut out the trouble I was experiencing, but I am wondering if there is any drawback in using such a scheme."—L. J. H. (Hinckley).

There is nothing wrong in the scheme, but you should find that you have obtained the desired end in an alternative way. You have used two series resistances, and two condensers which are, in effect, in parallel, and thus one resistance of 50,000 ohms and 4 mfd. fixed condenser may have worked just as well. On the other hand, there is sometimes a difficulty in removing instability by simple decoupling schemes, and a double circuit such as that which you have tried may have to be used. It is generally better, however, to try to find the cause of the trouble, and normal methods may be applied, rather than to use elaborate decoupling schemes.

Negative Feed-back

"I wish to apply negative feed-back to my push-pull amplifier, but am uncertain as to the method. Could you give a circuit and values for the necessary components? I am using two Osram KT.66's in the output stage."—D. L. (Dunstable).

If you are using transformer coupling in the push-pull stage, you should employ one of the split-secondary L.F. transformers so that each "leg" of the output stage may be isolated. The feedback components are merely a resistance and a condenser connected between anode and grid, and to enable the decoupling to be applied the feed-back is taken to the centre or low-potential end of the grid winding on the transformer. Therefore, with the split secondary transformer, each low-potential end is joined to earth through a 5,000-ohm resistance, and a resistance of 100,000 ohms is joined from the anodes of the output valves to the grid. This is recommended that a 100-ohm resistance be joined in each anode lead if you have not already done this, and furthermore that a 100,000-ohm resistance be shunted across each half of the secondary winding.

Reaction Control

"I am having difficulty in getting smooth reaction on the set. I have tried all condensers, but they do not appear to make things better. The coil is an old pattern (I believe home-made) and I wonder if this is the cause of the trouble. Can you suggest any improvement or way out of the difficulty?"—B. M. (Southampton).

The reaction winding may be too large, and thus have a very small capacity for reaction control purposes. We suggest you first make certain that H.F. choke and grid condenser and leaky are suitable, and then try this effect of a smaller winding. These remarks only apply if the reaction is fierce, that is, oscillation takes place before the signal has been built up to sufficient volume. If, however, it is difficult to make the set oscillate, even with a large coupling coil, the reaction winding is too small or is too far away from the grid winding.

Fruity Smoothing Condenser

"I have a small Universal mains set which has developed a fault in the form of very rough music and speech, the latter, in fact, being almost indistinguishable. I wonder if you can, from this, tell what is wrong with the set and how to cure it. I am using it on A.C. supply, 240 volts."—R. H. S. E. E. (Il.)

The trouble sounds very much like a raw A.C. supply getting through to the set—that is, instead of being smoothed. We imagine that the receiver is one of the "Midgets" with a field speaker winding used as a smoothing choke, and think the most likely cause of the trouble in an open-circuited smoothing condenser. This is, no doubt, an obvious theory, and, we suggest, that you try the effect of connecting a new electrolytic condenser between each side of the field and earth. This will no doubt cure the trouble.

Valve Screening

"I use in my set a metallised valve in the output stage, but I am troubled by instability. When I was testing round the set I found, however, that when I held one end of a long piece of copper wire to the decoupling transformer, the trouble stopped, although the valve is metallised and I have connected the correct filament pin to earth. This is indicated by the label 'E' stuck on the valve. Can you suggest why the metallising fails to stop the trouble in this case, and why my hand does it?"—B. D. R. (Newport, Mon.).

The metallising is generally carried down the length of the bulb, and you have probably metallicising a piece of wire in the grid, and thus any objections to it. The metallising may not be joined to the wire, and thus have left the trouble. On the other hand, the metallised surface may have fracturred in the point where the wire makes contact, and this is having the same effect. Probably the best solution is to obtain one of the small aluminium valve screens and place this over the valve and earth it, when your trouble should be removed.
H.F. Chokes

WHEN using an all-tube receiver some difficulty is often experienced in obtaining smooth reaction effects on all wavebands. The use of a properly designed all-tube choke should, however, ensure that the choking effect is adequate, and if such a component is used, and reaction is erratic, attention should be paid to other components in the detector stage.

If, however, any doubts exist as to the suitability of the choke the idea of connecting special short-circuit chokes in series at each side of the choke should be tried. Another idea which is not often seen in practice is to include a low-value non-inductive resistance on each side of the choke, in place of the short-circuit choke. Values up to 5,000 ohms may be tried.

Microphone Leads

WHEN using a microphone and it is desired to place this source of sound at the amplifier, it is quite in order to use long leads, provided that they are screened. If a transverse current type of instrument is used, the transformer and batteries associated with the wire should be placed as near to the instrument as possible, and the secondary then connected, via the extension leads to the receiver. Do not use the long leads on the primary side, as this may give rise to various troubles apart from the introduction of hum.
Quality Amplifiers

The design of an amplifier to deliver really good quality has been discussed before in these pages. Usually it is recommended that a very high audio output be aimed at, as the amplifier may then be run well within its capacity and better quality thereby obtained. For many domestic purposes however, a P.X.A type of valve will deliver sufficient output to enable the valve to be run within its maximum rating and will provide sufficient volume for normal purposes. Many listeners, in fact, do not like a loud signal, especially for talks and similar items. They prefer a quiet, subdued output which must be listened to without any background of talking or other noises. For these purposes the amplifier described in this issue will be found ideal, the maximum rated output being (fully loaded) 3.5 watts. The valve is, of course, of the type having an anode dissipation greater than 1 watt, and accordingly, no licence has to be obtained in order to purchase it. This is not a difficult procedure, however, and it will only take a few days to obtain the required permit. There are, however, many amateurs who already have a valve of this type by them or an equivalent, and this may be used without difficulty. The amplifier has been built from spare parts, but a fully detailed list of parts used is included for those who wish to reproduce the original design.

Drama and Feature Plans for 1940

Listeners are to hear more serial plays "The Four Feathers," made extracts from current stage plays, more comedies of the Wodehouse kind, and more radio documentaries like "The Shadow of the Swan-talia." These are some of the prospecta held out by the B.B.C.'s Drama and Feature plans for the New Year. Val Gielgud, Director of Drama, is pursuing his policy of introducing frequent radio serials owing to the great popularity of "The Four Feathers," "The Count of Monte Cristo," and "Scenes from Pickwick," all of which have had an immense listener following. Recently Norman Edwards's specially written serial thriller, "Curioser and Curioser," began. Another projected serial is "White Velvet," by Sax Rohmer. Anthony Hope's "Pensioner of Zenda" is to be followed by its companion piece, "Robbery of Hambra," Kipling's "Jungle Book" will, like the "Just So Stories," be serialised for broadcasting.

The next act from Shaw's latest play, "In Good King Charles's Golden Days," is shortly to be broadcast, with Ernest Thesiger and Irene Vanbrugh in the leading parts.

"Songs of the British Isles"

"Our Bill," from the Cotswolds and "Charlie" from Devonshire will complete the seventh of the series of programmes entitled "Songs of the British Isles," which will be presented by Gwen Williams and George Lewtrange on January 27th. The programmes comprise folk songs, traditional and national airs and dialect songs of England, Scotland, Ireland and Wales.

In the seventh of the series, three of the best-known singers from the respective countries will take part. They are James McCafferty from Northern Ireland, John Tarn from Scotland, and Haydn Adams from Wales. The flag will be kept flying on behalf of England by the composers, "Our Bill" and "Charlie," played by Freddie Grisewood and Charles Wreford respectively. They will be heard in dialect and will probably sing a song or two also. The B.B.C. Theatre Chorus, trained by Charles Groves, and the B.B.C. Theatre Orchestra will be conducted by Stanford Robinson.

Return of Glasgow Orpheus Choir

Over of choral singing will, on January 27th, welcome back for their second war-time broadcast the famous Glasgow Orpheus Choir under Sir Hugh S. Robertson. The Choir will begin its programme by paying tribute to the memory of Robert Burns in the anniversary week of his birth by singing Granville Bantock's arrangement of "Spies What Hae." It is a tradition of the Choir to sing the old Scottish tunes to which the metrical psalms used in Scottish churches have been set. In this programme the tradition will be retained by the tune "Cromond," items specially arranged for the women's voices of the Choir will also be broadcast and a selection of other choral music will include Gaelic motel music.

Crosby Band on "Caravan" Series

Bob Crosby and his band have been invited to broadcast on the weekly "Caravan" series over WLW and XBC, which began on Saturday, January 7th, as an "H. C. T. Helen Ward, songstress, and the Bobcats, "live" group within the band, will be featured. Bob, brother of the illustrious Bing, has had a rapid rise to popularity since organising his outfit several years ago. Exponent of the Dixieland type of dance music, his players are considered outstanding interpreters.
Tone Correction

Various Forms of Filter, Corrector and Booster

Fig. 1.—A device for cutting bass in a transformer-coupled amplifier.

High-note Compensation

The effect of very selective tuning circuits is to cut the side bands corresponding to the higher audio frequencies. To an extent this loss of upper register can be compensated for by employing a pebble-output valve. A better and more scientific plan is to use a low-frequency coupling which amplifies high notes more than low notes.

Frequency Cut-off

The circuit is shown in Fig. 5, and is similar to that in Fig. 4, with the exception that the inductance arm is tuned by a small condenser. The values of the inductance and condenser are so chosen that this part of the circuit is tuned to a fairly high audio frequency, in the neighbourhood of 4,000 cycles. At, or about, that frequency the circuit will give maximum amplification and will thus reduce much of the high note characteristic. Above 4,000 cycles, however, amplification rapidly falls off until there is more or less complete cut-off. The actual resonant frequency of the circuit can be adjusted to suit individual needs, but it will be found that the figure suggested gives a very satisfactory degree of correction and at the same time avoids heterodyning whirls to a very great extent. Certainly all whirls of frequencies above 6,000 will be suppressed.

For this circuit the inductance may be an ordinary high-frequency choke, but the value of the condenser must be chosen by experiment unless the makers of the choke publish specific information on this point.

Fig. 2.—In an R.C. coupled amplifier, the reduction of either C or R will reduce the bass response.

Fig. 3.—A bass booster for an R.C. coupled circuit.

Fig. 4.—The arrangement for a simple treble booster.

Fig. 5.—A treble booster giving a definite high-note cut-off.

It has often been explained in these pages that bass attenuation can be effected by reducing the value of the coupling condenser C in a resistance-capaciity-coupled amplifier. The same result, it should be noted, can be obtained by reducing the value of the grid leak R (see Fig. 2). This can be explained by considering the condenser C and the leak R in series as a kind of fixed ratio potentiometer. By decreasing the value of C the impedance of that arm of the potentiometer is increased to a greater extent for low notes than for high, and the voltage available across the resistance R will be reduced for low notes, whereas for high notes there will be little change. If, however, the value of the resistance R is reduced, the relative impedance ratio will be altered in exactly the same way. It is not possible to give actual values, but interesting experiments in tone control can be made by trying the effects on various values of grid leak.

Bass cut in the case of a transformer-coupled amplifier may be achieved by connecting a resistance of, say, 10,000 to 20,000 ohms in series with the primary winding, between the winding and the anode of the valve, and shunting this resistance with a condenser of from 0.1 to 0.2 mfd. capacity.

The effect of a resistance alone would be to make an overall drop in volume, but the presence of the shunting condenser permits a greater proportion of the higher note energy to reach the transformer, whilst energy corresponding to the lower notes will be to a greater extent absorbed in the resistance (Fig. 1).

Fig. 3 shows a bass booster for use in a resistance-capacity-coupled amplifier. It will be seen that the anode resistance is divided into two portions : R3, which should be approximately equal to the valve impedance, and R4, of about twice the value. R4 is shunted by a condenser of 0.1 to 0.2 mfd. capacity. As far as bass notes are concerned, the impedance of the coupling resistance is R plus R5, and full amplification is obtained. For the higher notes, however, the impedance is less because of the capacity shunt, and amplification will be reduced.

In the case of a resistance-capacity-coupled stage, this can be achieved by using, instead of a pure anode resistance, a resistor in series with an inductance of about half a hury, the resistance being approximately equal to the valve impedance (Fig. 4). Here the impedance of the circuit increases with frequency and is therefore greater for high notes than for low. Since the overall amplification depends upon the impedance of the external circuit compared with that of the total circuit, the gain for high notes will be greater than for low.

This arrangement has one grave disadvantage, however, in that this rising characteristic is operative over the whole range of audio frequencies, so that very high frequencies, including the squeals of atmospheres and the whistles of heterodyning stations will be very much over-accentuated. Fortunately, it is not difficult to avoid this effect. The method is to adopt a circuit which, indeed, amplifies the high notes more than the low but only up to a certain frequency, above which the high notes are not amplified but actually suppressed.

Fig. 3.—A bass booster for an R.C. coupled circuit.
Circuit are Discussed in This Article

Another form of heterodyne eliminator which has been used is the tuned-acceptor circuit. This consists of an inductance and variable condenser in series, and is connected in parallel with the circuit from which it is required to eliminate the heterodyne whistle. Thus, the acceptor may be connected across the resistance of an R.C. coupling, or in parallel with the loudspeaker. By tuning the circuit to the frequency of the whistle it is desired to suppress, the acceptor achieves a very low-pass frequency characteristic for that particular frequency, which is thus by-passed from the main circuit. The arrangement is shown in Fig. 6; the inductance may have a value of about half a henry, while the condenser may be of the pre-set type and of 0.01 mfd. capacity. This circuit suffers from the disadvantage that it is only operative at one particular heterodyne frequency, namely, that to which it is tuned. It is true that it may be tuned for other frequencies, but this does not fall in with modern ideas of simplicity of control. Present-day practice, therefore, favors another form of heterodyne whistle eliminator, namely, a low-pass filter, which is a circuit designed to pass all audio frequencies up to a certain value, after which there is a more or less sharp cut-off. Such a circuit can be inserted at various points in the receiver, either between stages or in the output circuit. Where the filter is to be added to an existing set, the latter is the best position, and one of the many commercial forms may be inserted either in series with an ordinary high-resistance speaker or in the primary circuit of the output transformer.

A typical form of this filter circuit is shown in Fig. 7. Complete units of this type, designed to cut off at some definite frequency such as 2,500 or 5,000 cycles, are obtainable. Fig. 8 indicates two alternative multiple-filter circuits. Fig. 9 shows a typical arrangement, using air-cored chokes, employed as a scratch filter with a gramophone pick-up.

Tone Control

Another system of combining tone control and whistle suppression is shown in Fig. 10, and consists of a resistance R inserted directly in the grid circuit of the first stage of the low-frequency amplifier section of the receiver. It follows a resistance-capacity interstage coupling. the bias for the grid of the L.F. amplifier being furnished from the resistance R. R should be about 500,000 ohms, while the shunting condenser C must not have a capacity exceeding 0.01 mfd. Any form of tone control which reduces all frequencies uniformly will eventually result in a serious loss of apparent strength of both very high and very low frequencies, and the bass and very high frequencies will become so attenuated that reproduction will be marred by the over-preponderance of the middle frequencies. Of the numerous methods put forward for avoiding this defect, the one here described, consisting of an adaptation of the tuned-acceptor circuit, is the most satisfactory. The arrangement is shown diagrammatically in Fig. 11. R is the usual volume-control potentiometer, in this case applied to a gramophone pick-up. In addition to the slider tapping, which gives the control of volume, there is a permanent tapping at about one-fifth of the way from the bottom end of the potentiometer. Across the bottom fifth of the potentiometer is connected the acceptor circuit, which comprises an inductance L of about 50 millihenrys, and a .5 mfd. condenser C, with a variable resistance R of 10,000 cycles - the variable resistance in series broadens the tuning and makes the control operative over a band of frequencies in the neighbourhood of 1,000. When the main slider is at the top of the potentiometer, corresponding to big volume, the effect of the acceptor is slight, but as the slider is moved downwards the proportion of the middle register absorbed by the acceptor increases progressively, thus maintaining normal tonal quality. An arrangement such as this can very easily be made up by the amateur. It is possible to obtain potentiometers with two sliders, but, alternatively, the tapping for the acceptor can be made by careful soldering.

As this is probably one of the circuits which will provide most interest to listeners who are interested in experimental work, on account of its rather novel form and the use of non-standard apparatus, it might be worth while to give one or two suggestions as to the best method of finding the best working values. Use a standard volume-control potentiometer (the value will

(Continued on page 403.)
Locating Faults
Methods of Tracking Down the More General Troubles Met
With in Receivers are Discussed by the Technical Staff

FROM the correspondence received by the Query Service Department, it is very evident that it is not only the beginners who experience difficulty in locating receiving faults which arise from time to time. While one can fully appreciate a new-comer to the hobby being at a loss as to the cause of the trouble, and the necessity to proceed to trace it, it seems rather peculiar that, say, constructors of several years' standing cannot (or will not) apply their knowledge in such a manner that the fault can be localised. Whether this failure indicates that their knowledge of radio only covers assembling a few components and wiring them up according to a full-size blueprint, or whether it shows that, while their knowledge might be quite sound, they lack the ability to apply it in a systematic sense to individual sections of a receiver, one cannot say, but it is hoped that the brief details given in this article will help all to tackle their problems in an active manner, rather than sit down and adopt, so to speak, a defeatists attitude, and send out frantic SOS's.

As it is not possible to tabulate all likely defects and their symptoms, some of the more general troubles will be discussed, as it should be possible, by applying a little common sense to track down even obscure faults by following the suggestions given below. If some predetermined procedure is adopted by the tester, he will find, after a little practice, that he will undertake to service receivers or amplifiers large and small with much more confidence than when hit-and-miss methods were applied at random. One's abilities will, quite naturally, be limited by one's practical and theoretical knowledge, and so it behoves all serious constructors, especially the beginners, to take every opportunity to increase their knowledge as much as possible. These nights of black-out offer good opportunities for a little serious reading of good text-books on the subject.

General Tests
When testing any apparatus which is new or unknown, always take the precaution of including a suitable fuse in the H.T. negative supply or, in the case of a mains-operated receiver, apply a simple continuity test between H.T. and the common negative earth line. This procedure will prevent any additional harm being done if, by chance, the fault is connected with the H.T. supplies to the various parts of the circuit. With battery-operated receivers, always make sure that the H.T., L.T., and G.B. batteries are above suspicion. One cannot always trust verbal evidence on such matters, as it is not unknown, as very many practical examples have proved, for a faulty or dirty connection or cell to be entirely responsible for many alleged faults.

If it is possible, make quite sure that all wiring connections are secure and that all components are so fixed that they will notfloat about or come adrift if the set is turned over during further stages of its examination, before applying any voltages.

No Signals
A multitude of faults can produce this annoying effect. If no special clue is avail-

able, then one must start at the very beginning and apply the following routine tests. After bearing in mind the above general remarks, and before applying any voltages, remove each valve in turn and, with a simple continuity tester, i.e., a small dry battery in series with a low reading voltmeter, or a high-reading galvanometer or milliammeter, test the filaments or heaters for continuity. If these tests do not reveal any faults, replace valves and check current consumption of receiver. This can most easily be done by connecting a suitable milliammeter in series with the H.T.

negative lead. For battery-operated sets a meter having a maximum reading of 2 50 to 100 mA's should be sufficient, but for mains sets a higher maximum reading would be advisable, say, 50 to 100 mA's, according to the number and type of valves employed.

Biasing Voltages
If a reasonable-total current consumption is indicated, it will denote that H.T. and biasing voltages are more or less satisfactory, but this should be verified by noting mA-meter reading and removing one valve at a time and seeing what current it is taking. This will be shown by the fall in the meter reading. Note: This procedure is not applicable to mains sets where the current consumption of each valve should be checked by connecting the meter in the H.T. supply to each anode in turn.

These tests will also show if the H.T. feed to each valve is complete, i.e., any valve not indicating a current flow should be subjected to further examination. For example, voltage tests between anode and H.T. negative and screening grid and H.T. negative, when valves of the S.G. and pentode types are being inspected. With mains valves, the cathode circuit must also be examined as a break in the bias resistance or the connection between cathode and earth (H.T.) will also result in absence of anode current.

High anode current calls for careful checks on anode and/or screen voltages and bias voltages, when such are applied. High H.T. or low G.B. will be responsible, while the opposites will produce low anode currents.

If the G.B. value is in order for the valve concerned, then attention should be given to the H.T. supply, which, if correct at the H.T. battery or rectifier, is no doubt being reduced to a low value by an unsuitable value of resistance, i.e., decoupling or anode lead.

It must be realised that when speaking of H.T. and bias voltages, any tests applied to determine these values naturally bring under observation all components in the anode circuit, i.e., H.T. choke, coils, switches, coupling, and decoupling condensers, L.F. transformers, L.S. or primary of output-transformer, and the reaction circuit, in the case of a detector.

On the G.B. side, one must also check up on the continuity of the grid return circuit, i.e., the coil, grid-leak or secondary of L.F. transformer.

Localising the Trouble
Assuming, at this stage, that the set under test is a simple three-valve of the H.F.-detector-L.F. type, the following procedure should be adopted to limit the field of tests to single stages, thus allowing the tester to eliminate as many likely points of trouble as possible.

In this instance, it would be advisable to concentrate on the detector valve, and the succeeding H.F. stage and the output stage can be cut out of circuit in the following manner. Connect the aerial through a small fixed condenser to the connection

(Continued on page 405.)
The Television Question Again

Once again I put the plea that the television programmes should be reinstated. I do not believe that our enemies abroad would rely upon such an indirect method of direction-finding as using the television signal. I know that aircraft instruments have reached a stage where they are independent of such methods. In these days, when the blackout is causing most of the population to spend longer periods at home in the evenings, anything that can be done to entertain them should be done. The television service, of course, serves the Home Counties, but there are 80,000 miles of rural Britain, and the reinstatement of the television service might encourage the sales of television receivers. Hundreds of people at present have expensive television receivers which they cannot use.

The B.I.R.E.

I understand from Sir Harold Moor that the Institution of Radio Engineers proposes to hold its annual transactions, and, as far as possible assist in the requirements of commercial enterprises. Mediocre, but, of course, been left in abeyance, although it is hoped to recommence meetings very shortly. Meanwhile, papers which would have been read at Members' Meetings are to be published in the Journal of the Institution. The decision to push ahead with the publication of the Journal was taken by the Council after careful consideration, and although war-time costs may affect the size of the Journal, it will, henceforth, be published at least once every quarter.

In deciding to proceed with this matter, the Institution claims to be the first Radio Institution in the world, apart from the American Institute of Radio Engineers, whose activities are solely concerned with Radio Engineering to whom we have been forward. The Torch Battery Prices

I see that the Central Price Regulation Committee have warned retailers that they must not charge more than the prices marked on the batter manufacturers as long ago as November 6th, and these include an increase in price. The public are invited to put a price, and to report any cases where list prices of British batteries are lowered. Some of the foreign batteries are, of course, dearer, and it is not possible to control such prices. However, the publishers of batteries the labels of which have been tampered with.

The B.E.F. Programme

Have you tried the B.E.F. programme now put out by the B.B.C. on 342 metres? We have listened to it on a number of occasions, and found the alternative programme very good. I generally find that transmission is marred by slow fading, although so far I have always been able to "hold it". Many of my friends, however, tell me that they cannot receive it at all in certain districts around London. Others can get it, but only at poor strength.

Of course, we must not complain, for we are only "savadropers". Nevertheless, I hope that the programme is received much better by those for whom it is intended than it is by listeners of my acquaintance.

One suggestion which has been made is that the transmission is "beamed" to our troops in France, but I have other theories concerning the fading and lack of punch.

Torch Battery Prices

I see that the Central Price Regulation Committee have warned retailers that they must not charge more than the prices marked on the batteries, and that such must not be offered for sale at more than that price. Such prices were, of course, announced by the battery manufacturers as long ago as November 6th, and these include an increase in price. The public are invited to report such cases, and to report any cases where list prices of British batteries are lowered. Some of the foreign batteries are, of course, dearer, and it is not possible to control such prices. Members of the public should beware of batteries the labels of which have been tampered with.

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"This Land of Ours"

The history of American cities, related in terms of the pioneers who founded them and succeeding generations responsible for their development, is being presented in a new dramatic series, This Land of Ours, which began on W.L.J. Sunday, January 14th, at 10.30 p.m., EST.

The programmes, which replace "Salute to the Cities," will be presented in a form differing substantially from the latter. The elements of comedy, energy, pathos and accident which played a part in the building of each city will be brought out in scripts by E. Carder of the W.L.J. Continuity Division, who will visit each city to obtain material for the series.

The initial programme told the story of Richmond, Indiana, incorporated in 1848. On the personal history of a man and his wife, from youth to old age, was superimposed highlights in the story of the city, ranging from the first council meeting to the present. One dramatic sequence dealt with the selection of a name for the city from three submitted to its inhabitants. The name Richmond was offered by David Hoover, an uncle, three generations removed, of former President Hoover.

A full dramatic staff will participate in the new series, with Harold Carr as production supervisor. A 39-piece orchestra directed by Uberto Tieole, will supply appropriate music, and, at the close of the programme, a serenade to the city whose history has been dramatized.

In his search for authentic information, Carder will comb each city thoroughly. He plans to see the mayor, newspaper editors, officials of historical societies and old residents—the latter to provide the "flavour" of the city's life as they found it in the past.

I think this idea could be applied to this country, which has a wealth of historic interest.

Response to Broadcast War Appeals

It is gratifying to note that the record sum of £75,000 has been collected as a result of Lord Baldwin's appeal for Seamen and their Dependents on December 14th; this figure includes Lord Nuffield's cheque for £25,000. The previous record collection was in response to Lord Northwood's Wireless for the Blind appeal at Christmas, 1938, which realised £42,163.

The response to broadcast appeals since their resumption on November 6th has reached the outstanding figure of £175,984 in 8d. This exceeds the sum collected and similar appeals in any whole year up to and including 1935.

The second most successful appeal of the war was that of the Polish Ambassador on behalf of the Polish Relief Fund on November 19th, which realised £27,400. Miss Gertrude Field's "Voice of London" Hospitals broadcast in £18,000, while the unknown blind man who appealed for the British Wireless for the Blind Fund at Christmas secured £2,850.

Comparison with the response in the corresponding months of 1937 and 1938 is interesting.

In November, 1937 and 1938, the appeals yielded £12,589 in 8d. and £14,779 in 6d., respectively, compared with £39,202 in 6d. in November, 1939. The December, 1937 and 1938 figures were, respectively, £3,450 in 8d. and £5,674 in 6d. compared with £1,878 in 6d. in December, 1937.

The response to the appeal on behalf of the Finland Fund broadcast in 1939 is reported as £9,000, but with the broadcast in January 7th is already £17,000, and many letters have yet to be opened.

B.B.C. Monitoring Service

The vital importance of broadcasting in time of war needs no stressing. Emphasis, however, on outgoing broadcasts might overshadow the enormously important work undertaken by what is known inside the B.B.C. as the Monitoring Service.

On the outbreak of war, the B.B.C., on behalf of the Ministry of Information and at its charge, put into operation an interception station by which, ever since, a day and night check has been kept upon foreign broadcasts from enemy and neutral countries. Throughout every twenty-four hours, a team of expert linguists with a wide knowledge of international affairs, listens to and notes down about one hundred and sixty foreign bulletins, containing in bulk over three hundred thousand words. This involves the reception of the foreign broadcasts in a hut on a hilltop somewhere in England, and the output of this receiving station is at present more than a quarter of a million words a day. Detailed digests are sent to various Government departments who have, since the outbreak of war, found the service of ever-increasing importance.
Grid Bias for Midget Portables

When a Very Compact Portable is Operated from a Low-voltage H.T. Battery, GB Voltage May Be Very Critical. Methods of Biasing Accurately in Such Circumstances are Explained. By FRANK PRESTON

When planning a pocket portable, or other midget set which is intended for operation from a comparatively low-voltage H.T. battery, a difficulty is encountered in biasing the bias for the output valve—generally a small power or economy tetrode or pentode valve. In many cases the valve used for output is a G.B. voltage of only about 3 at 100 volts H.T.; consequently, at say, 50 volts H.T. the correct bias would probably be less than 15 volts. In fact, it would in nearly every case be found that the receiver would operate perfectly well with the grid bias line simply being returned to the ear line. Unfortunately, if this connection were used the consumption of H.T. current might be higher than it need be. As almost every reader is aware, the anode current consumption is reduced as the grid bias voltage is increased.

Odd Voltages

If the valve would "take" 11 volts G.B. there would not be any difficulty, for a single cell could be used. If the battery used for H.T. supply were provided with bias tapping points the matter would be perfectly straightforward and the arrangement convenient. But if the correct bias voltage were slightly less than or greater than 11 volts some trouble might be anticipated. In general, when only "phones" are used the "thinner" reproduction obtained by using slightly more than the nominally correct amount of bias would not be of any consequence. On the other hand, the use of an excessive bias voltage results in a loss in L.F. amplification, and hence in volume. This cannot be afforded in a simple and ultra-compact set of the type under consideration.

There are various methods of surmounting the difficulties which have been mentioned, the simplest of which consists of employing automatic grid bias. This is always to be recommended for any type of battery receiver, but there are many constructors who are loath to fight shy of it because they think that there are some obscure difficulties. Before considering that aspect, therefore, it will be better to look at the matter from another angle.

Bias from the L.T.

It is not always appreciated that a certain amount of bias can be provided by the L.T. accumulator alone. This is explained by the fact, that if there is a voltage drop across a valve filament, and therefore a small potential difference exists between the end of the filament and each end. This is shown in simplified diagrammatic form in Fig. 1, where the voltage indicated is the anode voltage for the potential existing between the two ends of the filament is equivalent to the voltage of the anode, and, therefore, the voltage between the centre of the filament and each end of it is half the accumulator voltage; 1 volt for a 2 volt valve.

If it were assumed that the filament emitted electrons from its centre only, it would be easily understood that a negative bias voltage of unity could be obtained by returning the grid circuit (secondary of the L.F. transformer, coupling choke or grid leak) to the negative centre of the accumulator, which is generally wired to the earth line. On the contrary, a 1 volt positive bias voltage could be obtained, by returning the grid circuit to the positive terminal of the L.T. supply. In practice, of course, the matter is not so simple as this, for the whole of the filament is in use, although the emission from certain parts of the filament is greater than from other parts. Most experiments which have been made indicate that maximum emission occurs from the negative end of the filament; that is, in nearly every case, the end which is joined to the common H.T. and L.T. negative supply points. Because of this, the negative potential available is very small.

Positive and Negative Compensation

But, in practice, it is possible to make some use of the difference in potential across the filament, and when an exceptionally low anode voltage is employed sufficient bias can be obtained by returning the grid circuit to the negative side of the filament. It might be thought that no use can be made of the positive bias (usually slightly greater than the available negative bias) to be obtained by returning the grid to the positive side of the filament. That is not the case, however, for this small bias can be employed to "cancel out" a part of the voltage provided by an external G.B. battery or cell. Thus, it might be possible to reduce the effective voltage of a 1.5 volt cell to about 1.2 volts by connecting it as indicated in Fig. 1 to the positive end of the filament.

In many instances it will be found worth while to try the effect of transferring the positive lead from the bias battery or cell from the negative to the positive L.T. point so that the most available bias voltage can be found. This applies only when the anode voltage is unusually low, and when a very small G.B. voltage is required. When dealing with a larger receiver operating in these conditions it would probably be better to use a 50,000-ohm potentiometer in one of the grid bias-supply arrangements, but this is obviously out of the question for a miniature set.

Auto Bias

Automatic grid-bias is by far the best solution to the biasing problem with any type of battery set, and there are no difficulties which need be anticipated. Basically, all that is required is a resistor in the lead from the H.T. negative switch plug to the L.T. negative line. This is shown in Fig. 2. Then the grid circuit is returned to the negative end of the resistor, that is, to the end joined directly to the negative socket of the H.T. battery or eliminator. There is a voltage drop across the resistor, of course, due to the high-tension current which flows through it. It is this voltage drop which provides the bias.

By using the well-known Ohm's Law it is possible to determine the correct value of resistor, but in making the simple calculation it must be remembered that the total anode current for all the valves in the set passes through the resistor—not just the current for the valve being biased. In practice, it is scarcely necessary to make a calculation when dealing with a simple two-valve operated from an H.T. battery of low voltage. When the bias required is in the nature of one volt a 200-ohm resistor (1-watt or 1-watt) will serve quite well. When there are three valves, the value can be reduced to 200 or 150 ohms.

Finding Resistor Value

To the more scientifically minded, this method of procedure will appear very haphazard, as it is, but it has the merit of being good enough for almost all normal requirements. Those who are more accurate can easily find the best value by experimenting with a "plain" (as opposed to a grid-adjustable resistor) or potentiometer of about 1,000 ohms maximum value. Starting with the full resistance in circuit, the value can gradually be reduced until...

(Continued on page 403)
Proper Control

In the radio transmitting room of a modern television broadcasting station, every facility must be provided for the engineers in charge to exercise adequate control over the vision signal, prior to its being fed to the ultra-short-wave aerial array. This is of extreme importance, for at this last stage in the chain of events, from scene to tube, the slightest error or inaccuracy can be heightened by the medium to such an extent that it cannot be remedied. The supervisory staff, therefore, must be in a position to detect it very readily. As an illustration of how this work can be undertaken satisfactorily, suitable monitoring equipment has to be incorporated, and in this way a constant watch can be maintained and adjustments effected quite readily by the supervisory staff. For this reason, the control desk, mounted in the centre of the sloping back, is covered with the screen of an oscillographic cathode-ray tube. This may not be very clear, and under some conditions the waveform of the video signal, that is, the modulation and injected synchronising pulses, is traced out on the screen. This simple device shows straight away whether the form of modulation is correct (positive or negative). The ratio of synchronising pulse to full depth of picture modulation can be examined and adjustments undertaken immediately if this figure does not conform exactly to the published standards.

Emergency Provisions

Defects in the shaping of the synchronising pulses are also made visible at this point; if they should exist, whilst corrected pictures brought about by modulation of the corrector circuits will be in evidence and show the expert straightway where the fault lies. On this same control desk are the meters which portray the voltage and current conditions at various sections of the equipment, together with the switching buttons and control handles. When running up a radio transmitter of this type, and also when closing down, the various operations must be carried out in a definite order, otherwise a breakdown may occur, and at this stage the engineer in charge has complete control of the working in much the same way as a captain of a ship on the bridge. In an emergency, panic buttons can be depressed, and this will close down the station, but drastic measures of this nature are only resorted to under very extreme conditions. Behind the control desk can be seen the monitor rack, on which is traced out the complete picture, so that a check can be made on its characteristics during the whole period that a transmission is on the air.

To the left of this are further modulator oscillographs for vision and synchronising, while in the background are the racks housing the equipment for the transmitter proper. Built on clean engineering lines, with every part of the apparatus readily accessible for servicing and routine inspection purposes, the example chosen is indicative of modern practice both in Europe and America although, naturally, the details vary according to the power employed and the design used.

Television in the Air

America has followed up the work already carried out in Europe in connection with the reception of television signals in an aeroplane by conducting experiments at a very high altitude. This work was sponsored by the Radio Corporation of America in conjunction with the National Broadcasting Co., and when over 20,000 feet above Philadelphia, the television experts in the machine came within range of the standard United States transmitters and saw on the cathode-ray tube of their receiver housed in the aeroplane, the standard test pattern which is normally radiated so that set owners can adjust their controls. After this the occupants watched a football match in progress, and finally, when approaching their landing field they were rewarded with pictures of their own machine. It appears that electron cameras of an outside broadcast unit were situated at the spot and they focused on the circling machine and kept it within the field of view of the lens right up to the point of landing. It has been suggested that this last section of the performance represents in broad principle one method whereby an airplane can reach an airport safely, although the field may be shrouded in fog. An infra-red sensitive camera would have to be employed, and the pilot, once within range, would be enabled to see pictures of the approach of his machine towards the landing ground by watching a television set in his cockpit. How satisfactory this will prove in actual practice cannot yet be ascertained, but it is an alternative to the many other blind landing schemes which have been used or proposed to aid the safety of pilots forced to fly in bad weather conditions.

Sideband Filters

The television transmission standards which are in use at the present time by America for all the transmission centres on the air are vastly different from those which were employed in this country. A six-megacycle channel is assigned for the transmitted sound, vision, and synchronising signals, and the carrier of the picture transmitter is located at a point 1.25 megacycles from the lower limit of the sideband, it being appreciated that single sideband working is the order of the day at present. The sound-signals are radiated below this 1.25 megacycle limit, and the scheme adopted is such that any signal which reaches below 0.75 megacycle of the channel allocation is not accepted by the receiver employed to tune-in the transmission. It is essential, therefore,
Magnetrons for Reception

The magnetron valve has been applied to a variety of special purposes, and one of the latest uses is for the reception of ultra-short-wave signals. In this adaptation of the valve the filament is located centrally between two split anodes arranged cylindrically round the filament. Normally, the electrons released from the surface of the filament would travel in straight paths towards the pair of anodes, but for this scheme the route taken is altered to one of spiral formation. To produce this a strong magnetic field is arranged by an external winding to act in a direction parallel to the filament. The time of flight of each electron from filament to anode is thereby regulated by the strength of the field. In use, a dipole receiving aerial is joined to the split anodes by Lecher wires, and stabilising discs at each end of the electrode assembly are linked together, and pass through an impedance to a tapping on the voltage source feeding the split anodes. Rectified signals are produced across this load resistance and they are in turn fed to the grid of an amplifying valve in the receiving circuit.

Electron Multiplier Considerations

More and more attention is being given to the work of improving the practical applications of electron multipliers, for it is realised in the field of electronics that their use is becoming more and more important in scientific and commercial life. It is always interesting, therefore, to keep a careful watch on developments in this direction. For example, it is known that in many cases the grid type of electron multiplier is not working at its best when having to handle very small fluctuations of voltage. This arises from the fact that in addition to the A.C. variations being amplified, the D.C. component of current is amplified in an identical measure. One scheme which has been proposed to overcome this factor is to use a series of electron multipliers in cascade, either as completely separate units or housed together inside the same glass envelope. Each of these multipliers would be arranged to have a limited gain, and be coupled together by any of the well-known methods of circuit coupling, which effectively remove the D.C. component. Yet another attempt to improve performance is concerned with the very high output impedance of these devices which on many occasions restricts their use owing to the limitation of impedance matching in the output circuit. In one scheme it is proposed to counter this defect by making the output electrode of such a form that it has a non-uniform surface, so that the secondary emission of the electrodes is not dependent on the voltage applied, and the section of the surface to which electron impact is directed. It is claimed that in this way relatively low output impedances have been obtained, thus enabling better matching conditions for practical use to be achieved.

Home Projection Sets

Although the German television industry has standardised on a cheap home receiver model, some of the leading manufacturers are continuing to produce other sets in readiness for the market. One of the most interesting receivers in this class is a portable projection set which is of a very compact design. This is seen in Fig. 1, and to all intents and purposes it is an all-wave radio receiver with the minimum of controls. By referring to Fig. 2, however, it will be seen that the lid can be raised, and this houses a special type of reflecting lens screen which has been developed by Ferranti A.G., the company responsible for the big less screen which gave such remarkable results at the 1938 Berlin Radio Show. Although family viewing is shown being undertaken in a completely darkened room, the picture, which is approximately 20ins. by 18ins., is particularly bright. In addition to the contribution made by the new screen itself towards this condition of viewing, another important factor is the small projection tube which has been designed for this purpose. A front and rear view of this new tube is seen in Fig. 3 and the relatively small overall size can be gauged by comparison with the usual form of receiving valve. Instead of projecting the picture right through the fluorescent screen material with its consequent loss of light, the small built-up picture is projected from an opaque screen mounted obliquely inside the small cylindrical glass walls. The main electrode connection is brought out through terminals and the voltage used is 25 kilovolts. By using such a high voltage and employing a long tube with a remote electrode assembly together with electromagnetic focusing and deflection, a brilliant, sharp picture is built up on the screen. Due to the non-normal impact of the scanning beam on the tube's screen, a correction has to be applied to eliminate keystone distortion, but this has been done satisfactorily and even at close viewing distances the picture has excellent pictorial value.

Fig. 1.—In outward appearance this projection set resembles a normal all-wave radio receiver.
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 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. H owwood (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 1½in. deep. First, I drilled a ⅜ in. hole in the centre of the lid (to take the neck of an ordinary single circuit jack), and then I drilled another ½ in. hole in the bottom of the tin for the output grid lead.

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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, and the jack was completely enclosed and screened. The remainder of the grid lead between the screwing box and the valve pin was covered with metallicised braid, soldered at one end to the box, and earthed to chassis at the other. This removed the last vestige of hum, and also has the merit of cheapness.—J. THRELFA LL (Blackpool).

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 store 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. Collins, D,

are also fitted to support the semi-circular shields, the joints at these points being sealed with bitumen.—L. Berton (Sheffield).

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The new weekly journal for those engaged in all branches of the Engineering and kindred industries. 4d.—Every Thursday.
However good the B.B.C. Home Service may be, it cannot please everyone 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, enable the 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.

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. This 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 led via a 0.5-mfd. coupling condenser to the primary of the parallel-fed 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 m.A./volt, with an amplification factor of 5, and gives considerable power output with 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 as 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 indirectly-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 215 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.
Quality Amplifier

A Useful Unit Especially of 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, 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 50 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 of only 780 ohms to obtain a bias of 44 volts.

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 positive 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 line. 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 Weltinghouse metal rectifier type H.T.16 connected in the voltage-doubler circuit, with an A.C. voltage input of 230 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 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 unsmeared output of the rectifier at 22mA is some 350 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.

(C)ONTINUED ON NEXT PAGE.)
A SIMPLE QUALITY AMPLIFIER

(Continued from previous page)

As the action of the Westhouse 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 matters 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 Duoliber type 0281 style A, or else to incorporate a thermal-dwell 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.

Construcational 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 boarders type. The components are mounted as shown in the diagram. 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 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 components 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 setting 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 A.C./H.L. type valve tuned by an unscreened Duoliber type C.60, of which only the medium-wave windings are used. The long-wave winding is shorted out as indicated in Fig. 2, but don't connect terminal 4 of the resistor winding to earth, or you will short-circuit the H.T. supply.

Leave this terminal free.

The usual 0.005 mfd. grid condenser and 500,000 ohm grid leak set used, and the anode circuit is decoupled by a 25,000 ohm resistance and 8 mfd. condenser, and the usual load resistance of 20,000 ohms is also incorporated. The rectified voltages developed across this resistance are fed to the amplifier via the 0.04 mfd. and 100,000 ohm H.F. filter resistance. H.F. filtering is completed by the two 0.01 mfd. and 100,000 ohm valves, which is also employed in the usual manner with the reaction condenser on the "earth" 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 0.01 mfd. grid-condenser in the aerial lead and to adjust this, at the same time advancing the tuning control to a point just below oscillation, in order to increase selectivity. Used in this fashion, the unit is giving a good accord of itself in 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 A.C./H.L. reaction condenser, for three 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. 4

January 27th, 1940

PRACTICAL WIRELESS

Wavelength-frequency conversion Table.

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<tr>
<th>Wavelength (km.)</th>
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Note — To convert wavelengths in metres, divide 300,000 by the number of kilometres.

To convert wavelengths in km., divide 300,000 by the number of metres.

The magnetic unit is 600 cycles per 30,000 kilometres — 30 megacycles.
GRID BIAS FOR MIDGET PORTABLES

(Continued from page 395)

the optimum setting is found, but bearing in mind that it pays to have the highest value at which sufficient volume and satisfactory reproduction can be obtained.

When the best setting has been found, the value of the portion of the resistance element in circuit can be estimated by the position of the knob or slider. Thus, if it were one-quarter way round from the maximum-resistance position the value would be 750 ohms. Once the highest value has been found, a fixed resistor of the nearest equivalent value can be fitted. It will be seen from Fig. 3 that an electrolytic condenser is connected in parallel with the bias resistor to act as an H.F. by-pass. The value of this is not critical, and the working voltage need not be more than 12, so a convenient capacity would be either 25 or 50 mfd. A condenser of the flat, bakelite-case type or a tubular would be suitable and sufficiently compact.

L.T. Voltage Drop

There is another method of biasing which can occasionally be used. For example, if the two dry cells giving a total voltage of three were used to operate a two-volt valve, the voltage-dropping resistor could be placed in the negative L.T. lead and bias obtained by returning the grid circuit to the negative terminal of the battery. This method has only a narrow application, and the idea of feeding two-volt valves from a three-volt supply is not one normally to be recommended.

TONE CORRECTION AND FILTERS

(Continued from page 355)

25 to 1 mfd., according to the particular pick-up in use) and assemble the remaining components of the tone-control circuit. Then connect various small values of fixed resistance between the lower end of the volume control and earth—that is, to take the place of the "fixed" portion of the volume control already referred to. A few experiments will enable you to find the least effect at the maximum volume setting, and which is just having a noticeable effect at minimum setting of the volume control. It will not, of course, be possible to obtain the full tone-control effect owing to the fact that the arm of the volume control will not be able to travel across the fixed resistance which has been included in series.

LOCIATING FAULTS

(Continued from page 356)

which is normally taken to the top of the S.C. valve, and insert a pair of headphones in series with the detector anode. These should be connected as close as possible to the anode terminal on the valveholder, but if an H.F. choke is embodied they should be connected between the H.T. side of the choke and the H.F. supply. With these arrangements the circuit will be operating as a single valve, and will, therefore, prove whether the H.F. coupling coil, the detector grid circuit, and the reaction circuit are above suspicion. If any doubt exists about the operation of this stage, tests should be applied to all associated parts until the results are sufficient to warrant the theorizing that everything is operating in a normal manner.

After this stage, the L.F. or output valve can be brought into circuit by connecting the 'phones or speaker to the L.F. terminals.

and, of course, completing the connections for the L.F. coupling between detector and output. By doing this all the components associated with the L.F. coupling and the output valve will be put under test, while operating voltages on these two valves will also have to be correct for satisfactory results.

Particular attention should be given to the increase in signal strength, the quality of reproduction and the stability of the circuit at this stage, as these will prove the efficiency of the L.F. coupling and the output valve, and, of course, the values of applied H.T. and G.B. A milliammeter should be connected in series with the anode of the output valve to denote whether distortion is present and, incidentally, to check up on operating conditions. If the meter needle tends to kick down on loud passages, it will show that insufficient grid bias is being applied, but, if on the other hand, the needle kicks up, then excessive bias is being used.

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SHORT-WAVE SECTION

Suggestions of Things to Make for the Mechanically-minded Short-wave Enthusiast

By W. J. DELANEY

Condenser Drives

The modern receiver is incomplete without a really good slow-motion drive, and on short waves this drive must have not only a really good slow-motion action but must also be easy to handle. Many good components in this connection are rendered unsuitable for short-wave work simply because they are not capable of being smoothly adjusted by very small steps. Here then is one field for construction work, and if the enthusiast with drives it would be a good plan to endeavour to incorporate in the drive a band-spread device. This should be of such a type that it is not only adjustable separately but that it interlocks with the main drive. That is, supposing for instance that the band-spread device gives 10 degrees of band-spread movement for each degree of the main dial, it should also be so arranged that the setting for, say, 50.9 degrees can always be repeated by exactly the same setting of both the main and the band-spread device. This is not simple, but there are many interesting schemes which can be tried using either the special gear wheels, worm drives and similar items from the well-known constructional toy, or by pulleys and cords. The latter must, however, be so arranged that there is no slip which will result in different settings of the driven member for given dial indications.

It might be possible to arrange two windows through which the dial markings show. This is the simplest and most obvious figure which could be given its correct relation to the main dial settings, although an obscured dial, that is, one which only shows its individual setting, is not ideal owing to the fact that the direction in which it should be turned for a known setting is not immediately obvious. A large dial could be perforated so that the band-spread setting is visible through it, or dual pointer devices are more reliable, but there is endless scope here for experimental work.

Coil Switching

A good short-wave set utilises separate small coils for narrow bandwidths, and this simplifies tuning. Unfortunately, this generally means coil changing, and many sets are restricted to only two short-wave bands, these being rather too wide for comfortable long-distance work. Picking-in individual coils is tedious but the most satisfactory scheme for the real short-wave fan, and therefore some form of coil-changing mechanism is a good line for experiment. One well-known American communications receiver has the coils arranged in sets of three for each waveband in a die-cast aluminium box occupying nearly half the underside of the chassis. The connections for each set of coils are brought out to wiping contacts and the entire box is carried across the chassis, from one side to another, through a worm drive or rack and pinion movement. Definite steps are provided when each set of coils is brought into circuit, and a pointer on the panel indicates the band to which the set is tunable. This is a remarkably fine movement and very accurate and reliable in use, but is not difficult to copy with suitable workshop appliances. Rack and pinion may be obtained at any good photographic dealer's or scientific instrument stores, and the box could be built up with sheet metal. It must be rigid and weatherproof and the movement must be really smooth.

As an alternative, especially where only one coil is needed on each band, as in the simpler type of receiver, the coils to give the required coverage could be mounted on a rotating disc, arranged either horizontally or vertically, and again wiping contacts can be arranged in an arc at the periphery. When concerned with coil-switching, however, a perfectly firm contact must be obtained when the coils are in circuit, as failure to do this will cause noisy working and perhaps in signal losses.

To avoid noises when the coils are changing from one band to another, a switch could be operated through the coil-changing mechanism to break the H.T. negative lead and thus render the set "dead" between band setting.

Signal Lights

Many constructors have already incorporated dial lights of the two-colour type which indicate when the set is switched to long or medium waves, and this idea may be incorporated in the above waveband switching devices, only instead of coloured lights, small windows with indications showing the band covered could be fitted and the lights behind the windows brought into circuit with the coils, thus showing instantly to what range the set is adjusted.

The well-known Science Museum receiver incorporates the box for the two short-wave, and has two windows—National and Regional. These are illuminated as the set is adjusted and this idea may be extended upon in a modern home-food set to indicate any station to which the set tunes, in place of a tuning dial. This is ideal for operating in conjunction with a push-button mechanism, although the depressed button will indicate the station. It cannot, however, be seen from across a room, and with the small illuminated window, any doubt as to which station is being heard may be dispelled at a glance, even across a four-armed room, if the window idea is incorporated. Obviously with these dial-light ideas, some care is necessary in a mains receiver of the A.C. type, to avoid hum due to the number of leads which may be used and which will not doubt carry the raw A.C. supply for the lights. They will, of course, be run from a 4-volt winding on the transformer, and if there is not a spare winding of this type available for the purpose, they may be taken from a 4-volt winding which delivers current to spare after it has driven one or more of the valves in the receiver.

Obviously every idea has not been included in this article, but there should be some grounds for providing the mechanic with ideas which will help him to pass away the time during these dark nights.
Our New Year's Set

SIR,—With reference to the request on page 319, December 30th, 1939, issue, relative to "Our New Year's Set." May I humbly suggest that many of your readers would be very interested in a receiver of the type as described on page 251, December 9th, issue. This seems to be substantiated by Mr. W. Burton, in his letter on page 328 of the same issue.

I would suggest: (1) That the L.F. portion of the set be made optional (i.e., a switching device for cutting out same when not required). Thousands of listeners live within "good volume range" of the "home" program, and, generally speaking, L.F. in such a receiver would be a waste of current, except when required for "distant" reception.

(2) The range switch should be optional, i.e., specification of components to include two waveband coils, or (and) three wavebands.

If receiver only designed for two wavebands (medium and long) this would allow many short-wave enthusiasts to incorporate their own short-wave attachment.

(3) Provision for 'phone reception after fourth valve (D) to allow of long-distance reception, thus, the set would be suitable for "home" reception purposes, and also provide an added attraction for the "logie" and long-distance receptionist.

R. R. (Birmingham).

Exchanging S.W.L. Cards

SIR,—I am a reader of your fine magazine, and always like to see lists of coils heard by the various S.W.L.'s. I have been an S.W.L. for two years, and during that time have logged 2,500 hams in all continents. Seventy countries have been heard on 20m. 'phone. The RX is a home-constructed 0-02 using batteries, and my aerial a semi-germic, home-made N.S.

I have been QRT since October. DX heard during October includes 170 W's (in all districts and 39 states), 11, UV, LU, PY, KA, EQ, CE, ZS, TP, CP—all on 20m. 'phone.

I should like to exchange my S.W.L. card with anyone interested (W.L.'s, A.A. or hams), and will QSL the same day as I receive their card.—D. BOOTHAM (65, Eagle Road, Cenibury, Middlesex).

Problem No. 384

SIR,—Mr. Smithers wanted a super-capacity R.T. battery (66 volts) for his receiver, but owing to battery shortage could not obtain one. The master he could get was a low-priced small battery cell, and he accordingly decided to get this. Knowing that the capacity was dependent upon the size of the cells, he decided to go to the trouble of connecting all the cells in parallel in his battery in order to increase the capacity, and he accordingly did this. When he connected it to his set, however, he failed to obtain any signals. What was the trouble? Three books will be awarded for the first three correct solutions open to this class. Addressed to: The Editor, Practical Wireless, George Newnes, Ltd., Tower House, Strand, London, W.C. 2. Envelopes must be posted on or before January 21st, 1940.

Solution to Problem No. 383.

SIR,—Attitude overcorrected the fault that a short-wave converter can only be used with a receiver employing h.f. amplifiers, and that it was a detector type of combiner.

The following three readers successfully solved Problem No. 382, and books have accordingly been forwarded to them: B. Young, "Stony," Oxtoby Lane, Arundel, Sussex; J. W. Scott, 23, Waverley Park, Hastings; G. W. Fairbrother, 133, Wellington Avenue, Tilehurst, Berks.

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important part of the education of a
professional musician—and certainly
not the least pleasant—lies in the
attendance of concerts and recitals given
by the great executants of the day. The
critical listening to works that are being
studied when they are played authorita-
tively—that the work transcends the perfor-
mance. If the work being performed is well
known beforehand, many an error—very often
to minute dimension—can be spotted which
only a better performer would have
edged its way through in the practice
room. Also the larger sweep of phrase
and movement are heard in perspective,
as if we were looking at a play being acted
from the stalls instead of as one of the
participants on the stage. This is a most
very sensitive test, because twice we are de-
dendent either on our own personal judgment
of our work or that of friends or ac-
quaintance rather than which is always
impartial. Therefore the annotation of
questions of tone, dynamics, style, and
the general temp ensemble of the artist on
the concert platform.

Gramophone and Radio

It may be pleaded, of course, that the
gramophone and the wireless are effective
substitutes. In some ways they are.
No one could deny that the possession of
a record of something we are learning, and
the ability to play it over and over again
without having to leave our practice room,
is of the utmost convenience and value.
So much so, in fact, that many schools
and private teachers are co-operating their
use. Incidentally, it must relieve the
professor of much of his responsibility, and
the pupil of his nervous tension. When we
make the record at the exact spot where
we want to start it, as the wireless lecturers
do, we have instruction and example
combined, to the 6th degree.

But it is of something else I want to talk
about this week—the personal element.
Can this be wholly eliminated without
losing a vital spark? Can we dispense
wholly with the personality of the artist,
and still feel we have the complete thing?
Whilst admitting the undeniable fact that
the composer is greater than the performer
—if only as an introduction—the perfor-
mance—we should be able to enjoy two
arts at the same time rather than one. It is
the duty of the executant to breathe life into
the music—to be the intermediary between
the composer and ourselves and, whilst
never transgressing from what should be
to him the irremovable command of
the author, he should be big enough to add
his own personality to the original. The
two arts may be in an irresistible combina-
tion, and to suggest that any mechanical
reproduction wholly supplies the reality
is to suggest that a photograph is the equiva-
lent of a living person. Composing and
performing are twin arts, the one the
servant of the other. Or perhaps I should
use the expression companion. For a
humble and menial approach to the music
is just as objectionable in its results as one
of arrogant and unwarranted superiority.

St. James's Hall

I have been the privileged witness of
many wonderful scenes and the delighted
partner of unforgettable experiences in
the concert hall. The first of all was when
I was taken to the old St. James's Hall as
a small lad of some four or five summers,
to hear the irritable de Pachmann—
that magficial Chopin player and platform
buffoon—and remember vividly both his
playing the Waldstein Sonata, and my
sitting up on the back of the chair with
my feet on the seat. Of pre-1914 memories
I best remember Paderewski. Godowsky,
Sauer, Rosenthal, Backhaus and a truly
wonderful boy—white and effeminate Hungarian
genius, von Lengyel, whose performance of
the Liszt Sonata has probably never been surpassed.
Although pianists claim first
place, I vividly recall other instru-
mentalists such as Ysaye, Mischa Elman,
Kreisler, etc., as their tempestuous
in

take precedence. Not only was he a
supremely great pianist, but his person-
ality absolutely unique and terrible. With
him the personal element entered into the
music to a greater degree than with any
other artist of his time, but as he was of
the most aesthetic tastes he gave us a
perfect combination of the twin elements
in a beautiful union of all that was
touching and delightful. He was the finest
class entertainment nobody can forget
who saw him in his heyday. The packed
hall was always in a fever of excite-
ment and expectancy. He always kept
them waiting several minutes over the
advertised time of starting. He also
delayed between two and three times
the normal concert prices. Then, when
his lean, spare figure, surrounded with
the most marvellous aura of red hair,
occasionally stepped on to the platform,
the audience would rise to its feet and
break into a pandemonium of applause
lasting several minutes. Using his own
Erard piano, worn threadbare with his
work, he would pound it with a series of
satanic blows struck from the level of
his head. When these came to an end in
the tonic chord of the first piece on the
programme, further salvos would greet him.
But when he commenced in earnest, what
a player! What a poet! A prince of
pianists!

L.S.O. Concert

I heard him three times before 1914—
in two recitals and once at a memorable
L.S.O. concert, when the one and only
Arthur Nikisch conducted him in his own
concerto. He reappeared after the
war—1923, I think, was unforgettable.
Time and sorrow had greatly modified
him, and his playing had taken on an added
philosophy, and a sweeter reasonableness.
Of the years 1920-1923, following the
war produced a natural reaction, and
a musically starved populace welcomed almost
anybody, and everybody, with open arms.
Paderewski's return I have mentioned.
Just as vociferously and joyously was
Kreisler's, who came back in a series of four wonderful
recitals, all of which I shall never forget.
At the first one the warmth of the greeting
(his was the first as well as the greatest
of the ex-enemy masters to return)—his,
they are again our opponents)—so moved
him that his performance was almost
negligible. But all was forgiven—the huge
audience just cheered and cheered.

Post-war Masters

Giants of the post-war decade—most
of whose appearances I have heard
were, in addition to Paderewski and
Kreisler, Busoni, Irmel colonel of the
keyboard, Cortot, a Frenchman with
a manou, he of the Preludes; Heifitz,
the modern Paganini; Memish, greatest
of executors of the Schubert; Thibaud,
prince of conductors; Galli-Curci, the
modern nightingale; Gigli, Caruso's only possible
competitor in the West; Casals, the only great
cellist, and one of the world's great artists.
These are the really magical ones whose
names fill a concert hall of any size in any
part of the world, and whose deeds cause
a catch of the breath, and a thump of the
heart. Busoni is now dead and Paderewski
retired. I should not have forgotten Melba
or Caruso—both no longer with us, either.
There are literally scores of other
splendid artists as well. Pianists are ten
a penny, and conductors almost as
cheap. No, there is a certain grandeur
Cortot is an extraordinary chap, and
the only first-class artist I know whose
memory fails him in public. I witnessed
two very painful incidents when on both occasions
he flustered his temples and uttered "Oh
mon Dieu, mon Dieu !". The music did
not come back to him, and he had to resume
it at the most convenient point. I
believe Nikisch had a similar experience
to audience—purposely, I think, and Heifitz
breaking a string and having to start
his piece over again on another fiddle. A
head string also snapped during a recital of
Rosenhaft's, and the eling reverberated
right round the hall—a most unusual
incident. The pianist always gets the
credit for breaking a string, and is deemed
a great showman in consequence, though
such a thing is quite impossible. Even
to break a hammer is rare. Such is luck!

The ARGON Charger

T. W. THOMPSON, the makers of the
new and extremely popular "The Argon"
L.T. charger, inform us that the Oram
Argon valve is no longer obtainable, and the
only counterpart of this is the Philips
rectifying valve (type 1036), which retails
at 14s. 6d. This valve has identical
characteristics to the original, and can,
therefore, be substituted without any
modification to the original design.
Extending Your Loudspeaker
A Few Hints on How to Obtain the Best Results

Since the advent of the console type of set, with self-contained loudspeaker, it has been something of a problem to know exactly how to connect an external loudspeaker, either for use with the internal one or on its own. Almost every set on the market to-day has terminals for the connection of an external loudspeaker. This is all very well if you are going to use an external loudspeaker whose impedance characteristics are just as those of the internal loudspeaker. This is not very likely, and the problem remains unsolved, in spite of those two neat terminals at the back of the set.

Losing Quality and Volume
Quite apart from this problem of the commercial set, very few listeners seem to be able to work two loudspeakers from the same set without losing quality or volume, or sometimes both. There are so many occasions on which an extension of the loudspeaker system is wanted that we really think a few practical ideas will be welcome.

Let us consider first the type of set our readers are most likely to be using—a set with an output circuit connected internally to a loudspeaker, having an integral transformer. If you look at Fig. 1 the points marked A and B is marked for the loudspeaker terminals. Normally, wires go from these terminals to appropriate terminals on the primary of the loudspeaker's transformer. This is fine for just one loudspeaker, but exactly what are you to do when you want to connect up another loudspeaker?

We will assume that you are still going to use the present loudspeaker but that you want to hook on externally another loudspeaker of different characteristics.

Its Own Transformer
We are assuming that the external loudspeaker also has its own transformer. What you have to do then is to connect up your present output to this transformer, without disturbing the present matching of the internal loudspeaker. A 2-microfarad fixed condenser is the link between. Take a wire from the A end of the existing transformer to one side of the 2-microfarad condenser. This A connection is found in practice by trial and error, not really difficult because on one terminal you will hear nothing, and on the other the extra loudspeaker will work. To the other side of this condenser join a wire, which can be as long as you like—to the next room, down the garden, anywhere—and connect it to one side of your external loudspeaker. The other side of the external loudspeaker is connected to earth. By this we mean to a nearby water-pipe, radiator, or actually to an earth plate.

You will then find that the two loudspeakers will work very well together, but one may give more volume than the other. You may be able to overcome this by altering the tapping on the primary of the transformer of the external loudspeaker, but a more satisfactory method is to use a volume-control for the external loudspeaker. The easiest way of arranging this is to connect a resistance of 10,000 ohms across the primary of the loudspeaker transformer. This is, of course, a variable resistance, and will not appreciably affect the internal loudspeaker.

Now, it is quite possible that you may want to use two external loudspeakers as well as the internal one. This is just as simple to arrange. Instead of earthing the primary of the first transformer, connect this to the primary of the transformer of the second external loudspeaker. You then earth the remaining connection on the second transformer. The volume control is fitted as before—a variable resistance across the primary winding. You may have a simple set without an internal loudspeaker—just a set with a plain output circuit and no choke or transformer. This you may want to use with more distant external loudspeakers of mixed impedances.

The Fig. 2 circuit shows you how this can be done. A and B is the loudspeaker terminals. Between these two terminals connect a 30-henry choke capable of limiting the anode current of the output valve. Then from the point A, which comes from the anode of the output valve, take a lead to one side of a 2-mfd. fixed condenser. The other side of the condenser should be connected to one side of the first loudspeaker.

This may be either the primary of the transformer of a moving-coil loudspeaker, or the winding of any ordinary balanced- armature loudspeaker.

Using Two or More
If you want only one external loudspeaker, you earth the remaining side of it. If you want to use two or more loudspeakers, you connect the blank side of the first one to the one terminal of the following loudspeaker, as shown by Fig. 2. As you will see, the remaining side of the last loudspeaker is always earthed to some convenient point.

For levelling up the volume of the external loudspeakers, you can make use of the volume controls already suggested, that is, 10,000-ohm resistances across the loudspeaker windings or transformer primaries.

Whenever the extended loudspeakers are at a considerable distance, take care to use fairly thick gauge wire. We suggest single flex, such as is used for electric-light connections.

You might note that the Fig. 2 system can just as easily be adapted for using a pair of headphones with a loudspeaker. The variable resistance across the headphones will have to be adjusted so that volume is reduced to a comfortable strength.

With these few hints in mind many of you will be able to make your own arrangements for extending the loudspeaker, or for connecting up a loudspeaker in addition to those already in the set.

It is sometimes not fully realised how much more useful a set can be made by such an extension.

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W. D. 80: Economy Type ($1.00 P. O.).

MS. 90: Conventer Type ($1.00 P. O.).

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Mains Operated.

Two-valve, 1 blueprint, 1 each.

P.W. 70: Conventer Type ($1.00 P. O.).

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Mains Chokes

In the 'Wireless Encyclopaedia' you describe a cure for H.F. interference via the mains. I have two Eddystone Screened All-wave Chokes but I have been told that these chokes will not do. If this is so will you please inform me what chokes to use? — J. H. W. (Nottingham).

The chokes you mention are intended for ordinary anode circuits, whereas the mains should carry the total mains current. The receiver, and this will, of course, be greatly in excess of 10 mA. The chokes referred to for the elimination of interference on the mains will carry the total mains current of the receiver, and this will, of course, be greatly in excess of 10 mA. Furthermore, there is some doubt concerning the efficiency of the choke. They are employed, and these usually consist of a single layer of heavy-gauge wire, on a large diameter former. They should be enclosed in a non-metallic box so that there is no risk of a short-circuit of the mains taking place. If you wish to wind your own chokes for this purpose we suggest a 2in. diameter paxolin former, and a winding of 100 or 150 turns of No. 22 D.C.G. wire.

Class ABI

I have seen a circuit in which it is stated that Class ABI amplification is employed. I know that Class A is ordinary push-pull, and that Class B is a special arrangement with a fluctuating anode current, but I regret that I have not seen a description of the combination AB with the figure 1. Could you explain, briefly, what the arrangement is and its advantages or recommend an article which is devoted entirely to the subject? — B. R. (Norwich).

Class Substitute

I have started to build a set to a published design, but the specification included an aluminium chassis. I cannot get this and I also find that aluminium is scarce and I cannot get any copper either. Is it essential to adhere to the specification in this respect, or could I use ordinary wood? — P. R. O. (N.I.).

In many cases the metal chassis is mainly for rigidity, although it provides at the same time a measure of screening. If you cannot get the type of chassis you may use instead, and used screens for coils and chokes or other unscreened components which are placed on opposite sides of the chassis, it may be possible to obtain just as good results with an ordinary wooden chassis. Careful attention must, however, be paid to the particular layout and design.

Poor Selectivity

I wanted to make up a small one-valve for the Home Service broadcasts and had sufficient material all except the coil. I wound this fril from scrap material, using a glass former (old lamp chimney cut down) and 50 turns for the coil with a .0005 mfd. condenser. I have a Pressland selector in the aerial lead, but the Home Service station is all over the dial and no movement of the condenser makes the slightest difference to the dial. There is a drawback in that the signal voltage is developed across the coupling condenser and the grid leak, whilst the variable condenser is cut off for the next valve only across the grid leak. Thus, there is a loss of voltage across the condenser. There are a number of factors such as the self-capacitance of the resistors, etc., and provided that a properly-designed and really good transformer is used, it will give just as good results as the ordinary coupling. A poor transformer will not, however, give the quality of a poor resistance-capacity coupling.

Condenser Marking

It is stated that you must have a small condenser which is marked with the letters pfd., and I should be glad if you could give me an idea what this rating is. I have not been in wireless work for long and would like to know. — T. F. (Lowestoft).

The rating is the same as mfd.—microfarads. One pfd., or one mfd., is equal to .000001 mfd. There is, presumably, a figure in front of the letters mentioned, and you should therefore be able to ascertain the normal rating. Generally, 100 pfd., or 0.1 mfd., the pfd., or mfd., is not often used today, but the mfd. value being more common.

Replies in Brief

C. J. R. (Norwich). Unfortunately the effect is due to the origin of which we can give no explanation. There is no error, and the conditions have been submitted by an equal number of observers and are beyond the control of the B.B.C.

G. W. (Bolton). You can use the speaker with the set in question. Obviously, however, all stations will not have been asked for good loud results on the side.

H. S. (Droylsden). You may only recommend that you communicate with the makers of the set and request a replacement. The set may be in need of adjustment.

A. M. J. (Bolton). The I.F. Radio Company, 22 Holland Street, Fulham Road (Kingsway, London, W. 8), publish a series of suggestions for the improvement of aerial systems. G. G. (Inverness). Washington for the price of £1 curr. (as mentioned). We understand that this is still available. M. W. S. (Glasgow). The set in question was not delivered in this country, and we cannot therefore supply a blueprint. The paper in question is no longer on the market.

W. T. (Edinburgh). We have not tried the particular unit mentioned, but we understand that it provides a good signal and that it should be quite a satisfactory one to many standard sets. Unfortunately, we do not have a copy of your set which was described in a paper not now on the market but we cannot advise you for sure on this point.

A. M. G. (Paisley). We have given simple details but not in a way compatible with the format mentioned. We have described a simple valve main short-wave set—"Experimental," ARS 4/5. The output of the amplifier should be approximately 9 watts.

R. N. S. (Worthing). Good examples of 2s. 6d. would be preferable if you can get them. Of course, the rubber-covered or the same wire right through if possible. Any lines should be shielded. A piece of earth is indubitably desirable. The third and final suggestion is quite OK.

B. R. (Northallerton). The small condenser is merely a trimmer to balance out any stray capacities introduced in the wiring. C. M. (Hinckley). The coil costs 6d. ed. the transformer 2s. 6d.

G. T. (Neville). We engaged a longer resistance, about 100 ohms. The condenser should be 1 mfd.

T. E. G. (Bichley). A better transformer is recommended, such as for A. B. There is no ratio higher than 0.1. The output is quite satisfactory.

M. A. (Perth). The two of the valves are obsolete, but you may not have these if they are still giving good performance still they will not be of much value and will be useful in replacing them when they fail.

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

A very important point connected with the A.C. type of receiver is the ham given by manufacturers to leads carrying a heater supply, which is true of A.C. Receivers. In some cases it has been found that the ham may be removed by bringing certain of the A.C. leads close to each other, so that the fields interact and thereby cancel each other out. This is similar to the idea of using inductors in parallel to reduce the series impedance of the parallel impedance of the circuit. We have seen a receiver, however, in which the A.C. leads were of ordinary solid tin-covered copper, run through insulated sleeving and laid perfectly parallel throughout the set, and no ham of any kind could be heard.

It is recommended, however, that twisted leads be employed for the utmost reliability.

Mains Input

A FURTHER point in connection with A.C. mains receivers concerns the maximum input voltage rating. Where the exact mains voltage is not marked on the transmitter it is generally recommended to use the next lowest marking. It should be remembered that the H.T. winding is approximately 1 to 1 ratio with the input side, so that any variation in the mains input voltage will give a corresponding variation in the H.T. voltage. The heaters, however, due to the step-down ratio will not be so widely affected.

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