INTERMITTENT FAULTS— See Page 230

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Edited by F. J. CAMM

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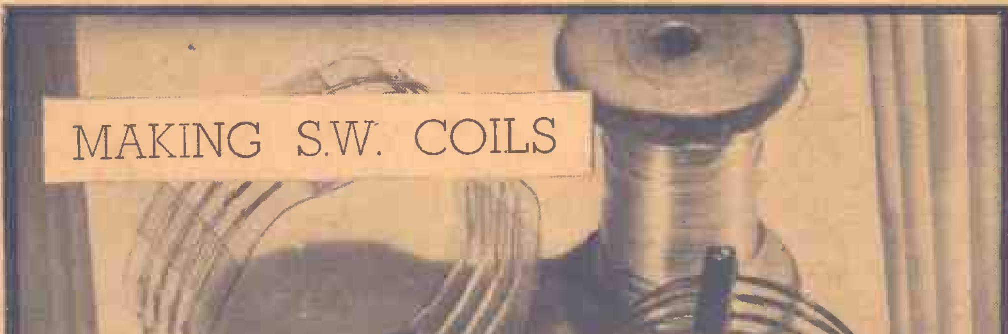
Practical Wireless and PRACTICAL TELEVISION

4D. EVERY WEDNESDAY

June 1st, 1940.



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Practical and Wireless
★ PRACTICAL TELEVISION ★

EVERY WEDNESDAY
Vol. XVI. No. 402. June 1st, 1940.

EDITED BY
F. J. CAMM

Staff:
W. J. DELANEY, FRANK PRESTON,
H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Coil Making

THERE is little doubt that one of the branches of radio component construction which offers the most interest for the home constructor is that of coil winding. There are many different arrangements which may be adopted, and the various articles which we have published in the past on the subject have always created considerable interest. Although medium- and long-wave coils of the unscreened or screened types may be constructed and offer several interesting types of design, the short-wave coils are probably more interesting owing to the fact that they need only a few turns of wire, and may be made in so many different styles. A few are illustrated on our cover this week, and in our Short-wave Section we give some details of one or two novel lines of construction. As most short-wave receivers utilise plug-in coils, it is a simple matter to wind a new type of coil and substitute it for one in use and thereby ascertain the differences in the coils. This is not so simple with medium- or long-wave coils and thus the short-wave experimenter undoubtedly finds coil-making one of his stand-by sources of experiment.

Choral Half-hour

SIR HUGH ROBERTON will bring the Glasgow Orpheus Choir to a B.B.C. studio on June 1st for a concert which will be typical of this famous choir's repertoire. The programme will include the Scottish Psalm tune "Crimond," arranged by the conductor, "My love's an arbutus," arranged by Stanford, and the famous "Hiawatha's Farewell," by Coleridge-Taylor.

"Gulliver's Travels"

AFTER having borne the strain of producing the radio version of "Pinnochio," it must have been a great relief to Gordon Crier, B.B.C. producer, when he discovered that the revival of "Gulliver's Travels" on June 3rd would be a recording of the original show broadcast last January. Of all radio tasks, none can be more harassing than that of the producer responsible for the adaptation of film musicals, particularly of full-length Disney or Fleischer creations. Preparations continue for many weeks, until the final hustle of the last few days of rehearsal, when, as often happens, part of the work of many days has to be altered at fever heat in as many hours, in order to fit in some other angle, discovered during the actual work with the cast and orchestra. But whether it be a recording or a live transmission, "Gulliver's Travels" should prove most welcome to listeners. Many more listeners will now have had an opportunity of seeing the film, since it has been generally released, and they may like to be reminded of its colour and comedy, and to hear again the lovely musical score.

FOURPENCE A WEEK

With much regret we announce an increase in the price of this journal to 4d. as from this issue. The very heavy increase in the cost of paper, which forms such an important part in our economics, as well as rising costs in other directions, have made the step unavoidable if the service to readers is to be maintained. The alternative of a reduction in the number of pages would have meant both the sacrifice of several features for which the journal is valued by its readers, and the loss of the services of our specialist writers whose contributions form such an important part of our work. We prefer to maintain our service and our features, knowing that our readers would endorse our decision. We feel sure that we can rely upon their loyalty and understanding in our difficulties.

We are doing our utmost to maintain during the war the high standard which has attracted this loyal readership, and made "Practical Wireless" the only weekly technical journal. We have an important part to play in the National war effort in helping to train men for the various radio branches of the Services, and we are gratified to know that many thousands of our readers are now placing their technical knowledge at the service of the country.

—THE EDITOR

Film Festival

WHEN the present series of "Monday Night at Eight" programmes finishes, Douglas Moodie will produce a series of revived screen successes with the general title of "Film Festival." Listeners are to hear the new series each Monday. The first will be "Alexander's Ragtime Band" (a fortnight after "Monday Night at Eight" comes to an end), and others will include "The Love Parade," "Shall We Dance?" and "One Night of Love."

In addition to revivals, it is hoped to give listeners a radio version of Shirley Temple's latest film, "The Blue Bird," an adaptation of Maurice Maeterlinck's play.

Jutland

ON the eve of the twenty-fourth anniversary of the Battle of Jutland, a feature devised and arranged by "Taffrail" (Captain Taprell Dorling, D.S.O., R.N.), and produced some years ago, is to be revived. "Taffrail" compiled the feature, which will be produced by John Cheatle, from his own writings, official records and from the works of Mr. Winston Churchill, Sir Julian Corbett, H. W. Fawcett, and G. W. W. Hooper, Commander George Von Hase, who was first Gunnery Officer of the Battle Cruiser *Derfflinger*, Shane Leslie and Captain A. W. Agar, V.C., D.S.O., R.N. The programme is particularly dramatic because, despite the fact that there are no scenes built up in drama form, some really graphic effects are obtained by straight quotations of signals sent out both before and during the greatest sea battle of the last war.

Joe Loss and His Band

NO fewer than nine broadcasts of dance music will be given by Joe Loss in the week beginning May 26th. The Loss band, which is one of the most popular on the air, has been carrying out a successful tour of the provinces and has broken several house records. It is probably the only touring dance band that goes on the stage to play dance music pure and simple, relying solely on musical appeal.

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

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

INTERMITTENT FAULTS—1

Why They Occur, and How to Locate Them. By "SERVICE"

THE intermittent fault is one of the most exasperating and can be one of the most costly of all troubles to which the modern radio receiver is heir. The hours of time spent waiting for the symptom to exhibit itself are equalled only by the wearisome search for the elusive source of the trouble. Many times it seems that the search is ended, only for it to be found that a general movement of the chassis has temporarily rectified the trouble, and that the locality of the fault is elsewhere from that inspected.

Types of Faults

There are several types of intermittent faults, which may be summarised as follows:

- Intermittent cessation of signals.
- Intermittent drop in volume.
- Intermittent distortion.
- Intermittent instability.
- Intermittent noise.

Despite the difference in the symptoms the causes of the various troubles may often be very similar. Although radio receivers function in accordance with electrical laws, most of the above troubles have their origin in mechanical causes. Long experience and analysis of service engineers' reports provide the following list of typical examples of causes of intermittent faults:

- Broken connections and "dry" soldered joints.
- Intermittent earthing of H.F. screens, valve shields, etc.
- Oxydised tags or wires beneath terminals.
- Connections to the internal elements of components faulty inside the component.
- Breaks in the winding of transformers, chokes, etc.

Any of the above can, of course, create a complete breakdown of a receiver, but it is the extent of the fault that determines whether the failure will be permanent or intermittent. For example, a break may occur in the primary windings of an output transformer, but if the wire has a cotton or silk insulation, the latter may keep the ends of the break together so that no cessation of reproduction occurs. With enamelled wires, wax impregnation can also cause this state of affairs. So long as no external movement displaces the ends of the wire, reception will be normal, but the slightest change in the physical disposition of the adjacent surfaces of the break will provoke noise and intermittent reception; but a further movement can just as easily bring the ends together again in their original position so that reception is once more normal.

Vibration and Current Surges

It requires but the slightest vibration to cause such faults to occur—passing traffic or a footfall on a carpeted floor. Loud reproduction from the loudspeaker can also cause the fault to appear, as can sudden surges of current through the coils. Because of this, it is often very difficult to find the seat of the trouble, as the slightest movement of the chassis when carrying out investigations will affect the fault and so give rise to erratic results.

Where a fair amount of repair work is in progress, the investigations into intermittent faults can waste a great deal of time—time that cannot be charged to the job without customer's dissatisfaction, as many service engineers will appreciate. After all, the customer's reaction can be well understood. When a bill for several hours' work is presented it is quite understandable for the customer to inquire as to just what was wrong with his receiver, and on being told that there was a partially-broken lead inside an I.F. transformer he will probably think that he is being grossly overcharged.

It is not fair that the service engineer should cut his charges, but on the other hand he doesn't want any dissatisfied clients. The solution is to reduce the time spent on the job and not to leave other more remunerative work while waiting for the intermittent fault to appear. This may be accomplished by employing a monitoring device that can be connected to the receiver undergoing a "soak" test, and which will give a warning when the output ceases or falls below a pre-determined level. This enables other work to be carried out in the meantime so that "waiting time" need not be charged to the job.

The E.M.I. Service Intermittent Fault Test Device.

E.M.I. Fault Test Device

Such an instrument is the E.M.I. Service Intermittent Fault Test Device which enables receivers with "on/off" intermittents to be soak-tested in silence. No aerial is required, nor does the normal service oscillator have to remain out of commission to provide a signal input to the receiver under test. It contains its own alarm device which by audible and visual means immediately proclaims the fact that the receiver has failed or has sustained a serious drop in volume of output.

The instrument is divided into three separate circuits to which three faulty receivers can be connected.

The test signal originates in a multi-vibrator circuit which provides, by means of harmonics, a signal frequency ranging continuously and simultaneously from 600 cycles per second to 1.5 megacycles. The output from the instrument is normally injected into the aerial circuit of the receiver, but may, if desired, be applied at other points. The output from the receiver which is being checked is fed back into the Intermittent Fault Test Device via an attenuator from whence the signal is presented to a valve and relay combination which indicates by means of green and red warning lamps, whether or not the receiver is operating normally. A bell is also incorporated so that audible warning may be given whenever the red light is showing, but the bell may be cut out of circuit when desired by means of a switch provided on the control panel.

Three Testing Channels

The fact that the three channels in the Intermittent Fault Test Device are independent of each other and due also to the wide frequency band of the testing signal, the channels may be used for three entirely different purposes simultaneously. For example, one channel may be used for a battery model tuned to the medium-wave band; a second channel may be used to provide a signal to an A.C. receiver which exhibits intermittent fading on its short-wave band, while the third channel may be used to provide a signal for the general repair of a chassis.

This is very useful, as once the fault has shown up, the circuit may be checked in section by connecting the H.F. input to various points. For example, the signal may be applied across the I.F.'s, thus eliminating the H.F. oscillator section of the receiver, and then to the gram. sockets, thus eliminating the I.F. circuits; in other words, the connections may be moved stage by stage throughout the receiver until the section containing the fault is located. Naturally, during the progressive testing of the receiver the attenuator setting will have to be altered at each change of position to allow for the difference in gain introduced by the move.

(To be continued.)

Ideas for Experimenters

Negative Feed-back Methods : Frame Aerials for Small Portables : Coil-winding Positioning : Simple Output Meter : Flexible Chassis Mounting : L.T. for "All-dry" Valves

by The Experimenters

NEGATIVE feed-back has been very much to the fore recently, but there are apparently many readers who have not yet tried it. There is seldom any difficulty in modifying an existing set to accommodate the system, and one very simple method is to connect a .5-megohm fixed resistor in series with a .1-mfd. fixed condenser between the anode of the output valve and the cathode of the valve which precedes it. The values given are not very critical, and in the absence of direct instructions in valve manufacturers' literature it may be found worth while to experiment with one or two different condensers in conjunction with a 1-megohm variable resistor.

Variable Control

The question of negative feed-back brings to mind a suggestion made by a reader who employed it in a quality amplifier. He used a .1-mfd. condenser, but wired that in series with both a 200,000-ohm fixed resistor and a .25-megohm variable resistor, the end of this being connected to the anode, as shown in Fig. 1. The variable component allowed him to experiment to find the degree of feed-back which produced the best results. In addition, he used a 25 mfd. electrolytic condenser which was brought into circuit by means of an on-off switch ganged with the variable resistor. Thus, when the variable control is set to its minimum position the switch contacts were closed, with the result that the large electrolytic had virtually the effect of short-circuiting the feed-back supply. This reader (Mr. O'Loughlin, of Oldham) assures us that the arrangement has proved very satisfactory. It is an idea that other readers may wish to try.

Portable-set Aerials

Portable sets are very popular just now, and there are probably many experimenters who are working out designs for new ones. When using a simple "straight" circuit, a throw-out aerial is often almost essential for good results, although a built-in frame is more convenient. The best arrangement is to fit a frame aerial in the set and make provision for a throw-out one in addition; all that is needed is a couple of turns wound round the frame and taken to aerial and earth sockets. The earth socket should also be connected to the common negative, of course.

Frame aerials present some difficulty when the portable is to be of very compact design, and a method employed by one well-known set maker is worth trying. In this case the aerial is made flat in the vertical plane, and therefore it occupies a negligible amount of space. The aerial may be wound on a simple framework—the lid of a box will serve—and the wire should then be liberally treated with wax or shellac varnish. After that has set, the supporting frame is removed and the wire removed. The corners are then bent over, as shown in Fig. 2. A frame of this kind can be mounted in the carrying case or on the receiver chassis by means of four strips of wood or fibre placed across the corners, as indicated in Fig. 2.

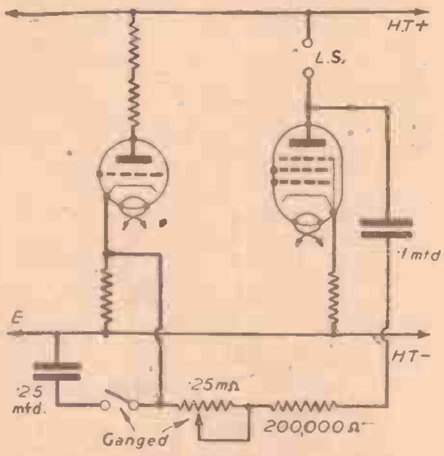


Fig. 1.—A negative feed-back arrangement where control of feed-back is provided by a variable resistor. A ganged switch is used to cut out the negative feed-back when desired.

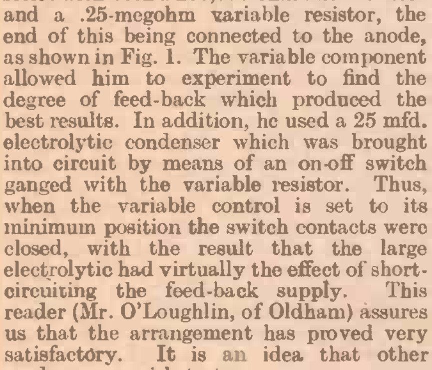


Fig. 2.—A compact frame aerial may be made by winding the wire on a temporary former and then flattening the corners.

Supporting the Wire

The wire used should be d.c.c., so that the covering will absorb a certain amount of the "dope." A simplified method of making a frame aerial of this kind, which we have found convenient, is to place a strip of thin paper round the former first, wind on the wire, treat both paper and wire with wax or shellac and then turn the edges of the paper over the wire. The whole assembly sets fairly stiff, so that the corners can be bent with little fear of the turns coming apart.

When making a frame for medium waves only wire of about 22 gauge may be used, but a lighter gauge is required for the long-wave winding. By following our suggestion, however, it is possible to use 28-gauge wire without the winding being too delicate to handle. We favour the method of using two separate windings and bringing each into circuit by means of a change-over wave-change switch, the centre terminal of which is connected to the tuning condenser and to the grid of the first valve. This is a popular method of wave-changing with multi-range coils (and even with some two-range tuners) and generally proves better than placing the windings in series. As most readers will remember, about 75ft. of wire is required for a medium-wave frame and about 220ft. for long waves.

Coil-winding

The above reference to coils and tuning circuits brings to mind a question often put to us by experimenters and constructors in connection with the arrangement of coil windings. They ask whether there is any advantage or disadvantage in the two alternative methods of placing the reaction or aerial winding on a small former inside the main one, or between the windings on a single former. We have never found any difference, provided that the basic design is correct. In either case the essential is to have suitable coupling between the windings. By making a few experiments it is easy enough to find the best position of, say, a reaction winding placed between medium- and long-wave tuning windings. But there may be some difficulty if a coupled aerial winding were to be used in addition.

In that case it would generally prove better to place either the reaction or aerial winding on a smaller-diameter former which would be mounted inside the main tube. This actually provides a very convenient method of finding the optimum position since the inner former can be moved up and down in order to vary the relative coupling with the two tuned windings. After the best position has been found, the inner former can be fixed, either by wedging it by means of a couple of rubber bands fitting round it or by passing screws through both formers.

Simple Output Meter

An output meter is often useful when experimenting with a fairly powerful amplifier or receiver, and one of simple type which we recently fitted to an experimental set might be of interest. We simply made use of an old triode valve and a milliammeter reading up to 2 mA, as shown in Fig. 3. It will be seen that the grid and anode of the valve were strapped together, so that the valve acted as a half-wave rectifier.

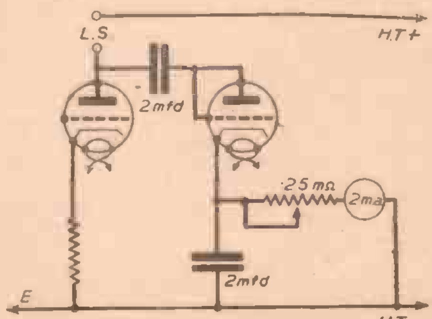


Fig. 3.—A simple output meter, for which an old triode is used as rectifier.

Comment, Chat and Criticism

Musical History–2

Further Notes on the Evolution and Progress of Music by Our Music Critic, MAURICE REEVE

IT is not surprising that the rise of Christianity, coupled with the ever-growing elaboration of its services, led to an increase in the study of music, and its possibilities. But side by side with this went a narrowing of its character and influence, and it is amongst the minstrels of England, the troubadours of France and the minnesingers of Germany that we have to look to find the birth of modern secular music, harmony and rhythm. Whilst the English minstrel used chiefly to play an instrument, his French compatriot would sing his melodies, and compose verses to them as well. These wandering and itinerant musicians gained lasting fame, and many of their songs are still extant. We know of them best, perhaps, from such characters as the great French poet and troubadour, François Villon, born 1421, and the fictitious but historically accurate Jack Point, the "Wandering Minstrel," in the Gilbert and Sullivan opera, "The Yeoman of the Guard."

The Canon

The fifteenth century saw striking developments in music, due primarily to the advance in counterpoint made by many notable Dutch musicians. Many of these men sang in the choir of St. Peter's, Rome, so, coupled with the purity of their style of writing, we can conclude that the Roman Catholic service exercised a great influence on them as on music generally. A favourite form, which has never lost its popularity, was the canon, a Greek term meaning a rule, a form of imitation where a melody commenced by one voice is imitated by the other voices at specified intervals. "Three Blind Mice" may readily occur to the mind as a suitable, if somewhat frivolous, example. Music was still purely vocal, with the instruments performing the sole function of acting as accompanists. The favourite of these was the lute, but the organ, which was first given pedals in about 1450, is often mentioned. The clavichord, the forerunner of the modern pianoforte, and known then as monochord, first saw the light of day. It is first mentioned in 1405 as the instrument of table shape, oblong, and of four to five feet long, and about two in breadth.

We have arrived at the point when we can, with reasonable accuracy, imagine the world of music for the first time. It was written in the modes already mentioned, or rather, those of them which met with the approval of the Church. The type of music was the single melodic line or voice, which was of two varieties: the "authentic," which extended between two keynotes—an octave—and touched both extremes in its course; and the "plague," which, though still of only one octave in compass, cut across the keynote, which fell somewhere in the middle of the tune. For accompaniment there was the organ, and choirs of men and boys.

Schools of Composition

Schools of composition now began to appear and develop, the first three being English, Franco-Flemish and Italian. John Dunstable was the founder of the English, and is one of the most notable names in musical history. Two of his pupils, Dufay and Binchois, were leading lights in France and the Netherlands, whilst Italian music culminated in the great name of Palestrina. English music owes much to Royal patronage, and both Henry the Eighth and Elizabeth were musicians of eminence. Queen Elizabeth's influence, as was the case in the many branches of the public life which she patronised, cannot be exaggerated. One of the many musicians, whose employment at the Chapels Royal gave them the security without which they could not have worked on their subject, was John Merbecke, who died in 1585, many of whose settings, including the Nicene Creed and Gloria in Excelsis, are in wide use to-day. Thomas Tallis, 1520-1583, and William Byrd, 1538-1623, were two others among many important musicians of the great Queen's reign. But the greatest name in music at this time was Palestrina, 1525-1594. The music of the Roman Church had fallen into such bad repute that Palestrina was specially commissioned by the Council of Trent, in 1562, completely to reorganise it, and to write new music for its services which should be a pattern for future ages. To what degree he succeeded is far beyond the scope of this brief sketch.

Development of Counterpoint

An important influence in the development of counterpoint, as of music generally, was the rise of the madrigal, during this same period and the early seventeenth century. The word is variously attributed to the Italian word *madre*—mother—implying a piece of poetry addressed to the Virgin Mary, and to the Spanish town of the same name. Musically it is a work of a light pastoral or amorous character, but contrapuntal, i.e., with constant counterpoint, and intended to be sung by a chorus of voices in three or more parts without the aid of instruments. A phrase of music begun in one part is quickly though freely imitated in the other parts. Amongst many excellent madrigalists, the greatest and, indeed, one of the greatest names in English music, was Orlando Gibbons, 1583-1625, whose anthem "Hosanna to the Son of David," and madrigal, "The Silver Swan," are immortal.

The clavichord was superseded by the spinet, which was played with a "jack" or quill. Many fine Italian specimens are in the South Kensington Museum. There was also the Virginal—Queen Elizabeth's favourite instrument—the precursor of the harpsichord. Whilst the clavichord was capable of making expression, being responsive to the performer's "touch," the spinet and virginal were much louder, but totally expressionless instruments. This century is also renowned for the rise of orchestral music, and the viol family of instruments first comes into use. Three celebrated books of this period were the "Triumph of Oriana" (chief contributor Morley), a celebrated collection of madrigals, the so-called "Queen Elizabeth's Virginal Book" (chief contributor Byrd), and the "Parthenia," a collection of virginal music by Bull, Byrd and Gibbons.

Harmony

Harmony was gradually released from the restriction of the old modes, though the Dorian remained a favourite. When the seventh was raised to form a leading note we had our modern minor scale. Musica Facta first gave rules for the introduction of accidentals in the modes to avoid tritones, and to form cadences. By this means the Lydian, beginning on F, and with a flat to the B, is the same as our F major scale. From 1450 harmony made rapid progress, passing notes and suspensions being employed though the dominant seventh did not yet receive modern treatment.

This very brief and rapid sketch of the rise and development of music now arrives at perhaps the most important and far-reaching stage in its progress. The commencement of the seventeenth century saw the definite establishment of our modern major and minor scales, with their fixed succession of notes, and their marvellous and astonishing adaptability to emotional and picturesque expression. This had momentous consequences. The contrapuntal design was to be eclipsed and superseded by the monodic. Hitherto, music had been written almost exclusively in many parts or voices, all equal in importance, and moving along to set rules. In the search for a more suitable way of setting words to music and the avoiding of their almost complete subservience, we may say that "melody" was invented—hence the term "monodic," or the writing of one part, usually in the treble and apart from the others, with the remainder of the voices less important musically, and subordinate to the melody. We would call it melody with accompaniment.

Opera, Symphony and Song

Although counterpoint was to develop into complexities, and to reach heights never dreamed of at that time, and to remain with us always, it was to become interwoven with, and an integral part of, harmony, and not the sole means of musical thought and expression, as hitherto. This revolution in music rendered possible everything that we have to-day. Opera, symphony and song in their modern form date from the time when the words both of the church service, or of the wandering minstrel and troubadour, were given a line of music capable of adequately expressing their spirit and meaning.

ON YOUR WAVELENGTH

By Thermion

Roll of Merit

I HAVE received so many letters from readers now in the Army, Navy, or Air Force—many, I am glad to note, serving as radio mechanics or operatives—that I feel the time has come to publish each week a roll of merit. I therefore invite all of my readers on active service to write to me giving their name and their home address, and I shall then publish an alphabetical list each week. If you who read these notes are on active service, please write to me giving these particulars. It does not matter what branch of the service you are in—the Artillery, Aircraft Mechanic, Pilot, Radio Operator, Seaman, Royal Army Medical Corps, I shall publish your name if you write to me. It is right that this journal should set on record the fact that it has helped in the National War Effort. I am gratified to receive letters from readers who pay high tribute to the service this journal has rendered in helping them to obtain posts in the Services. I hope to be able to publish a column of names each week.

That Wonderful Ray

NOW that the war is in full swing—at the moment of writing it is about ten days old—what has happened to those marvellous rays which were going to stop aircraft, motor-cars and tanks, and petrify the human race? What a powerful weapon it would be if we could discover such a ray. It would make war even more hideous, even though it may be a little more merciful than poison gas. There is not the slightest possibility, however, of such a ray ever being discovered. The war has given, I hope, the final quietus to the amiable cranks who drool their time away dreaming of death-rays.

Reserve all Technicians

THIS war will not be won by masses of men, but by masses of tanks and aircraft. I therefore suggest to the Government that every technician whose services can be utilised in the manufacture of raw material should be reserved. Wireless, of course, comes under that heading. In the last war the military authorities had supreme power over the population, and could call whom they chose to the colours. We had the fantastic situation of recruiting officers—usually trained soldiers who would have been more useful at the front instead of doing a clerical job at home—visiting munition factories and handing out calling-up papers to all those whom they thought were not doing skilled work. The result is well known. There was a shortage of munitions. Some men were replaced by women, and the Government at the time was so ignorant of technical matters that they thought that women could immediately perform skilled work. They produced more scrap in a week than the average workman in the whole of his career. Lloyd George became Minister of Munitions, and fetched the skilled men back from the front. From that moment we began to win the war. We are making the same mistake in the present war. I suggest that the military should have no power over those engaged in factories employed in the manufacture of armaments. Many thousands of skilled wireless technicians have been called to the colours, and we have the anomaly of frequent appeals for those with wireless knowledge when such men are already in the Army as privates.

There must be some straight and clear thinking during the present war. Man power must be used to the best advantage. An engineer best serves his country at his post and not shouldering a rifle. A thousand tanks are worth more than a hundred thousand men. Wireless communication is a most important part of modern warfare. Let us keep our technicians where they are performing work in the best national interests.

Price Control of Radio Sets

AS from June 10th, wireless sets, radio gramophones and gramophones, and accessories and component parts for them, as well as gramophone records, will be price controlled under the Prices of Goods Act. This means that it will be illegal to sell these at higher prices than prevailed on August 21st last year, plus any justifiable war-time increase.

This may cause certain set manufacturers to revise their prices. Let us compare one or two of them. Last July a certain receiver was placed on the market at 19 guineas. It is now £27 6s., an increase of 7 guineas. Another launched at the same time at £29 8s. now costs £35 14s., an increase of 6 guineas. Can these increases be justified?

The Club Movement Expands

I OBSERVE with pleasure that the club movement continues to expand in spite of the war. A number of new clubs have been formed, and many of them seem to be healthy. I have also noted with some apprehension the formation of a number of so-called correspondence clubs. Many of them are founded by individuals who appoint themselves more or less as proprietors of the club. The officers are not elected by vote. They do not hold annual general meetings. They do not produce balance sheets. They are not run on democratic lines. It is always impossible to find out the position of such clubs. As every member of a club is individually and severally responsible for its financial position, which means that any member could be sued for a liability, it is somewhat surprising that such clubs have any members at all. They are usually run for profit, and as such should be avoided like the plague. A properly run club would have its officers elected annually. It should hold regularly weekly or monthly meetings. It should have independant auditors, and it should not be run for profit. Beware of the club which has a self-appointed proprietor. You cannot be unaware of the personal investigation which I conducted into the affairs of a certain club not so long ago. This club had a high-sounding title which might lead the unsuspecting to believe that it was a national organisation. Its benefits were of the airy character—free technical advice, list of correspondents, etc. Usually such clubs have something to sell, and also usually at a fabulous price. Consult me before you join any such club and part with your shekels.

Stamped Envelope, Please

WILL readers please note that it is essential for them to enclose a stamped addressed envelope when a postal reply is desired. It is also essential to enclose the query coupon cut from the current issue. We cannot answer questions sent in by non-readers, nor can we reply by post to those who do not send a stamped addressed envelope. The increase in postage rates makes it imperative for us to enforce this rule.

Pool of Pilots and Air Crews

WITH the object of providing personnel for the further expansion of the R.A.F., a pool of volunteers is rapidly being formed. All elegible young men now have an opportunity of serving their country in the air.

Arrangements have been made to speed up the work of the Selection and Medical Boards, and so to secure a large reserve of R.A.F. personnel. Applications will now be considered from men between the ages of 18 and 28 for training as pilots, and from men between 18 and 32 for training as observers, wireless operators and air-gunners.

All men between these ages, who are medically fit and have received schooling up to the age of 16 are eligible, *so long as they have not yet attested in one of the other Services.*

Applications should be made in the first instance to the nearest recruiting centre. Suitable candidates will be interviewed and medically examined as soon as possible, and, if approved, be attested. They will then be in the reserve pool of the R.A.F. and be assessed for training in one of the three branches of air-crew duties.

Men who apply are advised not to relinquish their civil employment until they are actually called up for training.

For the Beginner

RANGE AND REALISM

Why a Good Frequency Response is Essential for "Quality" Reproduction and to Preserve Instrumental Characteristics

ZOOMP! Zoomp! Zoomp! goes the double-string bass. Zing! Zing! goes the cymbal. These are two items which are to be heard in practically any dance band, but which are hardly ever heard on the majority of broadcast receivers. You might say that you can hear the cymbal on your set, or perhaps the string bass, but whilst admitting that this may be true, do you hear them in their correct proportion compared with the remainder of the instruments? Look at Fig. 1. This is a chart which shows the range of frequencies produced by the majority of average musical instruments and voices. It will be seen that it is fairly extensive, but it gives only half the story. We do not wish to give any facts which will bore our readers, but there are certain things which must be explained if you are to understand the problem which is placed before your loudspeaker when you set it the task of reproducing the transmission which is received by your aerial.

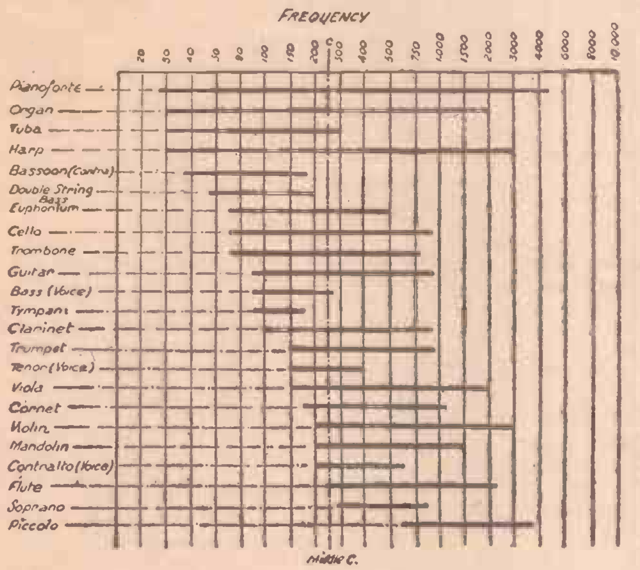


Fig. 1.—The ranges of different musical instruments and voices.

Fundamentals and Harmonics

This looks a rather formidable heading for a paragraph, but actually there is nothing at all frightening in it. The central note on a piano keyboard is known as middle C. This is a note which vibrates at a frequency of 256 per second. If, however, this same note is played by the violin it vibrates at the same frequency, yet there is a distinct difference, and it is easily possible to distinguish between the two instruments. Why is this? The note has the same period of vibration, and a string forms the note, why then should there be a difference? The answer lies in the word "harmonics." When the middle C of the piano is struck the string emits, in addition to its standard note (known as the fundamental), multiples of this frequency which you can imagine as octaves. That is to say, the real note is produced by the frequency of 256 cycles, but there is also a vibration of double this, or 512 cycles, 768 cycles, and so on, right up the scale. These multiples are termed "harmonics," and it is these, as distinct from the original vibration—or fundamental—which are responsible for the tone of the instrument, or what is known in technical language as the "timbre." The harmonics may extend as far in the audible frequency range as 20,000 per second, but—here is our first snag—the broadcasting stations of Europe are normally permitted to work with a separation of only 9,000 cycles. Our receiver must, therefore, to avoid interference between stations, be arranged with a circuit which will cut off at 9,000 cycles, and consequently no harmonics above this will be heard. What difference this can make may easily be demonstrated by carrying out the following test on your own receiver.

High-note Loss

With the average receiver all that is necessary to observe the effect of high-note loss is to turn up reaction to the limit before oscillation is reached. The quality of music suffers, but what is more noticeable is that speech becomes "woolly"; a violin sounds more like a 'cello, and similarly other instruments begin to lose their identity. A special record was once reproduced by the B.B.C. during a talk in which a violin, piano, and euphonium played the same note, and the higher frequencies were eliminated step by step until a point was reached where there was no distinction between the three instruments. So much, then, for the higher frequencies. When we come to the lower notes there is not the same need for idealism, but the rhythm section in dance bands contains the larger instruments such as double-string bass, tympani, etc. The "depth" of a band is completely lost by failure to obtain these instruments with their correct balance. Have you any old gramophone records? These were very deficient in the low notes, and you should try to obtain one and hear it on a modern gramophone. Music sounds terribly thin and lacking in life, simply because there is no response below about 200 cycles. If you can get one of these old records—preferably of a military band—and then when you have heard the effect of this, cut down the top-note response on your receiver by the reaction method, the extremes you obtain should be enough to convince you that to obtain realism it is essential that the lowest and the highest frequencies must be reproduced, and the following notes show the principal causes of lack of both of these and how the failing may be corrected or compensated for.

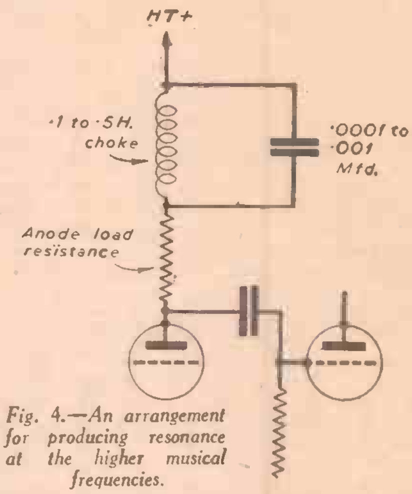


Fig. 4.—An arrangement for producing resonance at the higher musical frequencies.

Getting Bass

It is almost safe to say that, so far as the low notes are concerned, we may ignore our H.F. and detector stages and concentrate on the L.F. and output side of our receiver. We will start at the loudspeaker, as this is the weakest link in the chain. Obviously, if we are anxious to reproduce the lowest frequency transmitted by the B.B.C. we must use a moving-coil loudspeaker with a correctly designed valve. It is hopeless to expect to reproduce a thirty-cycle organ note, for instance, on a moving-iron loudspeaker; and therefore, a good moving-coil speaker and an efficient baffle are the starting-off point. The output valve should not be a pentode, if you are searching for idealism. Two super-power valves (each with an impedance not higher than 3,000 ohms) arranged in push-pull, with a correctly matched output transformer, will deal with the largest of

(Continued on page 245.)

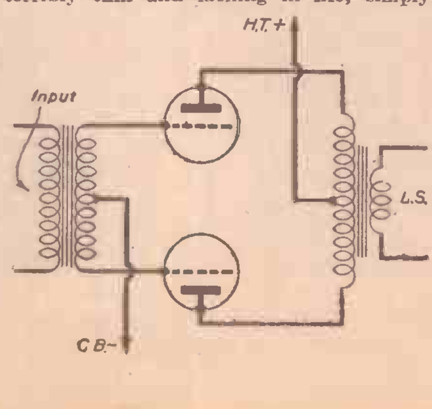


Fig. 2 (Left).—Circuit diagram for a standard push-pull output stage.

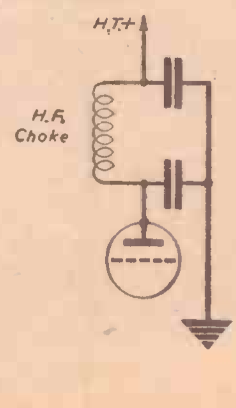


Fig. 3 (Right).—An efficient H.F. filter arrangement.

SHORT-WAVE SECTION

HOME-MADE SHORT-WAVE COILS

Some Novel Methods of Coil Construction, and Methods of Use.

By W. J. DELANEY

ALTHOUGH many constructors make their own short-wave apparatus, many do so with purchased or commercial components. It is quite true that the tuning condensers should be reliable short-wave components, but the coils offer a very interesting field for experiment and may be constructed on so

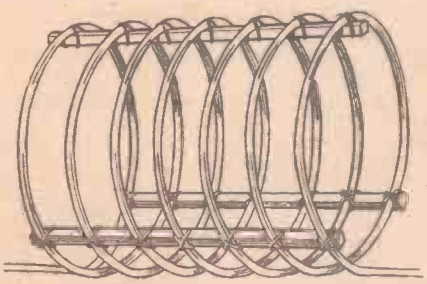


Fig. 1.—A very simple form of self-supporting coil for short-wave working.

many different lines that they offer one of the most interesting sections of constructional work. There are more variations in short-wave circuits than are met with in ordinary broadcast circuits and thus, apart from the methods of making up short-wave coils, there are additional means provided for test purposes. For wavelengths up to 100 metres it is possible to use bare wire, and this in itself affords an opportunity for connection or tapping at various places on the coil; the smaller coils, owing to the fact that the adjacent turns may be spaced, providing even further scope for novel schemes. In the simplest arrangement the coil will consist merely of a few turns of wire mounted in some way with a plug-in connector so that wavelengths may be changed. In addition to this, however, there may be a further two windings needed—one for aerial coupling and one for reaction, and it is in the disposition of these that the individual can find much of interest.

Single Coils

Dealing first with the simplest type of circuit which will be used for wavelengths up to about 50 metres, wire of fairly heavy gauge may be used, and may be made self-supporting. The usual method of winding such a coil is to obtain some fairly large diameter former of solid type, say a cylinder about 2in. to 2½in. in diameter, and to wind the wire round this with all turns touching, maintaining tension on the wire whilst it is wound. When the appropriate number of turns has been wound the wire is cut off and released, when it will spring open to a slightly larger diameter, and the turns will automatically separate themselves. Such a coil is ideal as there is no solid material in its construction to introduce losses, and the only point is that the coil will be rather fragile and must be mounted in such a way that the turns cannot move, as such movement would alter the inductance of the coil and reliable tuning could not be effected. The simplest way of locking the turns is shown in Fig. 1. Here matchsticks or thin strips of ebonite are slipped over or under the turns, and bound in position with stout thread. If you have suitable material available, a better idea is to slip strips of celluloid across the winding and anchor these to the wire with some amyl acetate or similar type of adhesive—a collodion paint, for instance.

A Better Scheme

A much more robust coil may be wound, especially for slightly higher wavelengths where a spaced coil is not needed, by using as a former one of the six-sided glass

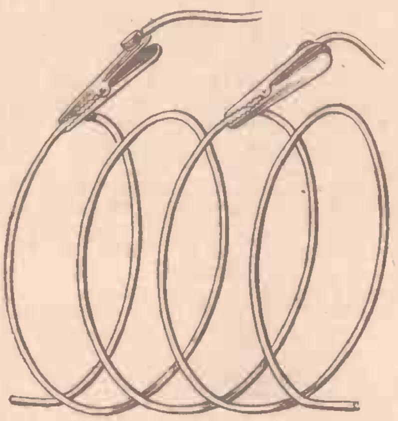


Fig. 3.—Tapping points may be obtained by means of crocodile clips.

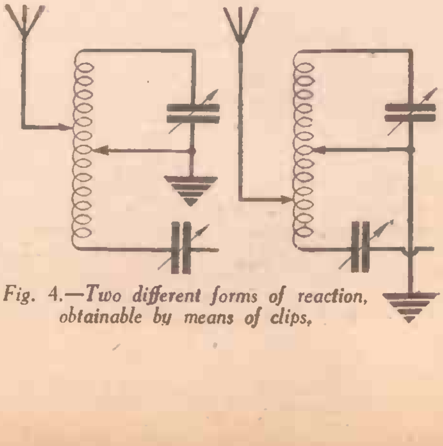


Fig. 4.—Two different forms of reaction, obtainable by means of clips.

pickle bottles. Strips of celluloid are cut and attached by their ends to the sides of the glass bottle. The wire is then wound on top of the strips, round the bottle, in the manner which the final coil will take—that is, with the required spacing between turns. When completed the ends are fixed in some temporary manner so that the coil cannot come out of position, and the collodion paint or other material is put on across the turns, making certain that it gets down to the celluloid. When thoroughly dry the coil may be removed by slipping a razor blade under the ends of the celluloid where it was attached to the bottle and then sliding off the coil. A cheaper way of making the same type of coil—provided that you have sufficient spare bottles available—is to use the adhesive parcel strip instead of celluloid, attaching this to the bottle and wrapping the coil on the sticky side after this has been moistened. When dry the bottle may be broken and the coil will remain intact.

Coil Mounts

The finished coil may be mounted on a small block of ebonite or ceramic material and a similar attachment mounted on the

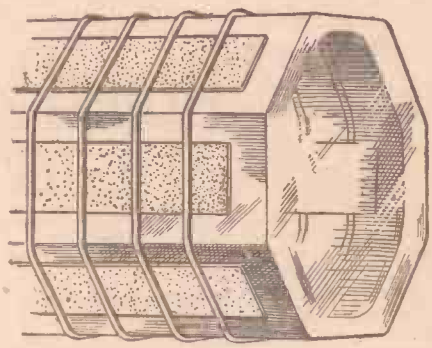


Fig. 2.—Here a solid former is used for the preliminary coil winding. It is afterwards removed.

baseboard or chassis. In the simplest scheme the aerial and earth connections may be effected by means of tapping clips, and this will enable a single coil to be wound without tapping points or joints. The complete coil will consist of the grid plus reaction windings, and the aerial will be tapped at one point and the earth at

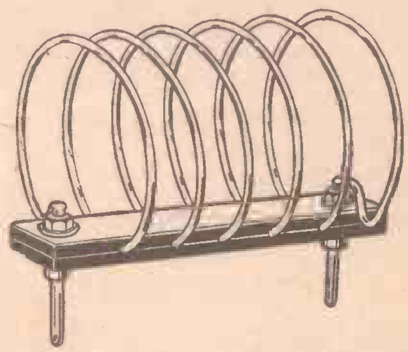


Fig. 5.—How to arrange for plugging in the coil.

another as shown in Fig. 3. This scheme permits of two types of circuit, the standard Reinartz reaction scheme or ordinary capacity reaction control, Fig. 4 indicating the two methods. Where a separate reaction or aerial coil is needed the same coil construction methods may be followed, using a separate mount for each coil unit. In this case it will be worth while making the aerial and reaction coil-holders adjustable so that the actual coupling between the

(Continued on next page)

SHORT-WAVE SECTION

(Continued from previous page)

coils may be modified. This is in addition to the reaction condenser control. It will be found that with very tight reaction coupling, adjustment of reaction will shift the tuning point, or pulling may take place as either reaction or tuning is adjusted. In the best position, however, the reaction control will be entirely independent of the tuning control. Similarly, the position of the aerial coil will affect selectivity and signal strength, and a position must be found where the desired compromise is effected. Thus a swinging adjustment will permit the setting to be made for each band or each individual tuning setting as desired.

The older form of movement resulted in the coil being swung away from the grid coil. This requires a fair amount of space as the effects are not so marked, and considerable movement has to be made in order to achieve the desired result. If, however, the coil is moved at an angle relative to the fixed coil, as shown in Fig. 6, a small movement will result in a fairly considerable modification of coupling, and thus not so much room is needed. The adjustments obviously have to be made more carefully with this type of coupling.

Switching

Where it is desired to make a coil to cover a band of wavelengths it may be necessary to introduce wavechange switching. This is not simple in the case of short-wave apparatus, owing to the losses introduced by the switches. However, it may be carried out simply and without much loss, by again adopting the clip connection scheme and short-circuiting the unwanted part of the coil, making this on the earth side. The additional capacity to earth may affect results, but this will depend upon the wavelength in use, the effect being more marked at the lower wavelengths (high frequencies). If desired tapping clips may be provided as suggested, and brought to sockets on a panel. By previous settings of the clips to cover definite bands, a separate earthing plug may be available on the panel, and selection of the appropriate band thus made without opening the receiver. This permits a cabinet to be used, and dust to be kept out of the short-wave set—and thus one form of trouble is automatically removed.

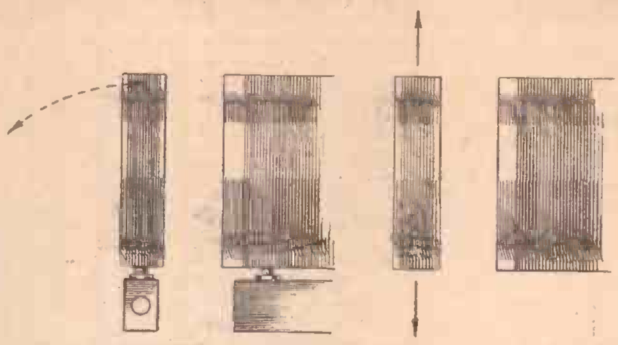


Fig 6.—Two different methods of varying a coil for reaction or aerial coupling.

The B.L.D.L. British Long-Distance Listeners' Club

Not So Good

WE hope this is not going to become a habit, but members will remember that we opened our columns in the issue of last week with disappointing news concerning the cancellation of QSL activities. This week, we have a word to say concerning the response to the proposed DX contest. Perhaps we are speaking a little too early, let's hope we are, but at the time of writing, the response of members to the suggestion that such a contest should be held is most disappointing. Had the idea been put forward without any consideration of members' requirements, such an unsatisfactory response might have been expected, but bearing in mind that we were only endeavouring to satisfy the many requests for some such activity, the disappointment becomes rather more acute.

Before the idea appeared in these columns, we had such a vast number of letters from members asking for a contest that we gave the matter our careful consideration and formulated a plan of operation. In spite of all this, it would now seem, however, that those members whose requests we have endeavoured to meet are no longer interested; therefore, unless a marked increase in the number of those willing to support the idea is apparent within the next day or two, we shall have no alternative but to drop the scheme.

We feel sure that all those genuine enthusiasts will feel much the same as we do about the lack of response, and we can only hope that some good will come of it in the form of greater active support from all members.

What We Like to Hear

ONE very definite way of keeping the activities of the club up to concert pitch is by the method we have so often advocated before, namely, the contacting of all members in individual areas, and their getting together so that they can undertake both practical and theoretical work of an interesting nature. In this direction we are quite prepared to do all we can to help those members in any one town to meet each other, and come to some mutual arrangement regarding, say, a fortnightly or monthly meeting. Such an idea, if properly developed, would add considerably to the general interest, and would eventually form the basis for inter-town or inter-county contests. One district is apparently fully alive to the possibilities of this, and we quote an extract from a letter from member 6311, to show what we mean.

"Since sending my last communication I have met several radio enthusiasts, especially short-wave listeners, in my district, so we have been able to have quite a conference, and at last I have been able to persuade them to form a local radio club. As none of these S.W.L.s were members of the B.L.D.L.C., I thought it would be better if they all joined, so that we should form, so to speak, one family with a common interest. When the club is formed, I will contact you again, and let you know of its activities, and also the results of such experiments we may undertake. I am sure there are other S.W. enthusiasts in the district, and I should like to get in touch with them, as the more we can get in the club, the better."

We would add that the member lives at 8, Hadley Road, Ketley, Wellington, Salop.

The First 500

WE are very pleased indeed to receive a most interesting letter from member 462, and we hope that it will be the forerunner of many similar letters from those members who helped to form the first 500 of the club. The member concerned is in the Services, and as he mentions, there must be a vast number of other members now in uniform; therefore, if they care to communicate with us we shall be only too pleased to hear from them. Member 462 goes on to say: "I am one of the first 500 of the B.L.D.L.C., my number being 462. I joined when the Club first started, in fact, it was 14.3.36, when I was stationed at Londonderry. I have a letter signed by the Secretary conferring the A.E.L., and as regards the new certificate that is now issued (the A.C.R.), what does one have to do? Although I have not sent away for QSL cards I still have a comprehensive log."

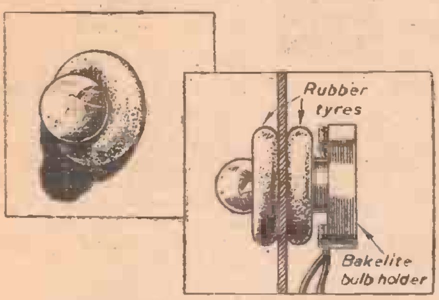
"Now, as regards the DX Contest, I have a few remarks to make. What about our Service members? They have not long for listening, and the zone you mention, Australasia, well, we don't have time to listen for stations in that area. Supposing, for example, we are only able to listen from 7 until 10 p.m., we don't stand much chance, but still, I will give the contest all the support I can, should I still be in England at that time. Something that I am not sure about, and I suppose other members of the C.W. listening class are the same, is do C.W. stations count? If a suggestion would not be out of place I suggest that the listening periods are from 20.00 hours to 22.00 hours from Monday to Friday evenings, and then from say, 15.00 hours to 21.30 hours on Saturdays, and almost unlimited time on Sundays. Restrict the bands to 13, 16, 19, 25, 31, and 49 metres, and if amateurs are being included in the contest, a veri. must accompany the entry of that station. For myself, I listen only on 10, 20, 40, and 80 metres, and purely C.W. I do this to keep my hand in so that when peace comes, and we are allowed to experiment with TXs again, I shall be able to get my transmitting licence, and go on the air. The outbreak of the war just stopped me from taking my full ticket.

"I find that receivers can be most interesting to make and pull apart, circuits to be tested and 'hunches' tried, with varying success, or failure, as the case may be. I find that a 1-v-1 gives splendid results, in fact, a hot 0-v-0 using an H.F. pentode, gives wonderful results when used with a good aerial."

Practical Hints

Protective Mounting for Pilot Bulbs

WHEN mounting pilot bulbs and indicator lamps on a metal panel, instead of buying special fittings I devised the following method. A ⅜in. hole is drilled in the panel to take the bulb. Then a small rubber tyre—as used on small toy cars—is put on the cap of the bulb and pushed right up to the glass. Then the bulb is put through the hole, and another rubber tyre put on the back. The bulb is then screwed into an ordinary M.E.S. holder. A little french chalk or talcum powder will assist this operation, because the tyres are slightly compressed when screwed up. Sometimes it will be found necessary to omit the second rubber tyre if there is not room on the stem of the bulb.—P. A. Shears (W. Horsham).

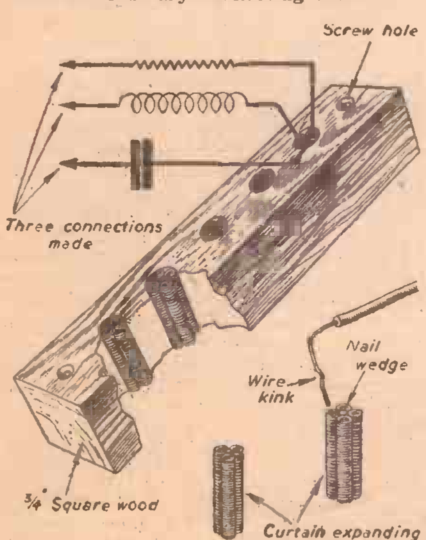


A novel method of mounting pilot bulbs on a panel

Quick Temporary Connections

DESIROUS of having a means of making quick temporary connections, I devised the scheme illustrated in the accompanying sketches.

I obtained a length of curtain expanding wire from a popular store; this has an interior hole of small diameter which just holds the ordinary connecting wire.



A method of making quick temporary connections.

THAT DODGE OF YOURS!

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

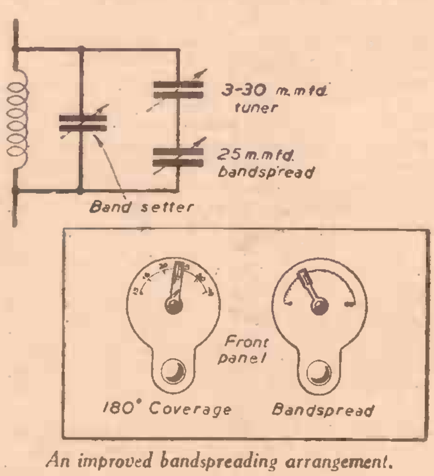
SPECIAL NOTICE

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

I cut this wire into ¾in. lengths, and putting three, four and five pieces together, found the outside diameters. I then bored holes with these above diameters into 10in. lengths of ¾in. squared wood. Placing in the bored holes the pieces of cut wire, I wedged the centre of each group with a brass nail. Screw holes each end make it easy to fit to any baseboard, etc., and temporary connections can be made at speed by pushing the ends of connecting wires in the appropriate group of spring ends. A slight kink in the connecting wire makes a tighter fit.—A. L. Banks (Sanderstead).

Improved Bandspreading

AN inconvenience commonly occurring in short-wave tuning is the fact that a bandspread suitable for 180° tuning of the lower frequency bands is much too large for tuning in the higher frequency bands. This can be overcome by fitting a small trimmer of low minimum capacity such as a 3-30 mmfd. in series with a 25 mmfd. bandspread. The trimmer, or better still another tuning condenser, should be accessible for alteration. When tuning to the high-frequency bands the trimmer is opened, thus making the bandspread into a smaller-capacity condenser. When on the higher frequency the trimmer should be closed until the desired capacity for 180° coverage of a band is found. The diagram and the formula will help in making modifications. To find the range of the bandspreading arrangement, set the trimmer and calculate with the bandspread at maximum and minimum.



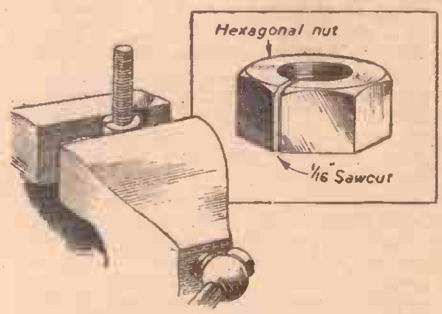
An improved bandspreading arrangement.

$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}}$$

Where C is the total capacity of the bandspreading arrangement and C_1 and C_2 as in diagram.—P. Zeid (Boscombe).

Grips for Screwed Rods

NO doubt many readers have at some time wished to hold screwed rod or long bolts in a vice without damaging the thread. With the aid of the grip illustrated, this may easily be done. Obtain nuts of various sizes—6BA, 4BA, etc.—and make a cut with a saw as shown in the sketch. The rod is screwed into the nut, and the nut held in the vice as indicated. Slight pressure holds the rod in a positive grip, and does not damage the thread. In this position any required operations can be carried out on the rod. Should the nut grip the rod too tightly to be removed when the vice is released, a screwdriver blade inserted in the sawcut will loosen it.—W. Howard (Stafford).



An effective clamp for holding screwed rods in a vice.

A Simple Lead-in Device

I WAS recently asked to install an aerial and earth system for a friend, but on arrival at the house was told that on no account would the owner consent to holes being drilled in the windows or walls. An outside aerial could be erected, but the problem was how to get the lead-in to the receiver without leaving a window always slightly open and without drilling holes. The arrangement finally used is as follows. Two strips of fibre, 1in. wide by 18ins. long, were obtained, together with a strip of copper (18-gauge), half an inch wide. This was placed centrally on one piece of fibre and a hole drilled 6ins. from each end. The other piece of fibre was similarly drilled, and the three pieces were then riveted together, the copper strip being in the centre. The ends of the strip were then tinned and the leads attached.—W. Wingrove (High Wycombe).

What is Polarisation?

An Interesting Explanation of an Important Characteristic of Electro-magnetic Waves.

By H. J. BARTON CHAPPLE, B.Sc.

WHEN reading articles or listening to discussions dealing with the propagation of electro-magnetic waves into space and their reception by aerial systems, it is often found that the expression "polarisation" is used. Although on the medium and long waves polarisation is not important, with carrier waves of high-frequency, such as are encountered in the short- ultra-short- and micro-wave regions, different conditions exist. Much of the failure to secure a satisfactory transfer of energy from point to point can be attributed to an inability to understand what is involved by the polarisation of an electro-magnetic wave.

Two Fields

Now, if it were possible to transfer the energy from a transmitting aerial by a true wave in the ether it would be a disturbance which would be found to travel outwards at a constant speed and which would retain the wave shape of the original disturbance (remember the usual analogy of a stone thrown in a pond to produce the ripple or waves which progressed from the point where the stone struck the surface in ever-increasing circles). Now the radiated radio wave has electric and magnetic fields at right angles to each other and although they are in space quadrature they rise or fall in amplitude in unison, that is to say they are in phase in so far as the time factor is concerned. Since these two effects are mutually dependent upon one another, their influence upon any aerial can be determined by considering each separately if that course is found desirable. It is generally a matter of convenience as to which course is adopted, but what must be remembered is that there is a certain similarity between light waves and these electro-magnetic waves.

An ordinary light source produces light waves which are vibrating in all directions and these are then said to be non-polarised. Depending upon the physical shape and position of a wireless aerial, however, the electro-magnetic waves produced have a varying electric strain in one direction and a varying magnetic induction in a direction at right angles. It is these waves which are said to be polarised (just as we can polarise light waves under certain special conditions of generation), and if the earth's surface is regarded as the datum line the accepted direction of polarisation is that provided by the electric component.

Examples

To see how this fact becomes effective in practice let us regard a simple vertical aerial such as a dipole, which is erected as far as possible in free space and whose length physically is slightly less than half the wavelength of the carrier wave it is desired to radiate. The curves of current and voltage shown for such an aerial in last week's issue show that the voltage varies between maximum and minimum at the extremities. There is therefore an electric strain vertically, and the varying electric field produced functions in a vertical direction, so that according to our accepted definition we have here a vertically polarised electro-magnetic radiation.

This was the scheme resorted to by the B.B.C. when the first high-definition service was inaugurated from Alexandra Palace. At the top of a very high lattice mast two separate and distinct aerial arrays were mounted as shown in Fig. 1. Eight radial arms held these arrays so that a uniform radiation of vertically polarised signals could be obtained. The vision aerials were at the summit of the mast, being designed physically and electrically to suit the chosen carrier frequency of 45 megacycles (6.67 metres), while the sound aerials below were made to resonate to another carrier frequency of 41.5 megacycles (7.23 metres).

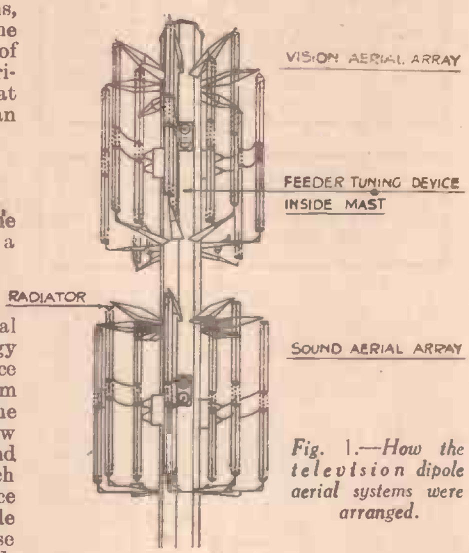


Fig. 1.—How the television dipole aerial systems were arranged.

In order to obtain the maximum radiation characteristics possible each dipole radiator had separate elements, while spaced a quarter of a wavelength behind was placed a reflector. This is shown clearly in Fig. 2, which is an enlarged view of the vertical elements as supported between two radial arms. That the scheme adopted justified itself was borne out by the relatively long ranges obtained for satisfactory ultra-short-wave television reception.

When America initiated its own television service, however, the experts in that country came to the conclusion, after a long series of experiments in the field, that better results would be achieved if horizontal polarisation of the radiated carrier wave was resorted to. Accordingly, all the aerial arrays used for transmission and reception in America are horizontal so that in relation to the earth as a datum surface the electric component is said to be horizontally polarised. One of the main reasons advanced for this opposite choice to British practice was to the effect that the magnitude of signal-to-electrical interference was superior to that obtained by vertical polarisation. How far this will prove to be true can only be settled when a vast number of quantitative investigations have been carried out and analysed, but in any case the two cases cited serve to show clearly what is meant by the term polarisation.

The Influence of Contours

When dealing with ultra-short waves, however, this question of polarisation presents special problems of its own due in the main to the geographical contour of the country over which the electro-magnetic waves have to pass after being radiated from their own particular aerial array. Recently at the Institution of Electrical Engineers the results of some tests using wavelengths of 2 to 3 metres were described. This investigation was undertaken within the optical range of propagation and it was found that within these limits and when elevated receiver and transmitter aerials were employed, the propagation of horizontally and vertically polarised waves was identical, provided the transmitter and receiver heights were not great when compared with the wavelengths used.

As against this, however, it has been established that with ultra-short waves many peculiarities are encountered. There is a definite rotation of the plane of polarisation and this rules out the possibility of being able to use both horizontal and vertical propagation of signals on the same wavelength and differentiate between them at a distant point by employing horizontal and vertical aerials. If this had been the case then it would have enabled two different television programmes to be radiated on the same wavelength, and so provide an alternative service without using up additional space in the frequency spectrum. Then, again, reflections and refractions produce peculiar polarisation effects, with the result that at any receiving point it is advisable to have facilities for orientating the aerial in order to determine the position best suited to optimum reception conditions.

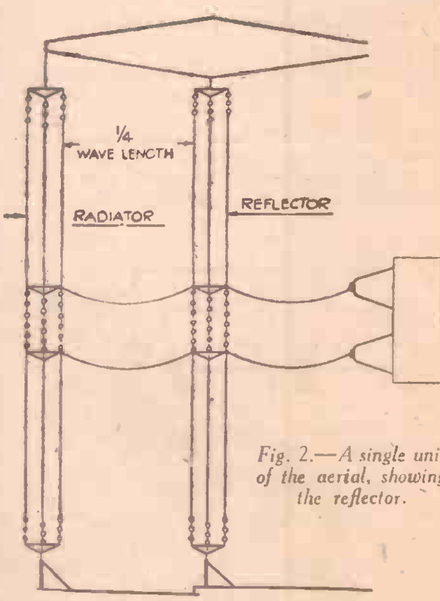


Fig. 2.—A single unit of the aerial, showing the reflector.

(Continued on page 241)

Matching the Feeders

The Importance of Obtaining Correct Dipole Aerial Loading

NOW that the fine days and longer evenings without black-out restrictions are with us, increased interest in the reception of short and ultra-short waves is manifesting itself among the keen radio amateurs. The reason for this is not far to seek, for as recent issues of PRACTICAL WIRELESS have shown to readers, the need for skilled radio technicians is growing steadily as the importance of wireless communication becomes more and more obvious. Furthermore, it is necessary to look ahead to the post war period, and understand that when normal life is resumed both the short- and ultra-short-wave aspects of radio will be even more important than pre-war, particularly the latter, owing to television. During this intermediary period, therefore, advantage should be taken of every available circumstance that enables knowledge to be increased. Facts which were accepted without corroboration should now be sifted to find why certain things were done.

In this connection it is found that an oft-neglected side is the aerial and feeder systems used when short or ultra-short-wave reception is resorted to. The collector of the radiated energy and the means whereby this is transferred to the set for ultimate conversion into intelligible results is just as important as the set itself. Any loss of efficiency will manifest itself in the inferior results achieved; it is useful, therefore, to know why certain steps were taken by the skilled installation engineer who was aware of these points.

A Measurable Resonance

When working over the broadcast band of wavelengths it is the usual practice to employ an aerial the physical length of which is much shorter than the wavelengths of the stations it is desired to receive. To cover the range, however, a tuned loading circuit is incorporated and this compensates for the fact. When working in the ultra-short-wave band this limitation does not hold, and aerial lengths comparable with the wavelength it is necessary to receive is the common rule. This was particularly the case when television transmissions were available, for it was then just a case of designing an aerial system which gave the maximum response to the carrier frequencies used for vision and sound signal propagation. For the bulk of ultra-short-wave work an aerial, the dipole, is employed, this being approximately equal to half the average wavelength it is desired to receive. A dipole aerial of this nature has a measurable resonance effect, and is always tuned. It has a high impedance at the ends, and a very much lower impedance at the centre.

Voltage and Current Distribution

If the distribution of current and voltage in this aerial is examined it will be found to take the form shown in Fig. 1. This is drawn to indicate a complete cycle of changes. The top half of this diagram portrays how the current alters, being distributed over the length like half a sine-wave, while the lower half of the same diagram shows the voltage changes at corresponding periods, being 90 degrees out of phase.

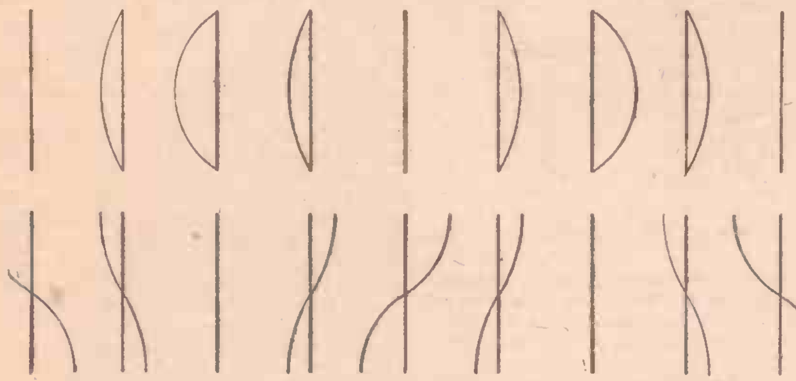


Fig. 1.—Showing the current and voltage changes for one complete cycle in a dipole aerial.

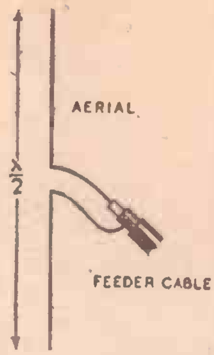


Fig. 2. — Current feeding with a dipole aerial.

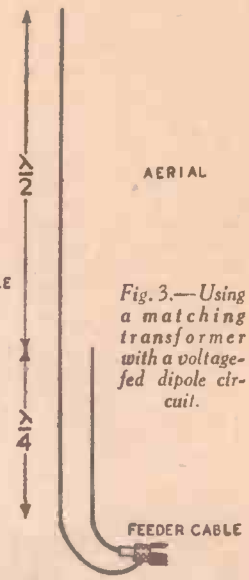


Fig. 3.—Using a matching transformer with a voltage-fed dipole circuit.

It will be seen that the current is always a maximum at the centre and zero at the extremities, while the voltage is zero at the centre, and a maximum at the ends. The degree of selectivity or resonance exhibited by this simple aerial depends, among other things, upon the diameter of the wire employed, and the thinner the wire the narrower becomes the resonance curve. At the centre of the aerial it has been found that the radiation resistance is of the order of 70 to 80 ohms. The knowledgeable wireless enthusiast realises that to transfer the maximum amount of energy from one point to another there should be a proper matching of the impedances at the terminating points. If this factor is not complied with there is a loss of energy and reflections occur in the line.

To transfer the energy induced in the dipole aerial by the carrier wave or relatively narrow band of waves for which it is designed, the first criterion is therefore to match the impedance of the feeder cable employed to that of the aerial. Most of

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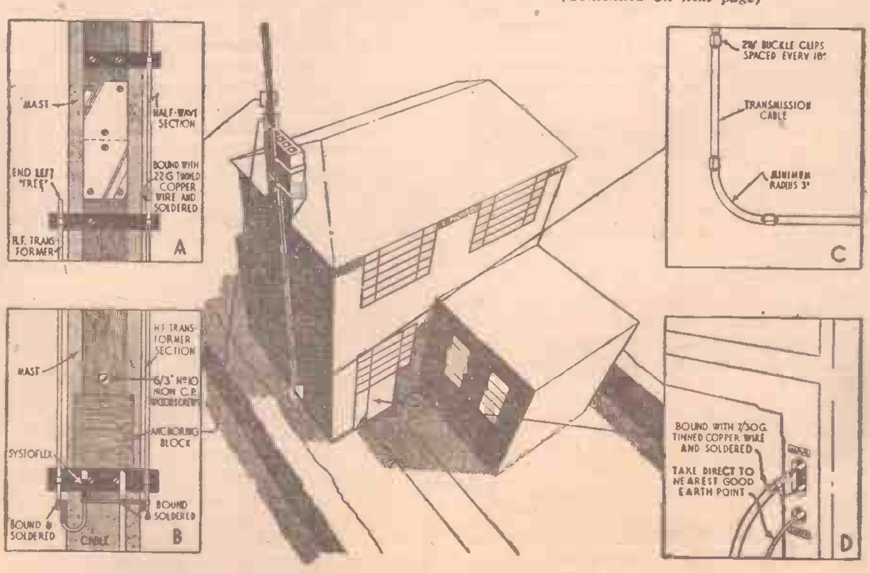


Fig 4.—Illustrating important points in one form of aerial and feeder installation.

MATCHING THE FEEDERS

(Continued from previous page)

the high-quality feeder cables used, especially the coaxial type which was so common for television purposes, had an impedance of the order of 70/75 ohms, so it is obvious that to ensure an easy impedance match it was merely necessary to split the aerial at the centre and join the feeder cable direct as shown at Fig. 2.

Useful Formula

If it is preferred to use a twin wire open feeder, then matching must still be watched, and it is therefore necessary to know how the impedance of an open wire feeder is obtained. There are several methods which may be employed, but the simplest is to use the formula:

$$\text{Open wire feeder impedance} = 276 \log \frac{D}{r}$$

where r = radius of wire
D = distance between wires.

On the other hand, cases arise where it would be far more convenient to join a low-impedance feeder cable to the aerial at a position where the aerial impedance is high as, for example, the end of the dipole where the impedance can be anything up to 2,500 ohms. In this case it is necessary to interpose a transformer between the feeder cable and the aerial. The simplest type for this purpose is two parallel wires each one quarter of a wavelength long and separated by a distance which depends on the factors as related by the following formula:

$$\sqrt{Z_1 Z_2} = 276 \log \frac{D}{r}$$

where D = distance between transformer wires
r = radius of transformer wire
Z_1 = impedance of feeder cable
Z_2 = impedance of extremity of aerial.

This form of connection is shown simply in Fig. 3, and it is interesting to note that this type of aerial and feeder connection was quite popular in the early days of the ultra-short-wave television service. One company issued very careful instructions describing how the installation should be undertaken, and the pictorial diagram of Fig. 4 was used to illustrate the important points. Anyone undertaking a similar installation at the present time will find these hints worthy of notice. First of all, one leg of the half-wave aerial, and one leg of the quarter-wave section are made electrically continuous. To prevent any strain on the feeder cable itself at that section where it is joined to the bottom of the H.F. transformer, an anchoring block holds the cable in a groove. This is seen at B, and the inner wire of the coaxial cable is soldered to the secondary leg of the transformer, while the metal covering or braiding is soldered to the primary leg. Buckle clips serve to hold the cable securely in place over the length of the run, and to prevent damage all bends should be undertaken with a reasonable radius. See C.

L.F. Instability

Simple Causes and Methods of Curing an Annoying Form of Trouble

IN previous articles we have dealt at some length with instability of the kind which is often present in high-frequency amplifying stages, and here it is proposed to consider the low-frequency portion of the receiver. It is somewhat difficult to draw a distinct line between the two kinds of instability which have been referred to as L.F. and H.F., since quite often the two are interdependent to such an extent that, for example, high-frequency currents are the cause of low-frequency instability and vice-versa. In order to make this point more readily appreciated, it might be mentioned that in some receivers L.F. instability of a violent nature can easily be produced merely by running the loudspeaker leads near to the aerial-earth leads, or even to the terminals to which the latter are connected. In the same way, the proximity of the speaker and pick-up leads can often be the cause of serious instability, whilst in a console type of receiver the same kind of trouble might be introduced by running the loudspeaker wires close to the tuning coils, or to the detector or S.G. valve.

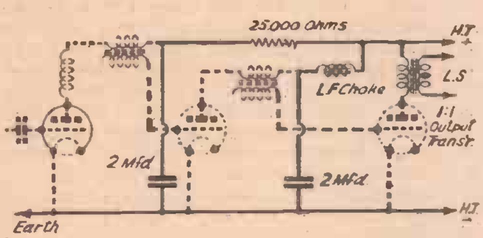


Fig. 1.—Theoretical diagram showing how the detector and subsequent L.F. valves can most easily be decoupled. The decoupling components and wiring are shown by full lines.

The causes of L.F. instability above referred to are perhaps fairly obvious ones, but they should always be looked for as a preliminary to the further tests that might be applied to a set which is behaving unsatisfactorily.

Detecting L.F. Instability

Before going any farther into the subject it might be best to decide just what we mean by L.F. instability, and also how it can be detected. As a matter of fact, this is often the most difficult part of our task, since the fault can manifest itself in so very many different ways. It might be noticed that reproduction is simply distorted; perhaps it sounds "screechy" or high-pitched; there might be a constant whistle accompanying all reproduction; a whistle or "groan" might be noticed on notes of certain frequencies or on loud passages; the noise which has been given the name of "motor-boating," due to its similarity to the sound made by the exhaust of a motor-boat, might make good reception impossible. Instability can make itself known in other ways, too, but one of the symptoms referred to is in most cases noticeable.

Next we should consider what is the prime cause of the trouble, so that we may be in a better position to localise the fault and to say exactly which component or connection is responsible for it. Broadly speaking, L.F. instability, like H.F. instability, is due to a feed-back or uncontrollable oscillation effect. But instead of the feed-back being one of high-frequency currents, it is low-frequency ones which are concerned, and because of this it invariably gives rise to effects which can be detected by the ear.

High-resistance H.T. Supplies

A very common source of the trouble is the high-tension supply. If this is of high resistance and the anodes of the detector and low-frequency valves are connected directly to H.T. positive through the usual coupling components but without the insertion of decoupling resistances, etc., it is a perfectly easy matter for the low-frequency currents appearing in the anode circuit of one valve to pass back to the anode of a previous valve, thus producing a definite and obvious feed-back or reaction effect. If the high-tension supply were of low resistance those currents would pass through it to earth and cause no trouble whatever. High-tension batteries, when in good condition, have a comparatively low internal resistance to L.F. currents and, therefore, do not tend to produce instability. But when the battery runs down, its internal resistance increases and there is a definite opposition to the easy flow of signal current through it. The very old, though obvious, idea of connecting a large-capacity (2 mfd. upwards) condenser across the positive and negative high-tension terminals is a good one, since the condenser provides an easy by-pass to the L.F. currents.

When an eliminator is employed instability is liable to be much more pronounced, due to the fact that it has, of necessity, a much higher resistance. This resistance is introduced by the chokes and resistances which are essential for smoothing purposes. Even with an eliminator, how-

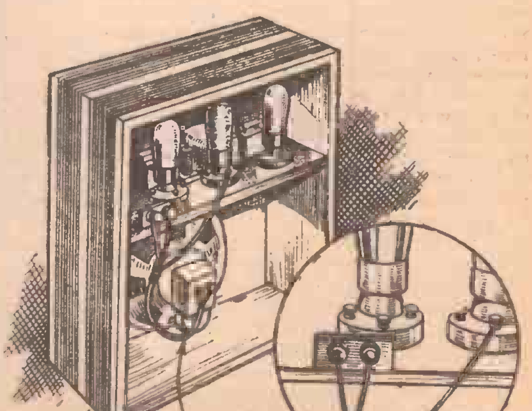


Fig. 2.—L.F. instability in portable sets can often be cured by screening the loudspeaker leads with metal braiding.

L.F. INSTABILITY

(Continued from previous page)

ever, it is often quite sufficient to connect a 2-mfd. condenser between the output terminals in order to reduce its L.F. resistance to a reasonably low figure.

Decoupling the L.F. Stages

In every case where the H.T. supply is responsible for the trouble it is considerably better to tackle the problem by decoupling the detector valve, at least. This is done by inserting a fixed resistance of some 25,000 ohms between the coupling component (resistance, choke, or transformer primary), and high-tension positive, and joining a 2-mfd. fixed condenser between the "set" side of the resistance and earth. The method just mentioned is very well known, but does not, by itself, always give the desired effect, especially when two or more low-frequency stages are included in the set. It is then a good plan to decouple the first L.F. valve also, and this could be done by following the same method, but that would not prove very satisfactory, because the resistance would so cut down the anode voltage that the valve could not operate under efficient conditions. But if a small L.F. choke were used in place of the resistance the voltage-drop would be inappreciable and efficiency would not be impaired. The output valve in any fairly modern set is adequately decoupled by means of the output transformer fitted to the loudspeaker, but where a speaker of the older balanced-armature type is still in use, the last valve can be decoupled satisfactorily by interposing a 1 : 1 transformer between the set and the speaker. All the methods of decoupling which have just been described are illustrated collectively in Fig. 1, the decoupling components and wires being shown in full lines, and the others by broken ones.

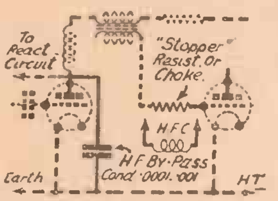


Fig. 3.—Different methods of preventing the passage of H.F. currents into the L.F. amplifier are shown here. New components and connections are indicated by heavy lines.

L.F. Feed-back

A prevalent source of L.F. instability in portable sets is feed-back between the frame aerial and loudspeaker leads. The two are bound to be placed fairly near together, so that the difficulty is not quite so easy of solution. One way of overcoming it is to screen the speaker leads by means of a length of the special metal braiding sold for the purpose. This is slipped over the wires, making sure that it does not make contact with them, and connected to H.T. negative (which corresponds to the normal earth connection of a "fixed" receiver) by means of a length of thin wire (see Fig. 2). Whilst on this subject it should be mentioned that the lengths of wire made up in the form of coil springs and intended for curtain runners are *not suitable* for screening purposes unless all the turns are soldered together. This is because the wire forms a small inductance coil, and thus, instead of preventing H.F. pick-up, it actually assists in that direction. The point is mentioned because it has come to our notice that a number of readers have made use of this apparently simple and inexpensive method of screening, with unsatisfactory results.

H.F. By-pass

With some portables it is not enough simply to screen the speaker leads, because there is a certain amount of H.F. current leakage into the last valve. In that case, a cure can generally be effected by connecting a small by-pass condenser between the anode terminal and H.T. negative; when a Class B output stage is employed, the condenser should be joined between the two anodes, or alternatively, a condenser may be connected from each anode. The capacity of the condenser depends upon the severity of the trouble, but a value from .001 to .005 mfd. will nearly always prove suitable. It should be remembered that if the capacity is too high there will be some slight loss of the higher notes.

H.F. "Stoppers"

Although the method of by-passing H.F. currents which reach the power-valve is fairly effective, it is generally better to prevent them from passing into the L.F. amplifier at all. High-frequency currents should really be entirely dispensed with in the anode circuit of the detector valve, but they do sometimes find their way farther into the set. The H.F. choke should prevent their passage into the amplifier stages, but it cannot be fully effective unless a by-pass condenser is connected from the anode of the detector-valve to earth. This is a point which is too frequently overlooked, although it only calls for a fixed condenser wired as shown in Fig. 3. The condenser may have a value between .0001 and .001 mfd., but in every case the smallest value which gives the desired result should be employed, since the higher values by-pass a small percentage of the higher audio frequencies as well and so tend to make reproduction rather low-pitched.

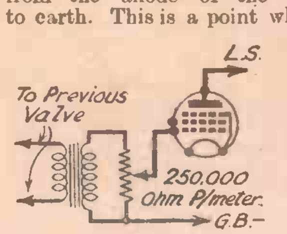


Fig. 4.—When instability is due to fitting a new high-amplification valve, a volume control should be connected between the L.F. transformer and the grid of the valve.

Another method of preventing H.F. currents from passing into the L.F. amplifier is to insert a "stopper" in series with the lead from the transformer or R.C.C. unit to the grid of the first L.F. valve. The "stopper" may be either a fixed *non-inductive* resistance of between 50,000 and 100,000 ohms or a second H.F. choke. This method is of particular value in the case of short-wave receivers, although it is by no means useless with normal broadcast receivers, especially portables. Connections for the "stopper" are given in Fig. 3.

New Valves

It was mentioned in previous articles on H.F. instability that the trouble could be due to the fact that new and more efficient valves had been used to replace older ones with which the set worked quite satisfactorily. The very same thing applies in respect to L.F. instability, and it is very often found that reproduction becomes almost unbearably poor when a pentode is fitted in place of a previous small power valve, for instance. Pentodes *do* give a certain amount of emphasis to the higher notes, but they should not cause reproduction to become distorted to the extent that it is accompanied by a constant "whine." Many amateurs tolerate this in the idea that the pentode naturally does not produce such good quality, although it increases the output volume. The idea is entirely fallacious, and if the effect mentioned above is noticed when changing over to a pentode it is a sure sign that instability has been introduced. In the majority of cases it can be removed merely by reversing the connections to the secondary terminals of the L.F. transformer. Sometimes, a "stopper" is required before the difficulty can be overcome, whilst in extreme cases it is practically essential to reduce the amount of amplification by replacing the L.F. transformer by one of lower ratio. Before going to the expense of such a modification, however, it is a good plan to try the effect of fitting an L.F. volume control, as shown in Fig. 4, or of reducing the step-up effect of the transformer in the way illustrated in Fig. 5. In the latter method two fixed resistances are connected between the secondary terminals of the transformer and the grid of the output valve connected to the junction between them. In some instances, the quality will be improved by shunting one of the resistances by a .01 mfd. fixed condenser.

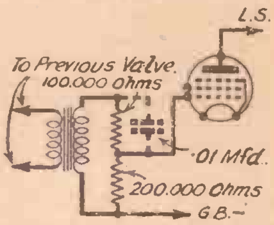


Fig. 5.—The amplification of an L.F. stage can easily be reduced by using the connections shown above, and explained in the text.

WHAT IS POLARISATION?

(Continued from page 238.)

Rotating the Plane

Some time ago the B.B.C. carried out a series of field tests when attempting to plot the field strength contours of the signals radiated from the Alexandra Palace. On open situations free from intervening objects likely to cause reflections, the plane of polarisation remained vertical. Close to the base of hills, however, the signal was found to have components which were certainly not vertically polarised. A rotation of the plane of polarisation was definitely noted behind hills, but this could be attributed not only to the hill itself but also to trees or other objects in the path which influenced the nature of the wave. On occasions just below the hill crest remote from the transmitter aerial it was found that the magnitude of the horizontally polarised wave was in excess of the vertically polarised wave, and yet at the point of signal generation, as will be gathered from Figs. 1 and 2, the horizontal component was non-existent.

For long-distance communication on the short waves both horizontally and vertically polarised transmissions are used under conditions of commercial or service communication. A lot depends on the form of contact which has to be made, and intricate problems of polar diagrams have to be solved in order to determine the nature of the aerial array best suited to each particular service. This is noticeable in communication with aircraft from ground to machine and vice versa, while polarisation also has its significance in direction finding.

A Universal Crystal Set

A Simple Receiver Designed to Enable the Beginner to Carry Out Experiments with the Minimum of Trouble and Expense

By L. O. SPARKS

AN efficient crystal receiver is undoubtedly the most satisfactory piece of apparatus with which the majority can commence their activities. It is not costly to construct or difficult to operate, and with the power now radiated by the Home Service transmitters there are few areas which do not come within the effective range of a receiver of this type. Unfortunately, however, distance between transmitter and receiver does play a very important part in the satisfactory operation of a crystal set, and as it is not possible to give exact figures for the effective range of reception, owing to so much depending on local conditions, it would be advisable for the constructor to make one or two inquiries from more experienced amateurs in his area, before commencing the assembly of a set of this type. Speaking in a general sense, quite good results have been obtained with simple crystal receivers, when used in conjunction with a good aerial and an efficient pair of headphones, over distances of 100 miles and more, but it would, perhaps, be safer to put the best listening maximum range at, say, 50 miles.

This problem of location of receiving station with relation to the transmitter need not, so far as the enthusiastic constructor beginner is concerned, be such a governing item as it would appear at first sight. It is not likely that he will be satisfied with a crystal circuit for long; he will wish to construct something more ambitious, something with a far greater effective range, once he has become familiar with his first set; therefore, it matters little if the signals are slightly on the weak side, as that will only tend to cultivate a *keen listening ear*, a very useful asset when undertaking real DX work at a later date, and make the operator experiment to try to improve the efficiency of the set.

A set made with a modern type of commercial coil is, of course, very neat and compact, usually quite simple to wire and assemble, and efficient, but from the constructor's point of view it does not give him much chance of "seeing the works," or of carrying out experiments to enable him to reason out the whys and wherefores. The set about to be described has been so designed that such additional interests can be secured, and what is even more important, the coil can be made by the constructor and used in valve circuits as progress is made.

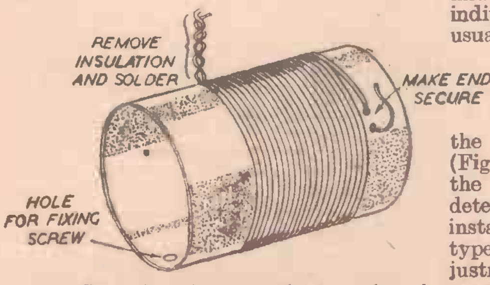


Fig. 2.—Shows how the tapping loops are formed and how the ends of the winding are anchored.

The Circuit

This follows the fundamental lines for a receiver of this class; the essentials are a tuned aerial circuit to enable the maximum signal to be obtained from the desired station and a crystal detector or rectifier to rectify the minute high-frequency alternating currents developed in the aerial circuit by the signal into alternating currents of a low or audible frequency which, in turn, flow through the windings of the headphones and cause, by means of a simple electro-magnetic system, the diaphragms of the 'phones to vibrate at frequencies corresponding to the original sounds produced in front of the microphone in the studio of the transmitting station.

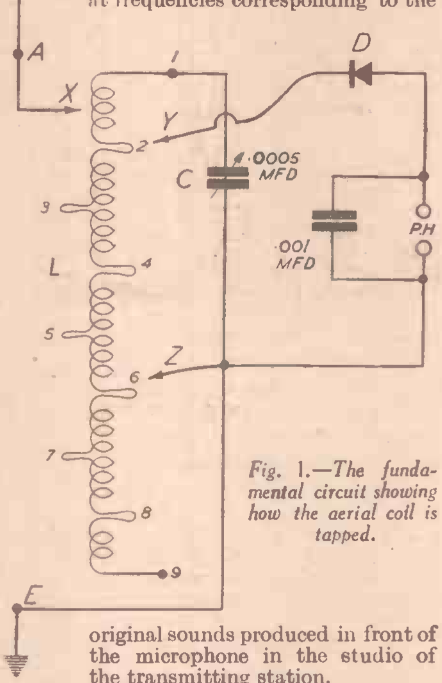


Fig. 1.—The fundamental circuit showing how the aerial coil is tapped.

The quality of reproduction, provided good headphones are used, is most satisfactory, and owing to the complete absence of any background noises, many listeners who appreciate faithful reproduction will find this simple circuit an ideal receiver for individual listening. The lack of selectivity, usually associated with a single tuned circuit does not in this instance become a serious item, owing to the limited effective range.

The tuned aerial circuit is formed by the coil L and the variable condenser C (Fig. 1), the circuit being completed by the earth connection E. The crystal detector is denoted by D, and in this instance a detector of the semi-permanent type is used to eliminate the irritating adjustments usually associated with those employing the fine spiral wire contact known as a "cat's whisker." The signal voltages developed across L and C pass to the detector and, after rectification, through the phones PH, one side of which, as shown on the diagram, is connected to the earth line.

The Coil

This is intended to provide the constructor with his initial experiences of coil winding and governing considerations, therefore, it is of the simple solenoid type and quite easy to make. It consists of a single layer of wire wound on a former, which can be a thoroughly dried cardboard tube having an external diameter of 3in. The length should be approximately 4½in., and for ease of winding and general efficiency, the wire is 22 S.W.G. enamelled, although if double-cotton-covered is to hand, that can be used.

It will be noted that seven tapping points or loops are taken from the coil, and these must be made during the actual winding. They call for a reasonable amount of care, otherwise there will be the danger of the turns becoming loose. The way the loops are formed is shown in Fig. 2. When the turn is reached from which a tapping has to be taken, the coil former should be fixed in something so that it cannot rotate, and holding the spool of wire in one hand and keeping the wire taut, the length of wire which will form the loop, about 3ins., should have its enamel insulation removed. This can best be done with a small piece of *fine* sandpaper. The loop is then twisted as shown in Fig. 2, and if soldering material is available, the twisted part should be rendered secure with a thin layer of solder. If these facilities are not to hand, then it would be advisable to bind the base of the twist with two or three turns of thread, or it will be found that it will start to unwind when any tension is put on it during the continuance of the winding.

The total coil consists of 80 *turns*. Tapping points are made at every 10*th turn* from either end, thus, together with the two end wires, providing 9 connections in all. Make quite sure that the coil is wound with all turns firmly alongside their neighbours and that no slackness exists. Secure the two ends by passing them through holes in the former.

Components

The other items required are a variable condenser having a capacity of .0005

(*Continued on page 247*)

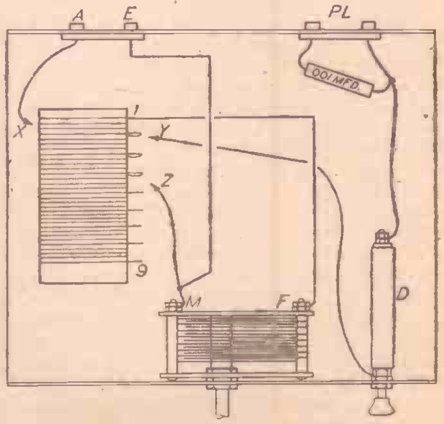


Fig. 3.—A suitable layout and wiring fed to specified parts. M indicates the moving vanes of the tuning condenser.

Open to Discussion

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

A Reader's Den and DX Log

SIR,—I enclose a photo of my den, which I hope will interest other readers. My RX is an 0-v-1 (4.5-160 m.) 5v. superhet (medium wave). The aerial is a 33ft. outdoor Hertz, 20ft. high, running N.S. Altogether 96 countries and 38 zones have been heard here. Latest DX includes: Phone — KA1RV, K6NYD, K6OQE, K6QHU, K6PLZ, K6BNR, KC4USA, W6PDB, W6NNR.

C.W.—HC1FG, HK2BD, KA1FG, KA1BN, KAIMN, KA1SP, K6QNX, K6SAO, K6CGK, K6PAH, KE6SRA, HH2MC, W6BVM, W6HZT, NNR, 1PV (Arizona), OYY, W9FYY (Colorado), W7GUR, HBB, ETK, VY, XU5WT and XUOA. All were received on the 14 mc/s band. — K. B. JACKLEY (N. Finchley).

A comfortable corner in Mr. K. B. Jackley's den.

Back Numbers Wanted

SIR,—I have been a reader of your fine paper for the last five years, and ever since I first bought it I have not looked back from the practical side of radio. I heartily congratulate you on a fine practical paper.

I should like to correspond with anybody about my own age (19) who is interested in Public Address work and Home Recording, with a view to exchanging ideas. I should also like to get in touch with anybody who has the issues of PRACTICAL WIRELESS dated December 17th, 1938, and July 4th, 1936, for disposal.—R. F. L. DANIEL, 23, Quay Street, Cardigan.

Condensers in Series and Parallel

SIR,—In a letter published in the April 27th issue, Mr. G. S. Bragg states that he used a .003 and .002 mfd. condenser, in series, to take the place of a .005 mfd. condenser. The total value of these condensers is, however, .0012 mfd. and I think that Mr. Bragg could get even better results if he connected his two condensers in parallel.—G. DAVIS (Isleworth).

Logged on an 0-v-1 Receiver

SIR,—I noticed in your issue of April 27th a 14 mc/s log from Mr. C. Harvey, of Wembley. Between March 18th and 30th I only logged ES, LY, EAW's, and OQ51M on CW. I found condx very bad, but since then I have got the following on my 0-v-1 receiver. KA, ME, RV, LB, CW, HC, HQ, DC, K4RJ and K5AA (40 m.), K6LEJ, MVA, OJI, KOV, GAS; PK2DI, LU8AB, AD, YAG; PY2HT, 1EA, IM, 7AI, AQ, 6AC; OA3E, 4C; U1, 2, 3; 6AK, 8IL, 9MJ, CO7AS, W5HBH, HPD, HDC, HFL, BAU, JC; 6OPE, ATS, ZQW, FU, ZC, LYL, MNR, BGW, CUF, EWE, RBS, AM, FJ, SC; 7GAE, 9BEU, BDE, CIH, ZMA, DDY, BRR, OKH, SDB, VHC, COI, MAB, BCQ, LTY, NAB, PIY, WMI, HKK, PXN, WED, TKS, QOB, IAS, EXD and CAL.—S. GARNER (Wallington).

Prize Problems

PROBLEM No. 402.

AS Temple was experiencing some instability in his home-made S.G. Three receiver, he decided that an improvement could be effected by screening the top-cap lead to his H.F. valve. He obtained a length of the standard screened sleeving and slipped this over his connecting wire and then tried the receiver. He could obtain no signals at all when this was done. After an examination he found that the screened covering was in contact with the lead, and he remedied this. When he switched on again, however, he could obtain no signals. Why was this? Three books will be awarded for the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 402 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, June 3rd, 1940.

Solution to Problem No. 401.

Black overlooked the fact that some H.F. valves have the grid taken to the top cap and thus when he connected his meter to the top cap lead he was not measuring the anode current and his test was therefore ineffective.

The following three readers successfully solved Problem No. 400 and books have accordingly been forwarded to them:
W. Farrell, 29, Bastwell Road, Blackburn, Lancs.
F. A. Vost, Finningley, Yorks.
J. Knudsen, 10, Third Avenue, Walthamstow, E.17.

A DX Log from Purley

SIR,—Noting the growing interest in short-wave DX that your correspondents show, I am sending you my results in the hope that they may be of interest to other S.W.L's. I have been DXing for two years on and off and have heard 97 countries on 10, 20 and 40 metres, and about 150 B.C. stations identified, of which the best are: VLR, VUD3, XGOY, JZK, CR7BE, CB960, OAX1A, HJDE, YV1RQ, VP3BG, TIWS, KGEI, XEWW, PRA8, etc. My 20-metre log includes CO7CX, 8AE, 2BA, 2MA, 8JK, 2WM, 2UF, 2AM, 2BR, XUOA, LU5AN, 1LB, 4PB, 4BC, YV5AB, 9AC, HC2HP, PY2IT, 2KT, 2IM, HKLAB, HK1BN HI3N, CE3EU, PY2EP, TI4AC, KA1LB and W7BAW. All heard on telephony.—T. B. WILLIAMSON (Purley).

Proposed Club for Bradford

SIR,—I suggest that a small radio club be started in the Heaton district of Bradford. Will any interested reader please apply, in writing only, to this address: G. Harrison, 344, Heaton Road, Heaton, Bradford.

Correspondents Wanted

G. KENSHALL, 23, Carpathia Street, Garston, Liverpool, is anxious to get in touch with any readers in Liverpool or Lincoln who care to correspond with him.

F. J. Thody, Fairdene, Bramber Avenue, Peacehaven, Sussex, would be glad to hear from any reader who has a copy of *Wireless Magazine* for November, 1934, for disposal.

RADIO CLUBS & SOCIETIES

BRISTOL EXPERIMENTAL RADIO CLUB

Headquarters: 21, King's Corridor, Old Market Street, Bristol, 2.
Publicity Manager: D. J. James, 40, Robertson Road, Eastville, Bristol, 5.

THE Second Annual General Meeting of the above Club was held at Headquarters on Tuesday, May 7th. The members' interest in the running of the club was clearly shown by the two hours' lively discussion that took place!

The following officers and committee were elected for the year 1940-1941:

Secretary: P. R. Dinham.
Chairman: D. J. James.
Treasurer: A. Taylor.
Registrar: J. E. Fry.
Publicity Manager: D. J. James.
Committee Member: W. White.

It was decided that meetings should continue fortnightly throughout the summer, and that the committee should endeavour to arrange a series of "Field Days."

A very successful feature at a recent meeting was a "Question Bee." The members present were divided into two teams. For each round a type of trouble likely to have been encountered by all members was suggested (e.g. Hum, Instability, etc.), and each member, in turn, was asked to suggest a cause and cure for the trouble.

At the next meeting, on June 4th, Mr. W. White will describe a new type voltage doubler power pack that he has designed.

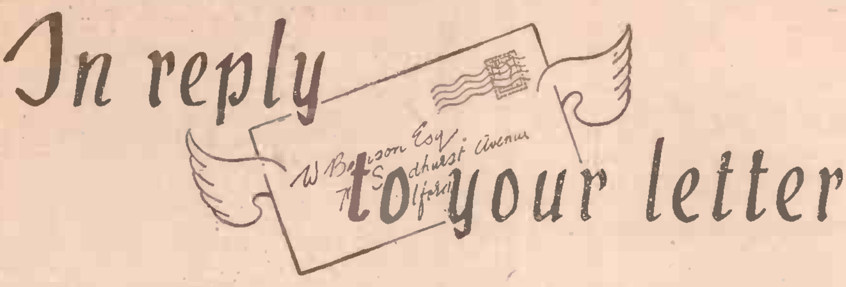
ROBERT BLAIR RADIO SOCIETY

Headquarters: L.C.C. Evening Institute, Blundell Street, Islington, N.7.
Hon. Sec.: Mr. H. Shelton, 5, Gordon House, Kings Cross, N.1.
Meetings: Every Thursday and Friday from 7.30-9.30.

AT a meeting of the above Society held on May 16th, we were pleased to welcome members of the Fulham Radio Society, who paid us a courtesy visit.

A keen interest was taken in our Morse Code groups, which after our last report in PRACTICAL WIRELESS has grown considerably, and a demonstration of speed was given by means of gramophone records which have recently been purchased. Results were very satisfactory.

After a very interesting evening a return visit was arranged during the first week in June.



How Many Valves?

"I am trying to design a very economical set, so that I can have all the modern features with low initial cost and low cost of running. I have decided on a triode-pentode, I.F. and D.D. Pentode and enclose a circuit. You will see I have A.V.C. and all other features and should be glad if you would criticise this for me."—H. E. T. (Bangor).

WHILST the theoretical considerations are quite in order, there are some important points which must be remembered. First, the question of A.V.C. With the arrangement as shown there is very little H.F. amplification and therefore there will be little actual volume control. Amplified A.V.C. should therefore be employed in this particular circuit. Furthermore, the use of the single L.F. stage would tend to make the use of the set for gramophone reproduction rather out of the question, and as shown the pick-up would give very little output. From the other point of view—namely, economy, the arrangement is quite in order.

Rectifier Circuit

"I am making some modifications to my set and propose to obtain a full-wave rectifying valve so that I can use this later on in a straightforward A.C. set. My present outfit is A.C./D.C. and the valve was originally a half-wave rectifier in the usual way. Should I just use one pair of electrodes in my new valve, or will this do any harm to the valve?"—N. E. (Liverpool).

WE would not advise the use of one-half of the valve as if this is carried on for some time, when you eventually come to use the two sections in a full-wave circuit you may find that the emission of the two halves would be unequal. We therefore recommend that the cathodes and anodes be connected in parallel so that the valve may be used as a half-wave rectifier in the usual way.

Screen Voltage

"I am finding difficulty in stabilising my straight set, which has a variable-mu H.F. pentode. This was a replacement for a straight S.G. valve, and I have fitted a fixed bias (9 volts) as I prefer to modify the screen voltage, which I understand is in order. The trouble takes the form of whistling as a certain adjustment is reached, and I am not getting so much amplification as with the original S.G. valve. Could you help me in this matter?"—D. H. (Peacehaven).

THERE are a number of points to be considered in this case. The G.B. voltage, the screen rating, and the actual circuit adopted for coupling the H.F. to the detector stage. The variable-mu valve has its amplification governed by the bias, the maximum bias giving minimum amplification. Therefore, the valve in use may be biased to its weakest point and a decrease in bias should be tried. The screen voltage is critical and your potentiometer or potential-divider may not be providing a suitable voltage for the screen. Finally, the impedance of the pentode is higher than the S.G. valve and your anode load may not be suitable. If you are using choke-coupling, we suggest the use of a better H.F. choke, preferably one of the type generally known as a "superhet" choke.

L.F. Quality

"I recently scrapped a fairly good L.F. transformer, as I wanted to improve quality, and was told that resistance-capacity coupling was best. The quality is not now nearly so good, being deep and muffled compared with the original scheme. Can you tell me what is wrong to cause this effect?"—L. W. E. (Woodford).

RULES

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

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

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

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

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

A TRANSFORMER may be "peaky" and giving you brilliance which is unnatural. Your change to R.C. coupling may have been good and the reproduction may be more balanced, but by contrast with the reproduction you have been tolerating may make the effect sound less brilliant and unnatural. On the other hand, you may be using unsuitable R.C. values, or the anode resistance may have so reduced the H.T. on the valve that it is now working at the wrong part of the curve and giving distortion. There is also the possibility that the speaker you had fails to give good top-note response, and the effect of the transformer was to emphasise top, tending thereby to mask the defect in the speaker. Thus your change, whilst giving better response in the circuit may not have the desired effect owing to the speaker being unable to cope with the improvement.

Bias Control

"In looking through some circuits recently I was rather puzzled by methods adopted in regard to the bias control for mains-type variable-mu H.F. valves. I see in some sets you have connected the arm of the control to earth, as well as one end of the resistance. In others, you have only joined the end of the resistance to earth, whilst in others only the arm is joined to that point. Could you give me the merits of the different arrangements and say which is actually best in practice?"—G. F. (Cleethorpes).

IN most circuits the bias control forms part of the screen potential-divider and usually a minimum bias resistance is joined between cathode and the bias control potentiometer. Actually all that is needed is a variable element between cathode and earth, but by making this part of the screen circuit the screen voltage is also adjusted to a certain extent. By earthing the arm of the control difficulties due to a metal panel and "live" spindle are overcome, and by earthing one end of the control as well the unused portion of the control is short-circuited. So far as the final effect is concerned the results are identical—the amount of resistance between cathode and earth is controlled and thus the voltage on the cathode is also controlled. The actual connections are thus therefore a matter of personal preference.

H.T. Circuit

"In a mains set I am modifying I find that there is a resistance in series with the main H.T. smoothing choke. There is also a smoothing condenser on each side of the resistance. Does this offer a better smoothing than a choke alone, or is it some special type of filter which is necessary in addition to the L.F. choke?"—F. M. (Penarth).

THE scheme is usually adopted to reduce the total H.T., where the mains unit is delivering a rather high output. The choke would be found in such a case to have too low a D.C. resistance to provide the requisite voltage drop and thus the resistance is added, with the condenser on the set side to provide H.F. by-passing. The smoothing offered is negligible and you could, of course, replace the resistance or leave it out, if the H.T. is not excessive or if you could obtain a choke with the desired D.C. resistance capable of reducing the H.T. to a suitable value with the current which is flowing in the particular receiver.

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.

N. W. (S. Yardley). You may be able to use a standard mains transformer and rectifier, and if you could supply details of the set we could specify suitable components.

J. C. McC. Y. (N.W.3.). The unit could be built with a battery valve and the mains section ignored. However, we hope to describe a similar unit in the near future.

J. V. H. (Shoreham-by-Sea). The valves are not now made and the circuit was only given out of interest.

B. G. D. (Hereford). The set may not be unstable, but the trouble may be merely faulty parts or valve. The noise when switching off is due to condenser discharge.

H. T. (Bangor). The chassis would be too small and the crowding of the parts would undoubtedly lead to trouble.

T. E. R. (Birkenhead). The tube may be cardboard, but ebonite or paxolin is much better.

N. W. (Aldershot). The set is really portable, and if you use an outside aerial the input circuit would have to be modified. The selectivity would be poor otherwise.

A. H. E. (N.W.5). The valves are perfectly suitable as substituted.

M. S. (Perranporth). We think the idea perfectly sound and would consider it worth while to proceed with the matter.

Q. U. S. (Horsham). Try increasing the voltage to 150. The valves are rated to take this maximum H.T.

P. T. (Chatham). The scale is a commercial product and we suggest you write direct to the Premier Radio Company.

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

RANGE AND REALISM

(Continued from page 234.)

grid swings, and obviously mains valves with 40 or 50 volts grid bias will be sufficient for domestic requirements. The principal points to watch are—large grid bias and correctly-matched output transformer. As an input transformer is required for push-pull working, this must be of high quality to avoid loss of bass, and preferably resistance-fed to avoid saturation of the core. If the coupling condenser has a value of .1 or .2 mfd. a slightly resonant circuit is formed, and assists in the maintenance of a straight line down to the bottom of the scale. Fig. 2 shows the circuit arrangements so far described, and the next problem is the supply for this stage. We would not recommend a further L.F. stage if you are out for idealism. A detector operating on the power-grid principle will fully load the

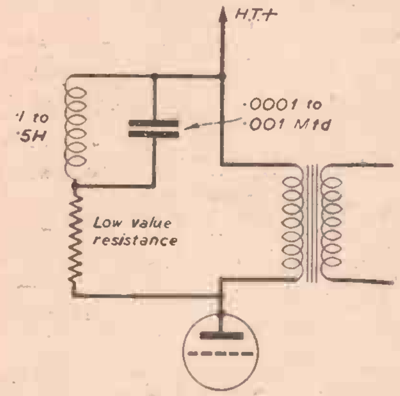


Fig. 5.—A similar arrangement to Fig. 4, but designed for transformer coupling.

output valves and will give practically straight-line results.

The Detector

The main methods of detection are the diode, anode-bend, grid leak, and power-grid. Without going into figures, it can be stated definitely that the diode or anode bend are the ideal methods, *provided* a sufficiently powerful signal is applied to the detector. Power-grid is next and ordinary grid leak last in the order of quality detectors. The grid condenser is responsible for the slight failing of the two latter forms of detection, and this is due to its impedance varying at different frequencies, and also its inability to deal accurately with transients. These are sudden changes and are typified by such items as cymbal crashes, pistol shots in radio plays, and other similar "sudden" noises. The condenser is unable to respond to these quick changes and rounds off the effect, and also has a different resistance for various frequencies. Its absence in the diode and anode-bend detector accounts chiefly for the good response given by these methods of rectification, but in power-grid detection the value of condenser used is so small—usually of the order of .0001, that its effect is not too bad. The ideal receiver should, therefore, employ diode or anode-bend detection, or a grid leak and condenser of such a value that the particular valve which is employed works on the correct part of its curve. To avoid distortion due to the presence of H.F. currents in the H.F. stage, an efficient H.F. filter must be provided in the anode circuit of the detector valve. Fig. 3 shows the best form for this, and provided a good make of choke is employed, the filtering is sufficient for normal requirements.

H.F. Stages and Top Notes

There only remains the question of the H.F. part of the receiver, and as the principal requirement of the detector is that it should be fully loaded, the H.F. stage will depend upon your situation. Obviously, close to a station, less H.F. amplification will be required than for the reception of distant signals. One efficient variable-mu stage should enable the English stations to be received in this country with high quality, but the foreign stations will naturally not be of quite the same standard. As selectivity will be required, we enter the field of top-note response, and the first point is therefore not to utilise too selective a tuning arrangement. Band-pass tuning, with a correct square peak of 10 kc/s, will give adequate high-note response for domestic purposes, but will not prevent heterodynes. Reducing the peak to 8 kc/s will help to avoid this form of interference, but the higher harmonics will be lost. On the majority of transmissions the loss will not be sufficient to spoil musical reproduction, and we may say, therefore, that from 8 to 10 kc/s is good enough. The choice of by-pass condensers in this stage will affect the high-note response also, and the value will depend upon the remainder of the characteristics of the circuit. Experiments should, therefore, be conducted with different values to find the most suitable for the particular range of response desired.

Tone Compensation

Much can be done with a receiver to improve response by arranging tone correction circuits, and this is a most exhaustive subject, and will only be briefly touched upon here. High notes may be strengthened by resonant circuits in the L.F. stages, a resistance in series with a condenser being joined across the transformer primary or the output choke. Bass response may be improved by arranging a resonant circuit in a parallel-fed transformer stage, the fixed condenser used for coupling being chosen in conjunction with the impedance of the transformer primary. A reduction in the high-note response (especially in the case of a pentode valve) will enable the

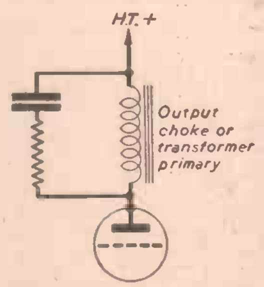


Fig. 6.—Reducing top-note response.

lower notes to appear more prominent. These methods are illustrated in Figs. 4 to 6.

Loudspeaker Characteristics

When choosing the loudspeaker it must be remembered that the response curve may not be perfectly straight. For instance, some speakers are designed especially for the reproduction of gramophone records, and therefore, have a very definite cut-off at the higher frequencies in order to reduce needle scratch. The design of the actual receiver or amplifier must, therefore, be arranged to work in conjunction with the actual loudspeaker which is in use, or a speaker chosen which has a straight-line response from the lowest to the highest frequency which it is desired to receive.

Practical Wireless BLUEPRINT SERVICE

PRACTICAL WIRELESS

CRYSTAL SETS

Blueprints, 6d. each.

	Date of Issue.	No. of Blueprint.
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94

STRAIGHT SETS. Battery Operated.

	Date of Issue.	No. of Blueprint.
One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P)	14.8.37	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three ((SG, D, Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve : Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P)	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90

Mains Operated

Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS

Battery Sets : Blueprints, 1s. each.		
£5 Superhet (Three-valve)	5.6.37	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	16.1.37	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model / Push Button 4, A.C. Mains Model	22.10.38	PW95

SHORT-WAVE SETS. Battery Operated.

One-valve : Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	1.10.38	PW68

PORTABLES.

Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86

MISCELLANEOUS.

Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.

Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450

STRAIGHT SETS. Battery Operated.

One-valve : Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G. 3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three : De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	*Mar.* '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minitube Three (SG, D, Trans)	*Oct.* '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans)	—	AW370
2HF Four (2 SG, D, Pen)	—	AW421
Self-contained Four (SG, D, LF Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF, Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

These Blueprints are drawn full size.

Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint.* A dash before the Blueprint Number indicates that the issue is out of print.

Practical Wireless (issues dated prior to June 1st, 1940)	4d.	Post Paid
" " (issues dated June 1st, 1940, and after)	5d.	Post Paid
Amateur Wireless	4d.	" "
Wireless Magazine	1/4	" "

The index letters which precede the Blueprint Number indicate the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.

Send (preferably) a postal order to cover the cost of the blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Mains Operated.

Two-valve : Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (HF Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	*July* '33	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May* '35	WM386

SUPERHETS.

Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. 6d. each.		
Heptode Super Three A.C.	*May* '34	WM359
"W.M." Radiogram Super A.C.	—	WM366

PORTABLES.

Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two HF Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans)	—	WM367

SHORT-WAVE SETS. Battery Operated.

One-valve : Blueprints, 1s. each.		
S.W. One-valver for America	15.10.38	AW429
Rome Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-Short Battery Two (SG, det, Pen)	*Feb.* '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve : Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July* '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF Pen, D, RC, Trans)	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super	*Nov.* '35	WM397

Mains Operated.

Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
"W.M." Long-wave Converter	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans)	—	WM391

MISCELLANEOUS.

S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM392 (1/-)	*Nov.* '35	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	*Mar.* '36	WM403
New style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	*May* '36	WM405
Wilson Tone Master (1/-)	*June* '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408

A UNIVERSAL CRYSTAL SET

(Continued from page 242)

mfds., a semi-permanent crystal detector, four terminals or sockets, one fixed condenser, .001 mfds. (this value is not critical), and, of course, a pair of 2,000 or 4,000 ohm headphones.

The baseboard and panel can be cut out of well-seasoned three-ply wood; the actual sizes are not very important, but 7ins. by 8ins. for each would be reasonable.

The variable condenser can be of the solid-dielectric or air-spaced type; the latter is preferable if it is to hand. The semi-permanent detector can be obtained from Messrs. Electradix Radios, if your local dealer cannot supply.

Layout and Assembly

The layout and wiring are quite simple, as Fig. 3 shows. The tuning condenser and detector are mounted on the panel, while the coil and terminal or socket strips are secured to the rear of the baseboard. When mounting the coils, support it off the baseboard by two small strips of wood or ebonite ½in. thick, the coil former being held in position by one screw at each end passing through the ends of the former and the distance pieces.

Keep the wiring as neat and direct as possible, and see that all connections are tight. It must be appreciated that with a set of this type it is very essential to avoid any possible losses, and as these can be introduced by poor or dirty contacts, particular attention should be paid to such items.

It should be noted that the connections X, Y and Z are formed with short lengths (6in. should be ample) of flexible wire, and that the arrow heads represent the small crocodile spring clips obtainable from most radio dealers. The object of these will be explained below.

Operation

Assuming that an aerial and earth are to hand, the aerial should be connected to the terminal A and the earth wire to E. After joining the headphones to the two terminals PH., the clip X should be clipped on coil connection No. 3, the Y clip on to No. 2, and the remaining clip Z to No. 7.

When these connections have been made, rotate slowly the tuning condenser, and the local station should be heard. If no signal is obtained, make a careful adjustment to the detector by *withdrawing* the knob, giving it a partial turn, and then allowing it to gradually return. *Don't turn it without withdrawing* it, otherwise the crystals will be ruined.

Once a station has been heard, experiments can be carried out to determine the best settings of the clips X, Y and Z. The greatest signal strength will be obtained with X and Y on connection No. 1. Greater selectivity and slightly less signal strength will be secured by tapping X and Y down the coil.

The Home Service station (449 m.) should be received with the variable condenser nearly all in. If it is tuned in with the condenser half or more open, move clip Z down to No. 7. If, on the other hand, the condenser has to be *full in*, then the clip can be moved up to, say, No. 5.

The best setting for all the clips can only be determined by actual test, then some interesting experiments can be carried out by the constructor. At a later date details will be given showing how to increase the range of this simple set and how to make use of the coil in a valve receiver.

Classified Advertisements

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

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

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

CABINETS

A CABINET for every radio purpose. Surplus cabinets (undrilled) from noted makers. We have hundreds in stock (no catalogues). Send measurements of chassis, etc., and say what kind of cabinet required. Stamp for reply. Inspection invited.

H. L. SMITH AND CO., LTD., 289, Edgware Road, W.2. Tel: Pad. 5891.

LITERATURE

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

LOUDSPEAKER REPAIRS

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

REPAIRS to moving coil speakers. Cones/coils fitted or rewound. Fields altered or wound. Prices quoted, including eliminators. Pick-ups and speaker transformers rewound, 4/6. Trade invited. Guaranteed satisfaction. Prompt service.

L.S. Repair Service, 5, Balham Grove, London, S.W.12. Battersea 1321.

MISCELLANEOUS

PRINTING.—1,000 Billheads, 3s. 9d.; Memos. Cards, etc. Samples free. — Creteway Press, 24, Buxted, Sussex.

BE TALLER !! Clients gain 1 to 6 inches !! Increased my height to 6ft. 3¾ins. Ross System Never Fails. Fee £2 2s. complete. Details 6d. stamp. —Malcolm Ross, BM/HYTE, London, W.C.1.

MORSE EQUIPMENT

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

MORSE TRAINING

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

NEW CHASSIS

ARMSTRONG CO. recommending the following economically priced Radio Chassis for good quality reproduction.

ARMSTRONG Model AW38.—8-valve All-wave Radio-gram chassis, incorporating the latest circuit, including 6 watts push-pull output. Price £8/8/0 + 5% war increase.

Armstrong Co. have many other models of equal interest, please write for catalogue.

Armstrong Manufacturing Co., Warlters Rd., Holloway, London, N.5.

NEW LOUDSPEAKERS

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

PUBLIC APPOINTMENTS

AIR MINISTRY.

AERONAUTICAL INSPECTION DIRECTORATE. Vacancies exist for unestablished appointments as Examiners in the General Engineering, W/T and Instrument Branches.

QUALIFICATIONS.

All candidates must have good general education, be able to read drawings, understand specifications, use micrometers and other measuring instruments.

(a) Applicants for the General Engineering Branch must have had practical experience in an engineering works. An elementary knowledge of materials testing is desirable.

(b) Applicants for the Instrument Branch must have knowledge of physics and training in light engineering or instrument making. Candidates with knowledge of optical instruments are also required.

(c) Applicants for the W/T Branch must have practical knowledge of W/T and electrical equipment with technical training in radio communication equal to City and Guilds final examination standard.

ACCEPTED candidates will undergo a period of training in inspection as applied to the above subjects, not exceeding three calendar months, and will be paid £3 10s. 0d. weekly during training. Subsistence allowance of £1 5s. 0d. weekly during training is payable to married men normally residing outside the training area. On successful completion of training, candidates will be appointed as Examiners at a salary of £246, if 25 years of age or over, with a corresponding reduction of £12 per annum for each year under 25 on joining (payable monthly in arrear) if service is satisfactory, and must be prepared to serve in any part of the United Kingdom.

NORMAL age limits 23 to 60.

CANDIDATES should indicate on their applications for which vacancy they wish to be considered—a, b or c.

APPLICATIONS must be made on Form 786, copies of which can be obtained on application, *by postcard only*, to: The Inspector-in-Charge, A.I.D. Training School (I.C.S./REC. 53), Brandon Steep, Bristol, 1.

NON-COMMISSIONED WIRELESS TECHNICAL INSTRUCTORS REQUIRED IN ARMY UNITS.

EMOLUMENTS.

Pay 8s. 3d. per day (7 days a week). Clothing, rations and accommodation, or if this cannot be provided, allowances at authorised rates. If married and otherwise eligible, family allowances payable in respect of wife and children subject to allotment from pay.

CANDIDATES should preferably be under 35 and over 24 and

(a) Hold one of the following qualifications:—
Graduateship of the Institution of Electrical Engineers.
Final (Grade III) Certificate of City and Guilds of London Institute Examination in Radio Communication.
Higher National Certificate in Electrical Engineering.
Certificate of City and Guilds of London Institute in Radio Service work.

or

(b) Be able to pass an examination on the following syllabus:
Simple algebra, including quadratic equations; simple trigonometrical ratios and identities; vectors.
Properties of electric currents; heating of conductors; magnetic fields: unit of current; ohms law; resistance in series and parallel; potentiometer.
Magnetic effect of current; fields due to parallel wires; field due to a solenoid; electro magnets.
Meters.
Induction; effect of rotating a coil in a magnetic field.
Mutual and self induction and inductance; effect of inductance on growth and delay of current.
Capacity; charging storage and discharge of condensers; through resistance and inductance.
Alternating currents; vector diagrams; effect of resistance variation; effect of L and C in an A.C. circuit; phase difference of currents; resonance in a series circuit; parallel circuit of L and C; Q factor.
Elementary knowledge of valves; simple theory of amplifiers, oscillators and detectors; general principles of radio practice.

SUITABLE candidates will be interviewed at local centres, and, if successful, will be enlisted and appointed acting Sergeant-Tradesman. For those who are on the Schedule of Reserved Occupations special arrangements will be made to enable them to be enlisted.

APPLICATION forms, obtainable by postcard from the Under Secretary of State, War Office (A.G.6.c.), Hobart House, Grosvenor Place, S.W.1, to be lodged by 6th June, 1940.

RADIO MAP AND GLOBE

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

RECEIVERS AND COMPONENTS

RADIO CLEARANCE, LTD., 63, High Holborn, London, W.C.1. TELEPHONE: HOLborn 4631.

LISSEN 2v. screen-grid valves, S.G.215 and S.G.2V, 3/6 each.

LISSEN 2v. battery pentode, 4-pin side terminal P.T.2A and P.T.225, 3/11 each.

LISSEN 4v. mains screen grid A.C./S.G., 4/11 each.

LISSEN 4v. mains output pentode A.C./P.T., 4/11 each.

LISSEN rectifier valve V650, 2/11 each.

ALL-WAVE super-het. chassis, 5 valve A.C. Latest Mullard valves T.H.4.B., V.P.4.B., T.D.D.4., Pen. A.4., L.W., 4/350v. Ranges: short wave 16-48 metres. Medium wave 200-560 metres. Long wave 800-2,200 metres. Size of chassis, 14½in. long, 7½in. deep, height overall 8½in. Controls, tuning at side. Volume on/off at side, wave-change, provision for pick-up. Complete with valves and knobs, £4/17/6. Special Speaker, 1,500 ohms field, 10/6 each.

ULTRA SHORT and short-wave choke. Lissen Hi-Q. inductance, 100 microhenries. Boxed, list, 2/-. Our price, 1/- each.

ULTRA SHORT and short wave double wound low-resistance choke. Lissen Hi-Q. resistance less than .05 ohms. Boxed, list, 2/6. Our price, 1/3 each.

LOW-LOSS Ceramic valve-holders. Lissen Hi-Q. Baseboard and chassis, 5- and 7-pin, 10d. and 1/- each.

MANSBRIDGE type condensers. Lissen Hi-Q. 250 D.C. working. Moulded case with feet .1 mfd. and 1 mfd., 6d. each.

ROTARY COIL UNIT. Lissen Hi-Q. Four-band from 4.8-91 metres, can be selected by a turn of the knob. With circuit. Boxed. List, 15/6. Our price, 6/11 each.

LOW-LOSS short-wave variable condensers. Ceramic insulation. Brass vanes. Lissen Hi-Q. Minimum capacity 5 micro-micro farads. Two types. Boxed. With knobs. 160 mmfd. List, 7/6. Our price, 3/- each. 20 mmfd. List, 5/6. Our price, 2/6 each.

CONE speaker unit. Lissen. Complete with reed and chuck. Boxed, 1/- each.

PUSH-PULL switches. Lissen. 2-point, 4d. each. 3-point, 6d. each.

ROLA P.M. speakers. Latest type, 7½" cone with power and pentode transformer. Boxed. 15/- each.

CLOCK-FACED dials. 5" x 3½". With printed 3-wave scale. Ox-copper escutcheon and glass, 3/6 each. Ditto, less escutcheon, 2/6 each.

FILAMENT transformers, input 200-250v., output 4v.4 amps., 4v.6 amps., 4/11 each.

MAINS transformers. Plessey. 350-0-350v., 90 m.a., 4v. 2.5 amps., 4v. 6 amps., 8/6 each.

MAINS transformer. G.E.C. American windings, 350-0-350v., 65 m.a., 5v. 2 amps., 6.3v. 2.5 amps. Suitable for replacements in G.E.C. models, 5/6 each.

MAINS transformers. Wearite. Type R.C.1, 250-0-250v., 80 m.a., 4v. 2.5 amps., 4v. 4 amps., 9/11 each. Type R.C.2, 350-0-350v. 120 m.a., 4v. 2.5 amps., 4v. 4 amps., 12/6 each. Type R.C.3, 350-0-350v. 150 m.a., 4v. 2.5 amps., 4v. 2 amps., 4v. 5 amps., 15/- each. Type R.C.4, 500-0-500v. 150 ma., 4v. 2 amps., 4v. 2 amps., 4v. 2.5 amps., 4v. 5.6 amps., 21/- each. All above are centre-tapped windings. Type R.C.5, 100-watt auto transformer, 100-110v., 200-250v., reversible. 12/6 each. All transformers 200-250v. tapped primaries.

CHASSIS mounting valve-holders. American 4-5-6-7-pin, 4d. each. Octals, 6d. each. Loctals, 10d. each. 7-pin English type, 3d. each.

1 WATT resistances, Polar N.S.F., 4d. each; 3/9 dozen. All sizes up to 2 meg.

VOLUME CONTROLS. American C.T.S., finest made, divided spindles. Length 2½". With switch 2,000, 5,000, 10,000, 25,000, 100,000, 250,000, 500,000, and 1 meg., 2/6 each. Wire wound, 5 watt (less switch), 2,000, 5,000, 10,000, 20,000, and 25,000 ohms., 2/- each.

24 MFD. can type electrolytics, 450v. working, 1/6 each.

MAINS TRANSFORMER, type R.C.D. Drop through. Capped. 250/350v. 100 ma., C/T. 4v. 6 amps., 4v. 2.5 amp. Wire-ends, 10/6 each.

SPEAKER transformers, pentode output, 3-4 ohm. matching, 3/- each.

B.I. wire-end type, bias electrolytics, 50 mfd., 12v., 1/6 each. Ditto, 50 mfd., 50v., 2/- each.

TUBULARS wire-end, non-inductive paper condensers. All sizes up to 0.1, 5d. each; 4/9 dozen.

B.I. 8 x 8 mfd., 550v. working. Cardboard electrolytics, 3/6 each. Ditto, 16 x 8 mfd., 4/6 each. Ditto, 8 mfd. tubulars, 2/- each. Ditto, 4 mfd. tubulars, 1/9 each. Ditto 2 mfd. tubulars, 300v. working, 1/3 each.

All orders must include sufficient postage to cover. Hours of business: 9 a.m.—6 p.m. weekdays; 9 a.m.—1 p.m. Saturdays.

PLEASE WRITE YOUR ADDRESS IN BLOCK LETTERS.

WE CANNOT UNDERTAKE TO ANSWER ENQUIRIES UNLESS ACCOMPANIED BY FULL POSTAGE (2½d.).

RADIO CLEARANCE, LTD., 63, High Holborn, London, W.C.1. TELEPHONE: HOLborn 4631.

RECEIVERS AND COMPONENTS

BANKRUPT Bargains. Brand new 1939/40 models, makers' sealed cartons, with guarantees, at less 30% to 40% below listed prices; also Midgets, portables, car radio. Send 2½d. stamp for lists.—Radio Bargains, Dept. P.W., 261-3, Lichfield Road, Aston, Birmingham.

TRANSFORMERS for L.T. Rectifiers for charging and safety, 12v. lighting, from 12/6.—Thompsons, 176, Greenwich High Road, S.E.10.

DENCO.—Ultra low loss S.W. components, receivers, polystyrene insulation. Send 2d. for Catalogue.—Warwick Road, Clacton, Essex.

VAUXHALL.—All goods previously advertised are still available; send now for latest price list, free.—Vauxhall Utilities, 163A, Strand, W.C.2.

COULPHONE Radio, Ormskirk. Collaro A.C. Motors, 12in. turntable, 27/6. Radiogram Units, 45/-. High quality crystal pickups, 25/-. Rola G.12 speakers, energised, 52/6. G12 P.M., 65/-. Guaranteed American valves, 4/6 ea. Octal, 5/6. 1d. stamp for lists.

LIMITED number of Meissner 3-valve short-wave kits in stock, price 21/- post free, complete except for valve, which can be supplied if required. Send cash with order at once to avoid disappointment. Large stocks of all valves, all types of electrolytic condensers at least 30 per cent. below list.—Gilpin Electric, 32, Edgeworth Crescent, Hendon, N.W.4.

OLDHAMS.—Ex-Police, slightly used, unspillable 2v. 7 amp. Accumulators, suitable for Lamps, Portables, etc. 2/- each. Also 6v. 38 amp. accumulators, slightly used, suitable for A.R.P. emergency lighting, etc., 10/- carriage forward. Special terms for trade. 7-strand best rubber covered copper aerial wire, 50 feet, suitable for all purposes especially S.W. reception. 2/- post free. See also last week's issue.—London Central Radio, 23, Lisle Street, W.C.2. Gerrard 2969.

SOUTHERN Radio's Bargains.
ALL Guaranteed. Postage Extra.
5/- Parcel of useful Components, comprising Condensers, Resistances, Volume Controls, Wire, Circuits, etc. Value 25/-. 5/- per parcel.
15/- Service Man's Component Kit. Electrolytic Condensers, Volume Controls, Resistances, Tubular, Mica, Paper Condensers, Valve Holders, etc. 120 articles contained in strong carrying case, 9" x 7" x 7", 15/- the Kit.
21/- Small Trader's Parcel of Components. 150 Articles comprising all types Condensers, Valve Holders, Resistances, Chokes, Coils, Wire, etc. Value 85/-, 21/- the parcel.
5/- 100 Wire-end Resistances, assorted capacities, ½ and 1 watt, 5/- per 100.
ORMOND Loud-speaker Units, 2/6; Crystal Sets, 5/6; Westectors Type W2, 2/6; Crystal Detectors, 2/-; Crystals, 6d.; Marconi V24 Valves, 9d. "P.O." Microphones on Stand, for use with any receiver, 5/-; Telsen W349 Iron-core Midget D.R. Coils, 5/6; Morse Tapping Keys, 3/-; Buzzers, 1/6.
2/- Tool or Instrument Carrying Cases, ex Government Stock; Wood 9" x 7" x 7", 2/-.
SOUTHERN Radio, 46, Lisle Street, London, W.C. Gerrard 6653.

FREE ADVICE BUREAU

COUPON

This coupon is available until June 8th, 1940, and must accompany all Queries and Hints.

PRACTICAL WIRELESS, 1/6/1940.

PREMIER RADIO

NEW PREMIER S.W. A.C. RECEIVER KIT

In response to many requests, we have now produced an A.C. version of the popular Premier Short Wave SG3 Kit. Complete Kit of Parts with drilled chassis, all components, Plug-in Coils covering 13-170 metres, 4 valves and full instructions and circuits £4/10/-. Completely wired and tested, £5/10/-. *Send for full details.*

PREMIER SHORT-WAVE BATTERY-OPERATED KITS for OVERSEAS NEWS
Incorporating the Premier 3-Band S.W. Coil. 11-86 Metres without coil changing. Each Kit is complete with all components, diagrams, and 2-volt valves. **3-Band S.W. 1-Valve Kit, 14/-. 3-Band S.W. 2-Valve Kit, 22/6.**

DE LUXE S.W. KITS

Complete to the last detail, including all Valves and coils, wiring diagrams and lucid instructions for building and working. Each Kit is supplied with a steel Chassis and Panel and uses plug-in Coils to tune from 13 to 170 metres.

1 Valve Short-Wave Receiver or Adaptor Kit	20/-
1 Valve Short-Wave Superhet Converter Kit	23/-
1 Valve Short-Wave A.C. Superhet Converter Kit	26/3
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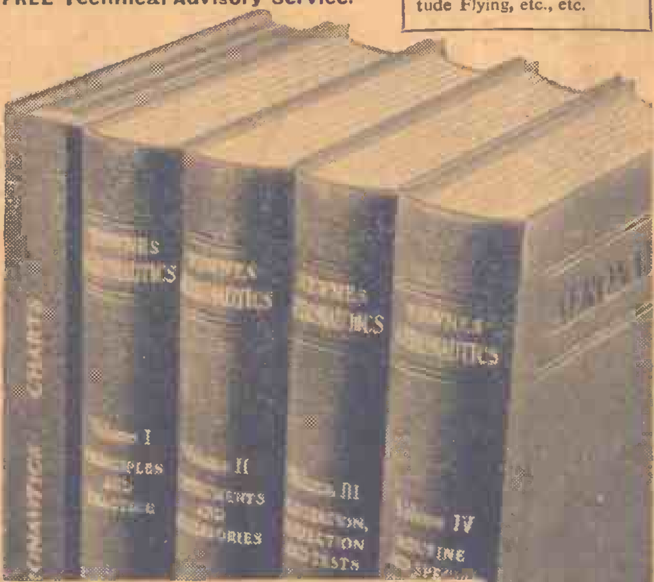

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SPEAKER MATCHING—See page 251

A NEWNES PUBLICATION

Edited by F. J. CAMM

Vol. 16. No. 403.

Practical Wireless and PRACTICAL TELEVISION

4D. EVERY WEDNESDAY

June 8th, 1940.

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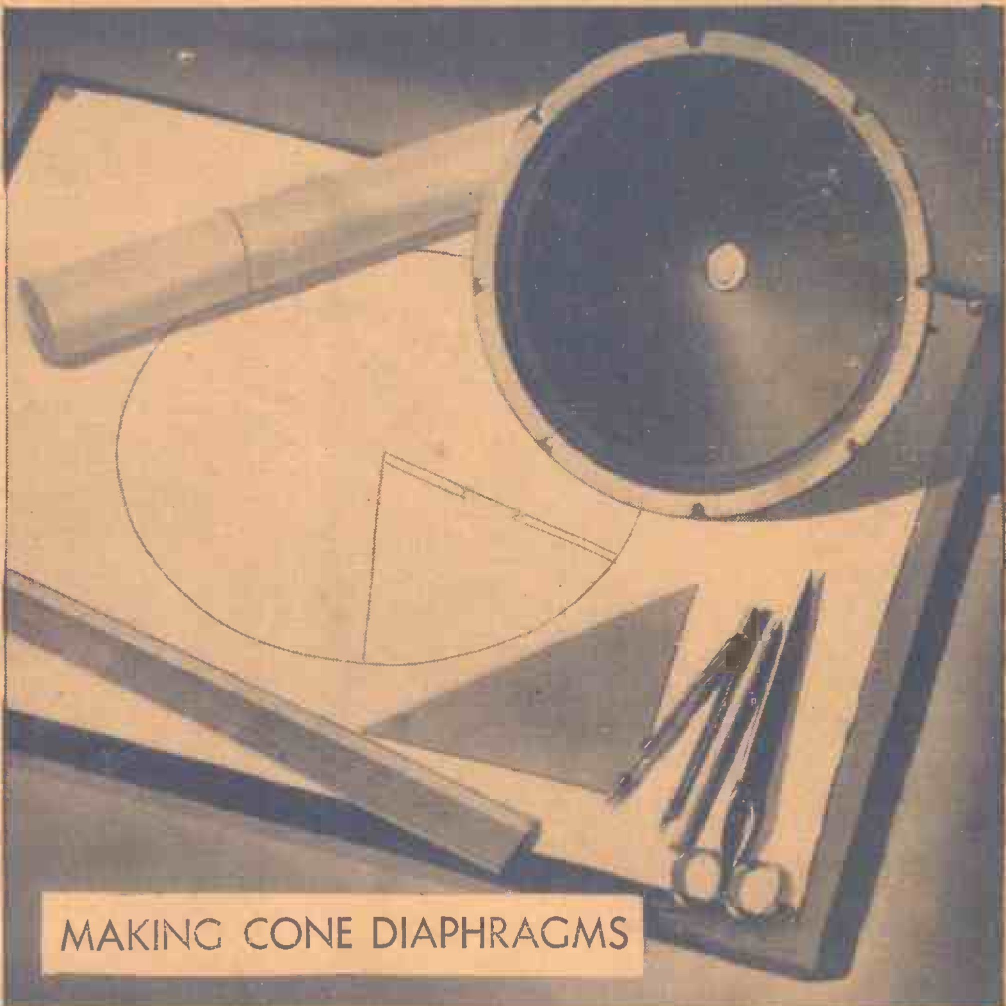

MAKING CONE DIAPHRAGMS

Practical Wireless and PRACTICAL TELEVISION

EVERY WEDNESDAY
Vol. XVI. No. 403. June 8th, 1940.

EDITED BY F. J. CAMM

Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Speaker Diaphragms

AT one time many constructors made up their own loudspeakers, using the ordinary magnet or moving-iron arrangement, and considerable interest accrued from the many ingenious diaphragm designs which were evolved. With the advent of the moving-coil speaker this phase of the hobby faded out, as the cone requires mounting with considerable accuracy. However, there are still many experimenters who are interested in the results obtainable with different types of cone material. The method of marking out a cone is not, apparently, well known and for the benefit of those who wish to carry out experiments in this direction we give some valuable data in this issue. It should be emphasised, however, that with moving-coil units great care must be taken in centring the speech coil and further scope for experiment is afforded in the design and fitting of the spider or retaining device. The information will also be of value to those who have a damaged speaker and wish to carry out the repair for themselves, although it may be mentioned that special replacement cones, with speech coils attached, are obtainable from firms which specialise in this branch of the work.

Oi! Ben Calling!

WHEN Jefferson Farjeon's thriller, "No. 17," was broadcast as a serial, it familiarised thousands of listeners with the Cockney character, Ben, as played by Leon M. Lion. The same actor will be heard as Ben in a new series for the Forces, starting on June 7th.

Each broadcast will be concerned with a separate adventure of Ben, who seems to have a remarkable aptitude for finding himself up to the neck in all manner of different kinds of trouble.

Hugo Rignold and His Orchestra

HUGO RIGNOLD and his Orchestra will be the "Band of the Week" beginning June 9th. This will be Rignold's first visit to Bristol with his band. He is at present responsible for the musical direction of "Present Arms," the new Arnold-Foster revue at the Prince of Wales Theatre in London. He has been heard several times in the Forces programme, and as conductor with other ensembles. He is a brother of Pat Rignold, a member of the Cavendish Three, who has recently branched out for herself in a new comedy line.

"Band Wagon" from the North

VARIETY programmes from the North in the near future are topped by a broadcast of "Band Wagon" from the Palace Theatre, Manchester, in the Home Service and Forces programmes on June 8th. A studio variety feature which is to be revived on June 6th in the Forces programme is "Listeners' Letter Box," starring Mae Bamber.

They're the de Vere Sisters. Their theme, Kreisler's "Caprice Viennois," is the signal for a quiet half-hour of songs and poetry on "Moon River," one of the oldest and most consistently popular broadcasts on WLW. Left to right are Marjorie, Ruth and Billie, whose vocal arrangements are heard nightly at 12.30 a.m. E.S.T.

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

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

Scarborough on the Air

SCARBOROUGH comes into the programmes on two occasions in the near future. On June 7th Kneale Kelley and the Spa Orchestra are broadcasting from Scarborough in the Forces programme. On the following day in the Home Service and Forces programmes, Richard Jerome's "Rolling Stones" Concert Party will be heard from the Floral Hall, Scarborough.

Fishermen All

WITH the title "To Catch a Fish," David Scott Daniell and Godfrey Baseley have arranged a programme about angling, to be broadcast for Home Service listeners on June 14th. Izaak Walton, who was born in Staffordshire, is a source for the literary background, and in this framework it is hoped to have two types of fishermen represented, the fly fisherman as aristocrat of the sport, and the coarse fisherman who lines canal banks in his hundreds. The programme comes appropriately on the eve of the opening of the Coarse Fishing Season.

"I Want To Be An Actor"

THE popular feature, "I Want to be an Actor," will be revived by Vernon Harris on June 14th, and it is hoped that it may develop into another series. In the past, this programme has been run separately, but often as part of another show. For instance, it appeared in "Band Wagon" at the beginning of the war. On June 14th, however, it will come from a Camp Concert, and all the potential actors and actresses will be Army, Navy, Air Force, A.T.S., W.R.N.S. or W.A.A.F.S.

Heroes Who Feed the Nation

STORIES about the heroes who go to fish in the war-racked North Sea in all weathers and all dangers, will be told in a talk on June 6th by a Scot, burly, cheerful, rubicund Bailie Adam Brown, of Fraserburgh, who knows the fishermen well.

All-purpose Testers

Details of Some New Test Instruments Designed for the Testing of All Components. By W. J. DELANEY

MANY experimenters, especially the "old hands," have made up their own test apparatus. In many cases this will consist of a multi-purpose meter reading volts, ohms and amps, with, perhaps, the addition of a valve tester. Beyond this, very little is done, with the result that insulation tests, condenser tests and similar all-important work cannot be carried out. It might be argued that a "short" test is good enough for testing condensers, but it does not always give a sufficiently accurate indication of leakage test for electrolytic condensers, neither does it give actual readings of the value of the condenser. It would appear, therefore, that there is room for a tester which may justly be called an "all-purpose" instrument, and there are many different lines upon which such an instrument may be built up. Perhaps it would be most useful if some actual constructional data of such a tester were given, as this would enable the various details to be followed.

The Circuit

The sketch shows a theoretical circuit of a tester which, in addition to measuring ordinary resistances, also tests condensers, giving their actual capacity, the leakage at low and high voltage, and their power factor, and by taking tappings from a secondary of a further mains transformer may also include a valve tester on the lines of that recently described in these pages. It will be seen that the input circuit consists of three mains transformers—one for the valve tester (which in this case is optional), one for the mains section used for the high voltage test purposes, and one for the low voltage. These could, of course, all be included on the one transformer, although this would mean that a special component would have to be wound. With the separate arrangement the individual transformers may be found on hand or more readily obtainable. The indicating device is a standard "magic eye" or electron-ray tuning indicator of standard type. When set up for testing, for instance, the leakage of ordinary fixed condensers (not electrolytics) the plug-in test leads are inserted in the sockets C and the zero adjuster manipulated so that the shadow in the tuning indicator is as small as possible. If, now, the two test leads are brought together (short-circuiting the terminals C) the shadow will fly open. If, therefore, a short-circuited condenser is connected across the test leads, the shadow will open, but if the condenser has perfect insulation (equivalent to leaving the test leads apart) the shadow on the indicator will remain at the setting obtained with the zero adjuster. Thus we have a good indication of the condition of a condenser, from perfect insulation to short-circuit, and as there is a leakage dependent upon the capacity of a condenser the width of shadow will give an indication of the internal resistance or leakage of the condenser and thereby some idea as to its value.

Testing Resistors

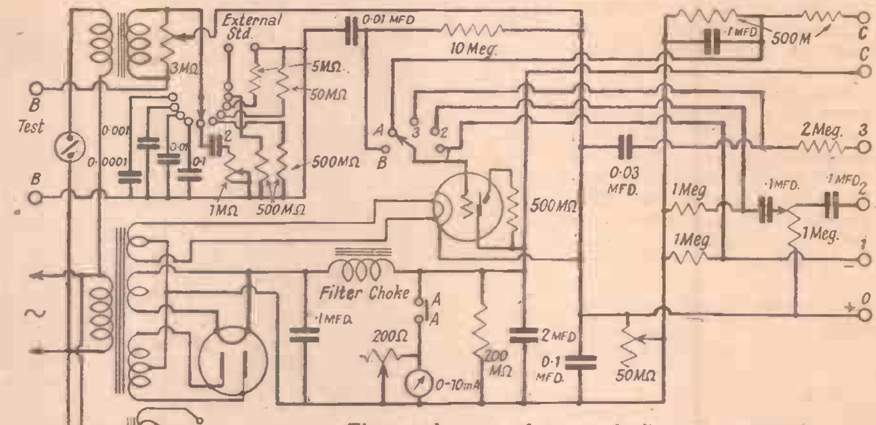
The small transformer is wired to a bridge circuit, and this has a number of component standards which permit actual capacity readings to be obtained, and also for resistances to be compared. The scale attached to the variable resistance has, of course, to be first calibrated for various readings on each range of the selector stud, although the pair of terminals marked E permit external standards to be added, so that ranges outside those obtained with the built-in components may be obtained.

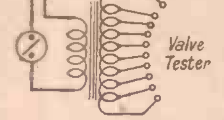
It will be noticed that there are several output terminals on this particular instrument, and by suitable combinations some interesting tests may be carried out. For instance, terminals 0 and 1 will give a high value D.C. which may be used for various tests, such as the application to a condenser, with meter in series for break-down tests. Terminals 0 and 2 give an A.C. voltmeter which may be used for any purpose to which such an instrument is applied—output meter, hum level indicator, etc. In this case the magic eye is, of course, the indicator, and is extremely sensitive.

By connecting the test leads to terminals 0 and 3 the instrument becomes a D.C. valve voltmeter, sensitive from zero up to about 10 volts. In addition to these standard forms of test the apparatus may also be included in part of a circuit for testing the function of circuits. As an example, it may be connected in the A.V.C. line of a receiver to check the efficiency of the A.V.C.

Other Testers

No doubt many other applications of combinations will occur to the experimenter, although it must be pointed out that we are unable to give explicit constructional data or other information relative to this particular circuit which is only included as an example of the type of apparatus which may be made up by the keen amateur. There are, of course, dozens of other types of apparatus which may be similarly constructed, using either ordinary meters, or the cathode-ray indicator for actual indicating purposes. The use of the standard 1 or 0.1 milliammeter in an all-purpose tester, reading various voltage and current ranges, and with the addition of a battery also reading resistance ranges, is very well known and is, perhaps, the best example of a combined type of instrument constructed from separate items. The valve tester is another example, whilst a set analyser or similar device is also capable of inclusion in the list. Probably the volt-amp-ohm tester is the most popular on account of the fact that it is useful to every listener, whereas the other types of instrument mentioned are more specialised, and thus only required by the service-man or the very advanced experimenter. We shall shortly describe a self-contained instrument of this type for those who are looking for a small all-purpose tester.





Theoretical circuit of a typical all-purpose tester.

AMERICAN RADIO TERMS

MOST people probably know that a valve is called a tube in America, an abbreviation of thermionic vacuum tube, a term often used in English scientific textbooks. Two other American terms which are very reasonable and actually to be preferred to the British equivalents because they are more explicit, are radio frequency (R.F.) and audio frequency (A.F.) for H.F. and L.F. (as applied to transformers, etc.). Reaction in America is always called regeneration, and is obtained by means of a "tickler coil"; in this connection it is interesting to notice that many scientific workers in England refer to reaction as retroaction. A circuit is usually called a hook-up in America, and the act of wiring-up a component described by the same term. Unfamiliar names for various components are: binding-post for terminal, tube-socket for valve-holder, with cushioned or floating socket for anti-microphonic valve-holder, loop for frame aerial, and headset for headphones. Screening is usually called shielding, and when screen-grid valves were first introduced they were called shield-grid tubes, although this has now given place to screen-grid tube. Theoretical terms are generally the same as in this country, although one sometimes comes across "capacitance" for "capacity."

For the Beginner

SPEAKER MATCHING POINTERS

The Importance of Correct "Load" and Other Factors

TWO phrases which are cropping up constantly in radio articles are "the optimum load of an output-valve" and "speaker matching." These have a very special significance, and readers cannot have their attention drawn too frequently to them if "quality" is to be the real aim of the set user.

The first phrase means that in order to obtain the maximum output from your set the impedance of the apparatus (loudspeaker and so forth). connected in the anode circuit of the output valve must at any rate be approximately equal to an "optimum" of ideal value, which depends upon the type and characteristics of the valve used.

The implication of the phrase "speaker matching" is that if the impedance of your speaker differs greatly from the optimum load of your output valve, matters must be adjusted by the use of a suitable output transformer or tapped choke, or distortion will arise. It is in this connection that the amateur frequently encounters difficulty, for in order to determine accurately the correct ratio for the output transformer, it is necessary to know the optimum load for the valve and the impedance of the loudspeaker, and then to perform a mathematical calculation which, although fairly simple in itself, is apt to puzzle those whose maths have become a bit rusty.

Optimum Load

In order to assist readers over this problem we propose to discuss briefly why each valve has its "optimum" load value, how a transformer can "match up" a speaker to a valve, how the essential calculation should be made, and, finally, to submit various methods whereby this calculation may be simplified to a considerable degree.

To begin with, then, why is there an "optimum" or best value for the load in the anode circuit of an output valve? You will, of course, agree that the power output of a valve is represented by multiplying together the effective variations in the anode current of the power valve and the value of the effective A.C. voltage drop across the load. In the case of a simple set the load is the speech winding of the speaker. It should also be clear to you that if the impedance of the speaker (that is, the opposition it offers to varying currents), is very small compared with the impedance of the valve itself, the voltage drop across the speaker will also be small, and naturally the power expended in the speaker will be small.

The relation between the output and the load impedance for a given valve can be calculated, and can also be determined experimentally. If corresponding values of load and output be plotted in squared paper, the resultant curve will be of the form shown in Fig. 1. Here, you will observe, at low load values the output is small, as we would expect, but the output increases fairly rapidly as the load is increased. Beyond a certain load value, however (A in Fig. 1), the increase of output with increasing load is not so great, while after reaching the point B, further increase in load impedance makes little or no appreciable improvement in the power output.

Distortion

It would appear, therefore, as if any value of load impedance between, say, C and D in Fig. 1, would give much the same output, and thus the optimum load value is not critical, but this is a mistake. This will be made clearer by a reference to Fig. 2, which shows the same graph as in Fig. 1, and in addition a further graph in the form of a dotted line. This line indicates the percentage distortion of output for different outputs. For a definite set of conditions, that is, grid bias, anode voltage and load, and output of a valve depends upon the strength of the signal voltage applied to its grid. As the characteristic curve of the valve is not quite straight, there will be a certain amount of distortion, and the distortion will be greatest at full output, because in order to get this full output the grid swing will cover more of the curved portion of the characteristic. Thus you will see that the distortion curve indicates greater distortion at big output than at low output.

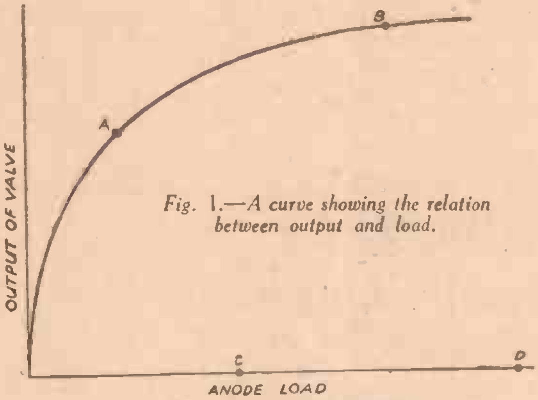


Fig. 1.—A curve showing the relation between output and load.

It has been found by experience that as much as 5 per cent. distortion can be permitted without seriously impairing the quality of reproduction, so the published optimum load is selected as that value of load impedance which gives the biggest output consistent with reasonably small percentage distortion. In the curve reproduced in Fig. 2 the optimum load would probably be taken as A, for with this value practically the maximum possible output is obtained, and the distortion is within the limit of 5 per cent.

It may be remarked that the distortion curve plotted in Fig. 2 is the second harmonic distortion curve. In the case of a pentode output valve the third harmonic distortion is likely to be more serious than the second harmonic, and must be taken into consideration when deciding upon the optimum load.

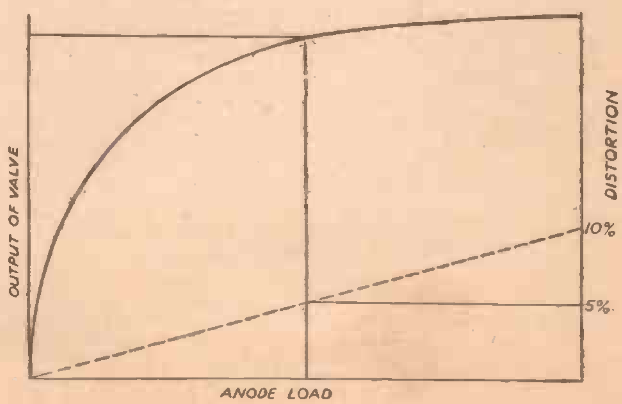
Adjusting Matters

We must now consider why an output transformer can adjust matters if the impedance of the loudspeaker does not happen to be more or less equal to the optimum load. First of all, what is the impedance of the speaker? It is not necessarily the resistance of the speech winding. The opposition the winding offers to alternating current is different from that which it offers to direct current, and, moreover, is different for every frequency. It is usual to use for the purposes of calculation, the impedance at a definite frequency —usually at 1,000 cycles. This figure is quoted by most speaker makers in their catalogues and leaflets. In some cases, however, the resistance only is quoted. In that case, you will not be far wrong if you consider the impedance of a moving iron speaker to be the same as its resistance, and of a moving-coil speaker to be about one-and-a-quarter times its resistance.

If the speaker impedance is greatly different from the optimum load for the valve with which it has to work, a transformer of suitable ratio must be used to balance matters. The primary winding of the transformer is connected in the anode circuit of the valve, and the speaker is connected in the secondary circuit of the transformer. If the turns ratio of the transformer is correctly chosen, the primary winding will form a suitable load for the valve, while the speaker winding will form a suitable load for the transformer. The correct value of the ratio of the output transformer is calculated from a formula. We will not worry you with a long explanation of how the formula is deduced, but will give it to you right away:

(Continued on next page)

Fig. 2.—This curve shows the relation between output and load with the addition of distortion curves.



SPEAKER MATCHING POINTERS

(Continued from previous page)

$$\text{Transformer ratio} = \sqrt{\frac{\text{Optimum load of valve in ohms.}}{\text{Impedance of speaker in ohms.}}}$$

For those who are not mathematicians, we must explain that this means that to ascertain the correct ratio you divide the optimum load of the valve by the speaker impedance, and find the square root of the result. The answer to this little sum is the accurate value of the transformer ratio.

Of course, in many instances the result will be an awkward number like 1.82, or something similar. There is no need to try to purchase a transformer with an odd sort of ratio like that, for the actual value is not quite so critical, and the nearest standard ratio to the figure you obtain from your calculation will, in many cases, be found satisfactory.

Helpful Data

For the convenience of non-mathematical readers, the graphs reproduced in Fig. 3 and Fig. 4 have been prepared. To use these graphs all you have to do is to divide the optimum load by the speaker impedance. Then find a point on the upright scale of Fig. 3 or Fig. 4 corresponding to the result of your division. Follow this point horizontally across the paper until you meet the curve, and then follow the point downward until you meet the horizontal scale at the bottom, on which you can read off the correct transformer ratio. Two curves are provided, one for use when the result of the division is comparatively small, say under 150, and the other for higher values up to 4,000.

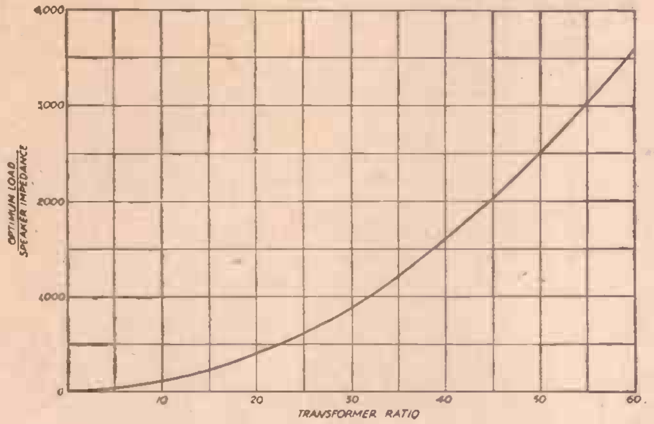


Fig. 3.—A matching chart for low-resistance speakers.

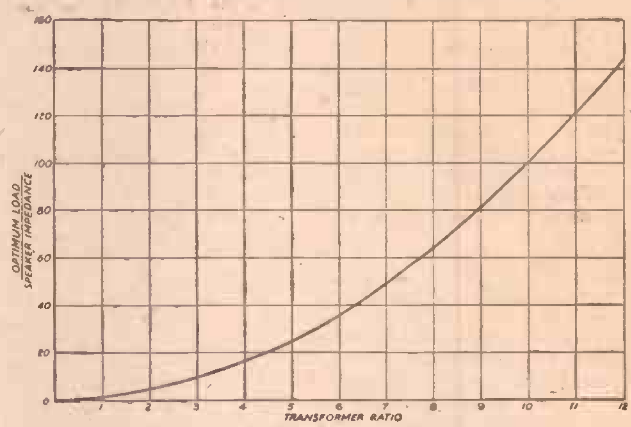


Fig. 4.—A similar chart to Fig. 3, but for high-resistance speakers.

Balanced Feedback for Multi-stage Push-pull Amplifiers

Curing a Form of Instability

WHEN negative feedback is applied to multi-stage amplifiers, it is often found that phase changes in the amplifiers and in the feedback path may exceed 180 deg., with the result that negative feedback may be converted into positive feedback and consequently may cause oscillation at some frequencies.

In the case of amplifiers having output transformers, this difficulty can sometimes be overcome by taking the feedback voltage from the primary winding of the output transformer instead of from the secondary winding. An example of such an amplifier is shown in Fig. 1.

This form of feedback connection, however, gives rise to a disadvantage in the case of an amplifier having a push-pull output stage, as in Fig. 1. One of the advantages of a push-pull output stage is that even harmonics generated by the output valves are cancelled in the common output circuit. In the arrangement shown in Fig. 1, these even harmonic components which, of course, exist in the separate anode circuits of each valve, are fed back, and although these components may thereby be reduced in the anode circuit of the valve V1, they will be increased in the anode circuit of V2 and furthermore, the usual cancellation effect in the common output circuit will no longer take place.

Modified Feedback Circuit

A modified feedback circuit which does not interfere with the desirable cancellation effect of the push-pull output stage for even harmonics is shown in Fig. 2. Here an additional feedback path is taken from the anode of V2, and whereas that from V1 is applied to the cathode of the valve V, the additional feedback is applied to the grid of this valve. The connections may, of course, be reversed, but in either case, the effect is to cancel out all even-order harmonic potential differences between the grid and cathode of the input valve V. The output valves V1 and V2, therefore, normally carrying out their suppression effect and no even-order harmonics appearing in the input circuit, none appear in the load circuit of the amplifier. The proper balancing out of even-order harmonics in the input circuit is easily effected by the correct choice of the feedback-path parameters. The arrangement does not, however, balance out odd-number harmonics in the input circuit and there is, therefore, cancellation of these harmonics in the output circuit in the normal manner with feedback.

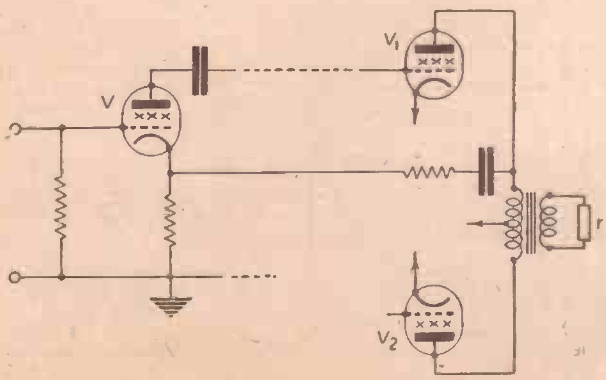


Fig. 1.—Standard push-pull amplifier with feedback taken from the primary of the output transformer.

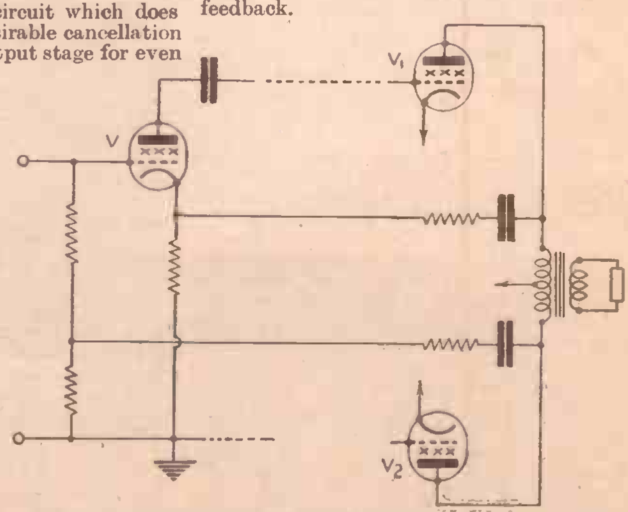


Fig. 2.—Additional feedback is provided in this circuit—balancing out even harmonics.

ON YOUR WAVELENGTH

By Thermion

An Appeal

ONE of my readers, whose address I may not give, belongs to a battalion which is isolated in a remote part of the country, and is without radio. He wants to know if any reader has built the Gas-mask Box Receiver described in our issue dated May 11th, and who is prepared to let him have it so that they can listen in to the news. Any reader anxious to help may obtain the address of the applicant by addressing a postcard to me, marked J. W.

Our 400th Issue

GRATEFUL acknowledgments of all those letters I have received congratulating us upon our 400th issue which appeared a few weeks ago. Let us hope that the war is over by the time we reach our half-century mark, which I am certain will be celebrated, like the victory we hope to achieve, in some signal way.

The News

THE vital difference between this war and the last lies in the fact that we now have wireless telephony, and it is possible to listen in to the news broadcast by each country. Thus, whereas in the last war, we had to wait for a considerable time before the news reached us from the fighting front for broadcast through the Press, it can now be transmitted within a few minutes of its happening.

Obviously each country interprets the happenings of war in a different way. Whilst there may be the tendency for each country to place the best interpretation upon the news, I think every British listener will agree that this country presents the news fairly and without exaggeration. It does not pretend to belittle the gravity of the situation. The wireless, however, exerts a remarkable influence in helping to keep up the morale of the nation, and we can feel but pity for the Germans—and others !—who are kept in ignorance of the facts when such facts go against them. The truth must prevail in the long run. If German methods are to prevail by force, life will, indeed, lose its interest for those who hold the sanctity of veracity dear. Honesty must be the best policy.

"The Radio Training Manual"

SO great has been the demand for our presentation book, "The Radio Training Manual," that we have had to reprint it. Thousands of copies have been despatched, and hundreds of letters of congratulation have been received here. Another successful PRACTICAL WIRELESS effort.

Property and Persons

THE recent legislation mobilising the entire resources of the nation gives the Government complete control over all property and every individual. Any person may thus be ordered by the Government to do a particular job. It is essential, of course, that the person be given the job he is best equipped to do. Readers of this journal, I have no doubt, are mostly skilled at some particular job, apart from radio. Those, however, who have concentrated on radio will find opportunities will exist for them to help the National War Effort. At the time of writing it is not possible to forecast exactly how the Government will apply the Act, which applies to everyone, rich and poor alike, skilled and unskilled.

The "Radio Engineer's Pocket Book"

IN response to an insistent demand we are issuing in pocket-book form the series of sheets which were recently concluded in this journal under the title of "Radio Engineer's Pocket Book." We had intended readers to cut these out and themselves make up a little pocket book. So many readers, however, have missed their copies, and have been unable to obtain back issues in these days of paper shortage, that we are producing the sheets in book form. The book has the addition of a list of contents, and a fully cross-referenced index. It is bound in stiff boards, with round corners, and will be sold at 3s. 6d., or 3s. 9d. by post. It will be ready shortly.

Books and Magazines for the Forces

THE Postmaster-General announces that until further notice, books and magazines may now be handed in at most Post Offices in England, Wales and Scotland for the use of sailors, soldiers and airmen. But at the small Post Offices where all collections are made by postmen on foot or on cycle, a notice will be exhibited informing the public of the nearest office which will accept them. The scheme will not apply to Northern Ireland, the Channel Islands, and the Isle of Man.

The Post Office will convey the books without charge to a central depot which is under the direction of the Admiralty, the War Office and the Air Ministry, whence distribution of the books to the various units of the Navy, Army and Air Force at home and overseas will be effected.

Donors will use their judgment as to the kinds of books and magazines that will be acceptable, but the experience gained in the last war in connection with a similar scheme conclusively proves that novels and weekly or monthly illustrated magazines are most appreciated by the fighting services. A small number of educational textbooks, including foreign language teaching manuals, will be of value. Newspapers, whether published daily or weekly, cannot be accepted.

Books and magazines intended for the free collection must be clean and in good condition and should not have any address, wrapping or packing. They must not be posted in letter boxes, but handed in over the counter at one of the many Post Offices nominated for the purpose. No acknowledgment can be sent to donors, but they may rest assured that their gifts will be warmly appreciated by the men.

Any book or magazine addressed to an individual or to a particular unit or hospital, or ship, must be sent by post and fully prepaid in the ordinary way.

Sabotage by Noise

NOW that practically every industry in the country is working at top speed, and employees are operating day and night shifts, under the strain of securing maximum output, it is about time that drastic steps were taken to safeguard their rest. One has only to visit any suburb to hear the blatant blare of numerous loudspeakers which, due to the thoughtlessness and lack of consideration of those people who appear to lack the slightest sense of feeling, are shattering the peace of the whole neighbourhood. It does not seem to dawn on such people that some of their neighbours might be attempting to sleep, so that they can resume their work, at night or early morning, in a fit condition. Bearing in mind that every ounce of effort is now of vital importance to the nation's welfare, the owners of the sets which are responsible for such discordant noises are doing much to reduce the efforts of those on whom so much depends.

It is hoped that all readers of PRACTICAL WIRELESS will appreciate that during the summer months, when one naturally has windows wide open, a room appears to act as a soundbox, and causes the output from a loudspeaker or gramophone to radiate and carry over a very wide area, and that they will take every precaution to see that the volume of their loudspeaker is only sufficient for the occupants of the room, and not for the whole neighbourhood.

ELECTRONIC BREVITIES

A Few Notes on Cathode-ray Tube Developments

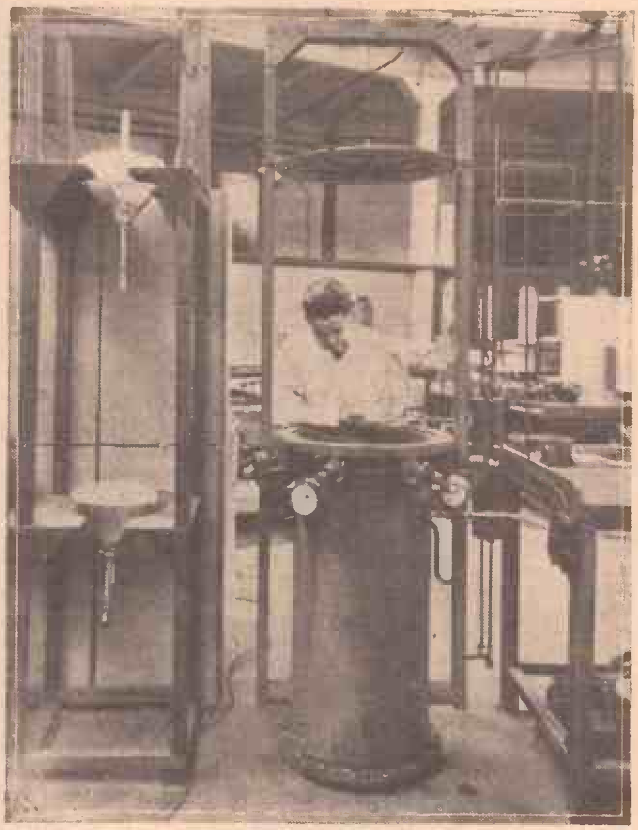
By H. J. BARTON CHAPPLE, B.Sc.

High-pressure Testing

THE degree of accuracy associated with the working of a cathode-ray tube, no matter what its particular application may be, is dependent upon a number of inter-related factors. First of all, the electrode system, whether of the simple form suitable for electro-magnetic focusing and deflection, or the more complicated assembly which has to rely on electrostatic deflection and focusing, has to be jig assembled. Proper alignment of the electrodes to prevent the electron stream from fouling any of the plates during its travel from the point of generation at the cathode surface to its final point of impact on the fluorescent powder coating on the interior of the front glass face has to be guarded against. In many cases this entails a special shaping of the individual electrodes, and in this same connection must be remembered the formation of the electrostatic field which is charged with accelerating the electrons from the orificed anode before they depart on their short and rapid journey. The connections at the cap itself must be so positioned that there is not the slightest risk of a flash-over from the high-voltage pin to one of the lower voltage, and the material used must be immune from leakage. Apart from all these items, however, comes the important one of the glass envelope itself. The technician's work will be wasted if the glass container shows the slightest defect. The shape of this envelope has a very important bearing on the ability of the tube to stand up to normal service usage when it is of the high-vacuum variety, for with the larger sized tubes the external atmospheric pressure becomes enormous. If during the process of manufacture the annealing has not been correct, a fracture will appear in the glass wall and the vacuum be destroyed. It is for this reason that the final pressure test of the completed tube becomes so important. A reference to the accompanying illustration shows how this is undertaken. A metal cylinder with appropriate pressure gauges has a perfect fitting top cover which is normally held down by a series of U-shaped hand screws. Once the tube has been placed inside the tank, and the cover screwed down so that it is airtight, a pump applies an external pressure up to three atmospheres for a period which averages half an hour. This will ensure a very stringent factor of safety, and if the envelope successfully survives this operation it is reasonable to suppose that it will function satisfactorily in any of its multitudinous applications.

Looking Ahead

ALTHOUGH it would seem of no immediate concern in view of this country's other activities, there appears to be an undercurrent of comment in relation to the degree of definition for television pictures. The bulk of this discussion is taking place in America, although it is known that certain European countries are giving the matter serious consideration. It is as yet difficult to say whether this is materialising because of the public reaction to existing standards, or is due to the desire for larger pictures. If the last-named there is every support for the argument, since the larger picture, without any increase in line dissection, results in a coarser grain, and in consequence viewing must be undertaken at a greater distance away. The pre-war tendency in this country and developments abroad all tended towards the use of large television pictures, this being a relative term in so far as home sets were concerned, but a matter of 20ft. or more for big-screen theatre working. Unfortunately, the science of television will always be saddled with the drawback of receiver obsolescence,



An important part of cathode-ray tube manufacture is the final pressure testing, and the illustration shows a tube about to undergo this process.

as definition or other changes are made while the present methods of transmission and reception are employed. That is to say, unless a complete control of reception can be exercised from the transmitting end, changes of picture standard will need alterations to a receiving set. It is for this reason perhaps above all others that so much attention has been given to the American Du Mont system where this admirable feature exists. If any post-war matters are being dealt with by the authorities at the present time it would seem opportune to adopt a bold policy, and investigate all that would be involved in a material increase in picture definition. Surely some scheme could be devised where existing set-owners would not be penalised and future set-owners would have removed at one stroke all thoughts of changes in definition because of the choice of a really high standard.

Electrode Shaping

The shaping of mirror surfaces to certain geometrical patterns for the purpose of producing light beams of a definite character is well known, and this same principle has been applied with success to the electron microscope. It is now learned that electron multipliers have been designed with shaped cathodes. In many types of this device it is found that there is a bad noise level at the cathode surface, and this coupled with leakage effects due to stray fields, etc., produces a non-uniform performance characteristic. In an endeavour to overcome some of these troubles, the photo-sensitive cathode which is activated initially by the incident light variations being converted to electrical signals is made of a concave shape. The plane of the first multiplying grid stage is then positioned inside the tube walls so that it coincides with the centre of the circle of which the cathode surface arc forms a part. The primary electrons released from the cathode by light activation then tend to focus or direct themselves in a stream towards the centre section of this first multiplying grid stage. This avoids the necessity for special focusing arrangements in the initial stage, and by arranging a guard electrode the free space between the guard and first grid is shielded. The subsequent path of the electrons as the secondaries are released by impact at each stage follows normal practice, so that the final current collected represents a multiplication factor of anything up to 100,000.

Making Speaker Diaphragms

Valuable Hints and Data for Constructing Paper Cones

IT is quite obvious that with either a moving-coil type of loudspeaker or with a simple cone unit with moving iron or balanced armature movement, the actual part which is responsible for the sound is the cone itself. This has to move with a piston-like movement, and its function is to cause varying air pressures so that a reproduction of sound is enabled to reach our ears. It is essential, therefore, that the cone should only move in accordance with the impulses which are fed to the operating mechanism, and it must not introduce other movements of any kind to the surrounding air, or distortion will be the result. There are quite a number of additional movements which can be introduced by a wrongly designed cone, and these include such things as cone resonances, vibration of the cone surround, focusing effects, and various kinds of buzzing or jarring effects something like the noise of a comb-and-paper musical instrument.

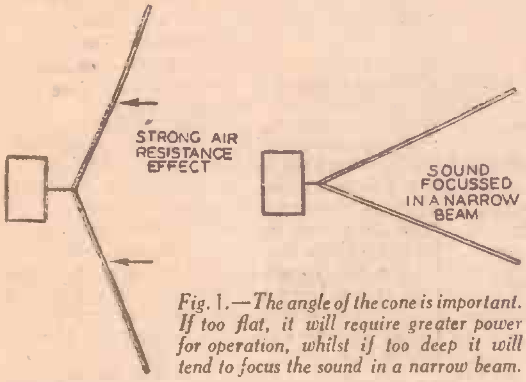


Fig. 1.—The angle of the cone is important. If too flat, it will require greater power for operation, whilst if too deep it will tend to focus the sound in a narrow beam.

Cone Materials

Dealing first with the actual material from which a cone should be constructed, there is a very wide choice. Unfortunately, it is not possible to lay down a direct medium for any one type of speaker, owing to the fact that a certain amount of "coloration" is permissible. Thus, if a receiver is known to be rather on the deep or boomy side, it is quite in order to employ a cone which will add a certain amount of brilliance, and vice versa. Where a speaker is being designed primarily for gramophone record reproduction it is also quite possible, and in fact preferable, to design a brilliant type of cone in order to make up for lack of brilliance in the gramophone record. Among the many materials from which to choose may be mentioned the drawing paper known as Bristol Board, Kraft paper, ordinary brown paper, vellum (such as is employed for lampshades), and buckram. The Bristol Board for normal purposes should be of the type known as Two Sheet, and the Kraft paper should be of the grade which goes 120 to the ream. The other materials are not graded in any way, and it will, therefore, be necessary to experiment in order to find a suitable grade. Generally speaking, the material should be stiff, light, and free from unevenness in thickness. A light, thin material will, as a rule, give a reedy tone, whilst a heavy, thick material will give a deep tone, although this may be modified by the actual substance from which the cone is made.

The Shape of the Cone

Apart from the dimensions of the cone there is the angle to be considered. If the cone is too shallow it will be difficult to move and will not, therefore, give good reproduction. If, on the other hand, it is too deep it will suffer from a focusing effect. That is to say, it will radiate in a narrow beam in a straight line and signals will only be comfortably heard when standing directly in front of the speaker (Fig. 1). For all normal purposes it will be found that an angle slightly over 45 degrees will be most suitable, and to obtain this angle a circle should be drawn on paper of the desired size, and the sector which is cut out to form the cone should be roughly a right-angle. In Fig. 2 this is illustrated,

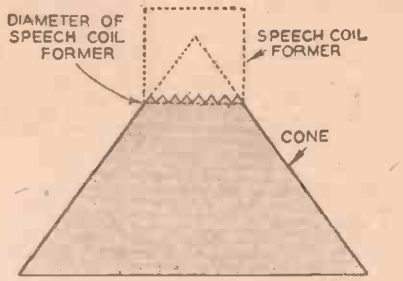


Fig. 4.—Cut off the apex of the cone for a speech-coil mounting.

and it will be noted that a strip of the material has to be left inside the angle for joining purposes. We will not give the various formulæ for ascertaining the radius of the circle required for a given size of cone of a given angle, but the small table on page 256 will assist you easily to find a required size for normal use. The angle generally used is approximately 45 degrees.

Making the Cone

To make the cone, obtain the material which it is decided to use, and describe a circle according to the predetermined size of the cone (see the next paragraph). In order to enable the edge of the cone to be held in a suitable manner a further circle should be described about ¼in. outside the first circle. Now mark out the segment angle from the centre point, and about 5/16ths of an inch inside one of these lines mark a second parallel line. This will give an overlap for a joint, although an alternative method for joining, and one which is sometimes preferred from the point of view of breaking up a resonance, is shown in Fig. 3. For this method it will be necessary to mark a parallel line 5/16ths of an inch away from each of the lines of the right-angled section. Cut out the area inside the two closest lines as shown by the shaded area in Fig. 3. Fold the cone over so that the join is correctly overlapped, and cement with Durofix or some similar adhesive, that is, one which is unaffected by dampness or heat, and will ensure a reliable joint. Leave to thoroughly dry before proceeding further. If the cone is intended for use with a moving-coil type of speaker, the point of the cone will have to be cut off, and the most accurate method of doing this is to join up the cone before cutting, and then to slip the speech coil over the apex and mark its diameter round the cone with a

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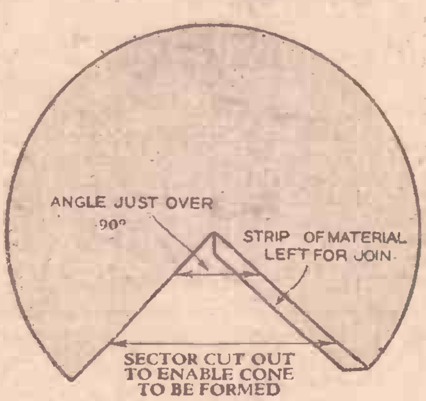


Fig. 2.—Marking out the cone. Note the angle of the cut-out section.

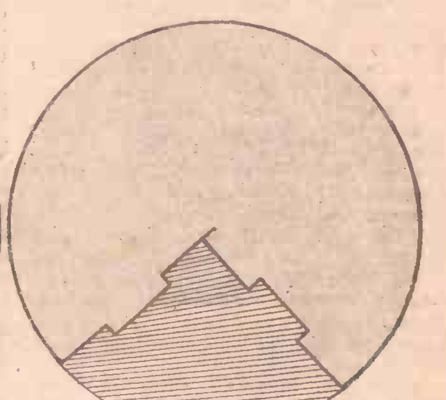


Fig. 3.—A lapped joint is preferred by some constructors.

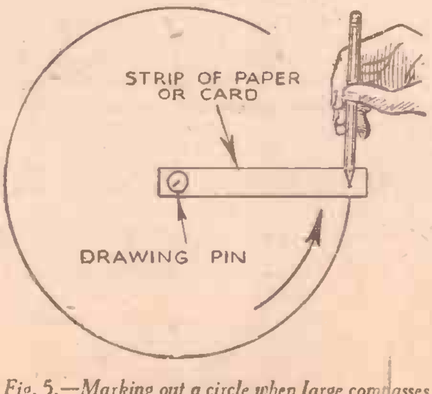


Fig. 5.—Marking out a circle when large compasses are not available.

MAKING SPEAKER DIAPHRAGMS

(*Continued from previous page*)

pencil. Using a sharp penknife or a razor blade, cut off the apex slightly above the pencil mark and then cut up to the line in a series of small points as shown in Fig. 4.

Marking out the Diaphragm

The diameter and apex angle of the finished cone depends on the radius of the "development circle" and the angle of the segment that is cut away to form the cone.

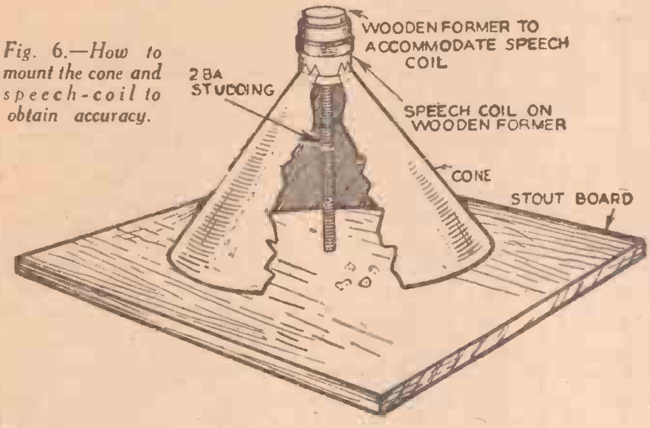


Fig. 6.—How to mount the cone and speech-coil to obtain accuracy.

The following table gives useful data on dimensions and angles. In this table, A represents the apex angle, S the segment angle, and R the ratio of the radius of the development circle to the diameter of the cone (approximately):

A	S	R
90°	105°	0.71
100°	84°	0.65
110°	65°	0.61
120°	48°	0.57
130°	34°	0.55
140°	22°	0.53
150°	12°	0.52

To illustrate the use of this table, let us suppose that you wish to make a cone with an apex angle of 110° and a diameter of 10in. From the table you will see that you need to describe a development circle with a radius of approximately 10in. x 0.61in., that is, of course, 6.1in., and to rule two lines, radiating from the centre to the circumference, forming a segment with an angle of 65 degrees.

As regards apex angles, for instance, it should be possible to secure quite enough data by selecting three or four representative values—say, 90, 120, and 150 degrees—and experimenting with cones having apexes of these angles. There is no necessity to make up a separate cone for each different diameter you wish to try out, if you adopt the simple expedient now described. The cone paper is marked out with a number of concentric development circles, instead of only one; the radius of the smallest circle may be that needed to form a cone, say, 6in. in diameter, and that of the largest circle may be suitable for a cone, say, 16in. in diameter.

In the absence of proper drawing instruments, the circles (or arcs) can be marked out by means of the simple expedient shown in Fig. 5. The strip of paper is pivoted at the centre of the desired circle by means of a drawing-pin; a small hole for the pencil point is pierced in the strip at a distance from the drawing-pin equal to the radius of the circle that is to be described. The pencil and strip of paper are then swung round in a complete revolution about the drawing-pin that acts as a pivot, and a perfect circle is thus described on the cone-paper.

Mounting the Cone

If the cone is to be used with a moving-iron unit the point will have to be snipped off and the cone clamped between two cone washers, and felt between will be found useful in this connection. Felt washers are placed between the metal and the paper cone and when the split collet is locked tightly there will be no fear of rattles or other noises arising from a poor joint. With the moving-coil instrument the small points must be cemented to the speech-coil former, using the type of adhesive above mentioned. In this case, however, it is absolutely essential that the speech coil shall be parallel with the axis of the cone and it will, therefore, be worth while to make up the small arrangement shown in Fig. 6. The upper wooden former must be just large enough to enable the speech coil former to slip over, and the cone is placed on the lower base as shown, and the speech-coil former is then slipped down into its position and the points stuck down, a rubber band holding them in contact until set. The edge of the cone must now be turned in order that it may be stuck to some suitable surround, and to ensure a parallel and evenly turned edge the small tool illustrated in Fig. 7 must be made up. Two thin pieces of wood, about ½in. wide and 2in. long are rounded at one end as shown, and these are nailed together with a piece of material from the cut-out section of the cone sandwiched between them. The end of the strip must be cut quite square and it should be fitted so that there is a space of ¼in. between the points of the wooden strips and the edge of the cone material. Holding the cone in one hand, and the bending tool in the other, insert the edge of the cone in the small slot, and whilst you run the tool round the edge of the cone carefully lever over the edge and after running round the cone once or twice you will have a neatly turned edge.

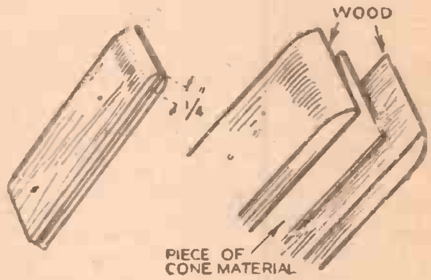


Fig. 7.—A novel tool for turning the cone edge for fixing purposes.

Notes from the Test Bench

Vibration and Tuning

MANY users of superhet receivers of the self-contained type (that is, those with a built-in speaker) may have noticed that with some stations the signal appears to fade in spite of the inclusion of A.V.C. circuits. This is, perhaps, only noticeable on very loud signals, and it will be found in the majority of cases that it is due to vibration. If the A.V.C. is working properly, a loud signal should not fade, although it may be found that a weak signal may vary in strength. This is due to the fact that the initial signal does not provide sufficient control. The loud signal, however, offers ample variation in bias for the controlled valves, and therefore no variation should take place. If, however, the tuning condenser or any wiring in the tuned circuits is subject to movement, the signal may appear to fade, due to the actual readjustment of the frequency in the tuned circuit. Wires should be so short that the variation is not sufficient to upset tuning, but vibration of the tuning condenser vanes, or of the entire condenser, may have a bad effect. If the condenser is of a solid, well-built type it may vibrate as a whole with little effect, and this is preferable to a rigid mounting, which might result in the separate vanes in one section vibrating. The condenser may be mounted for this purpose by fitting rubber grommets on each side of the holding-down bolt.

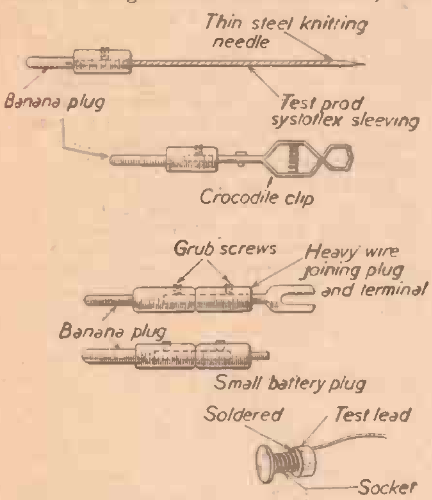
Cabinet Repairs

WHEN overhauling a receiver it is a good plan to overhaul the cabinet at the same time, and there are a number of devices now obtainable for giving a finish to a damaged cabinet. Scratch eliminators may be obtained for light marks, but where the cabinet is chipped or cracked, ordinary wood filler should be used. This should be stained to match accurately the finish of the cabinet, and then inserted into the crack. It should be left for a day or two to shrink in (putting on slightly more than is needed to make a level finish) and then with a hard block and a fine grade of sandpaper it should be levelled off, taking care not to mark the cabinet on each side. A good sharp razor blade may be used instead of the sandpaper. The entire cabinet should then be thoroughly cleaned free from grease with a rag slightly moistened with methylated spirit. An excess of spirit should not be used as it will strip the polish. A good polish reviver may then be rubbed on.

Practical Hints

Test Prod Accessories

WHILE using my test meter recently, I noticed that the test prod generally provided was not always suitable for making connections to various circuits. This is particularly noticeable when making current measurements, and



These handy fitments facilitate testing work.

it is required to leave the meter in circuit while the controls are operated.

To overcome this difficulty I found the following accessories indispensable. Two banana sockets are soldered to the test leads and several plugs to fit these are obtained. These plugs are attached to crocodile clips, spade terminals, etc., as shown in the accompanying diagrams. Thus the most suitable fitting can be attached to the test leads with the minimum of time and trouble.—J. G. WHITE (Dublin).

Improving the Layout

WHEN arranging the layout of a modern receiver, too many constructors are under the impression that it is absolutely essential to have all the controls on the front panel, with the result that the appearance is often marred by a badly arranged, or an excessive, number of knobs.

It is not sufficiently realised that it is quite in order to locate the volume control, wave-change or radiogram switches at the side of the cabinet, as this often facilitates wiring and avoids bringing unnecessary wires to the front of the panel.

By adopting this procedure the stability of a circuit can often be improved, as grid and anode wires can be kept isolated from each other and certain connections made much shorter.—L. SPUR (Birkenhead).

Interference from Neighbouring Sets

TO minimise interference from neighbouring sets it is a good plan to arrange your aerial at an angle to the nearest aerials instead of parallel to them. An independent outside earth is also advisable, and in certain cases it is advisable to resort to a capacity or counterpoise earth rather than a connection to a water main, which may be used by many other receivers. If you cannot arrange an outside independent earth, try connecting a .0002-mfd. fixed condenser in series with the earth lead.—J. DILL (Plumstead).

THAT DODGE OF YOURS!

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

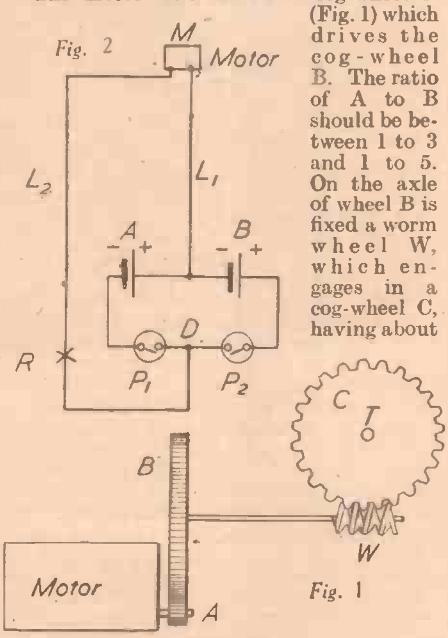
SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page 268.

Motor-driven Remote Control

I RECENTLY built a remote-control device which may interest some readers. It is extremely simple in construction and very effective. It consists of a toy electro-motor which, after being suitably geared down, is coupled to the tuning control.

The motor axle carries a cog-wheel A (Fig. 1) which drives the cog-wheel B. The ratio of A to B should be between 1 to 3 and 1 to 5. On the axle of wheel B is fixed a worm wheel W, which engages in a cog-wheel C, having about 30 teeth. The axle T of the wheel C is coupled by means of a connecting piece to the tuning control rod. Fig. 2 explains the wiring. A and B are two 4½-volt flashlight cells. The negative pole of the one is joined to the positive pole of the other, and a tapping L1 is taken and connected to the motor. The lead L2 divides at D. A bell-push P1 will connect it to the negative pole of A, while another bell-push P2 connects it to the positive terminal of B. Thus the bell-pushes P1 and P2 can change the direction of the current and thus change the direction of the motor. It is *important* that the field magnets of the motor are *permanent* magnets, since a motor with electric field magnets will *not* reverse its direction of rotation when the current is reversed. A rheostat can be inserted at R to control the speed of tuning.

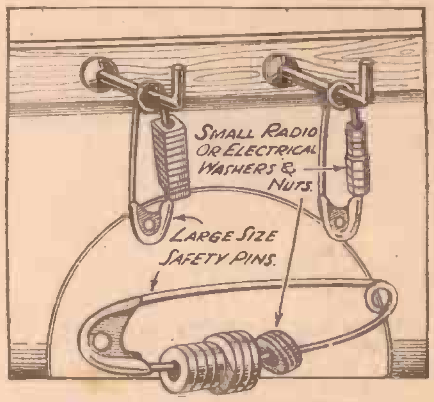


A simple motor-driven remote-control arrangement.

With this arrangement I am able to tune my wireless set from a different room. The station names are illuminated on my extension-speaker by a method described in a previous issue.—ERNEST HUMBURGER (Dollar, Scotland).

A Safety-pin Filing System

MANY constructors will at some time or other have experienced the difficulty of finding a nut or a washer



A novel dodge for holding nuts, washers, etc.

of just the right size for the job in hand. An excellent "filing system" which immediately enables one to overcome this difficulty is shown in the accompanying sketch. Large safety-pins are used to hold washers, nuts, split-pins, etc., of various sizes, and if the pins are suspended by hooks in the tool chest, or from a shelf above the work bench, they are always at hand when required.—D. LANIE (Hendon, N.W.).

Comment, Chat and Criticism

Outline of Musical History—3

The Progress of Music during the Seventeenth Century, by Our Music Critic, MAURICE REEVE

THE Italian musician, Monteverdi, is the father of modern opera, and his "Arianna" and "Orfeo," produced in 1607 and 1608, made great sensations. The vast improvement in organ building effected during the century brought with it a succession of great performers and writers for it, including the Englishmen, Bull and Philipps; the Dutchman, Sweetnick; and the Italians, Frescoboldi and Buxtehude. Between them they established the form and character of the modern fugue.

Virginal Music

Side by side with these developments went the rise of virginal music, which culminated in the famous Fitzwilliam collection of over three hundred pieces—preludes, dances, fantasias and variations—by such brilliant musicians as Byrd, Bull, Mundy, Richardson, and the two Farnabys.

Although it appears that the contemporary system of fingering virginal music almost precluded the use of either thumb or fifth finger, the brilliance, originality and difficulty of these compositions were not dimmed by the subsequent works of either J. S. Bach or Handel a hundred years later.

Yet another stage in the development of music was the evolvement of the violin from the old viol. Dating from Tieffenbrucker and the Amatis in the early sixteenth century, it met with much prejudice and opposition, but Monteverdi's experiments with it proved it to be the only rival that the human voice was ever likely to have among the family of the instruments. A brilliant school of French and Italian musicians, including Corelli, Vivaldi, Vitali, Verucini, Tartini and Somis as the most notable, established its present reputation and fame. Paganini, in the early nineteenth century, was the logical culmination of the earlier masters' pioneer work.

Famous French School

The famous French school of the reign of Louis XIV made a great impression on music, and most of its work is still beloved by modern musicians. Its founder was J. B. Lully, 1633-1687, though its most illustrious member is unquestionably François Couperin, 1668-1733; and its most profound thinker, G. P. Rameau, 1683-1764. Couperin's music, like Molière's comedies, is the quintessence of the French genius. Lully was the inventor of the overture, and his name is linked with that of a great Italian, Alessandro Scarlatti, 1659-1725.

The growing resources of opera called for an "overture" of larger proportions and more dignified character than had hitherto been in use; consequently those written by Lully became known as the "French" and those of Scarlatti as the "Italian," overture. The French example consisted of a slow, solid introduction, a quick fugato, and a quiet dance measure at the end. On the other hand, the "Italian" type commenced with a robust allegro followed by a meditative slow movement, and a lively finale in conclusion.

These types profoundly affected musical form for over a hundred years, and Mozart's descent from their influences is easily traceable. Handel's Overture to the Messiah is typical of the "French" style, whilst any of Bach's orchestral works could be cited to illustrate the "Italian" vintage.

Debussy and Ravel

Couperin composed large numbers of exquisite pieces for keyboard instruments, whose charm, grace and tenderness are still admired. He was the founder of that impressionistic school which has culminated in our own time in the powerful personalities of Debussy and Ravel. Couperin was also the inventor of the rondo, a potent musical form which reached its zenith in the master works of Beethoven.

Naturally, the scope of the present series of articles enables us only to mention the most illustrious names in musical history; those only, in fact, who are considered to have affected the historical course of their art.

Italian Masters

Chief of the many Italians of this period were A. Scarlatti, already mentioned, and his son, Domenico (1683-1759). The father had a powerful influence on opera, whilst his son's "500 sonatas" have been the delight of all subsequent generations of music lovers. Domenico resided for most of his life at the Spanish Court, and his works abound in the gaiety and vivacity of that life. Many of the leading Italian musicians of this and the period immediately following were pupils of one or other of the Scarlattis, including Corelli, who perfected violin playing and violin music. Nor must the name of Stradivarius (1650-1737) be omitted, whose violins are still prized as the finest and rarest in the world, and are worth huge sums.

English Music

Although English music cannot boast of all this lustre at this period, it contains many eminent names, amongst whom is one generally reckoned our greatest musician prior to Elgar: Henry Purcell (1658-1695). When the Merry Monarch, Charles the Second, returned to the throne of England after his long exile, he found that music had become much too grave and sober, under the influence of Cromwell and the Puritans, to suit his lively disposition. So he sent Pelham Humphrey to France specially to study with Lully and to see whether he could infuse into English music some of the *joie de vivre* and high spirits which abounded in contemporary France. Humphrey not only proved an able ambassador, thoroughly justifying his master's confidence, but an even better master, for Purcell became his pupil, and Purcell's music abounds in those qualities which Humphrey had sought across the channel. His "Dido and Æneas" was the first English opera, and one of the first anywhere.

Sonatas

The word Sonata is not used here in its present meaning of a long, complicated, emotional and highly varied work in three or four movements. The sonatas of Scarlatti and his contemporaries were short movements in simple binary form that took four or five minutes to perform, including repetitions. There were two kinds, the "Sonata di Chiesa," or Church Sonata, and the "Sonata di Camera," or Chamber Sonata. The former contained slow or fugal movements, whilst the latter were usually based on dance rhythms. Prior to the foundation of modern "sonata form" by Haydn, these examples reached their perfection in the "sonatas" and "suites" of J. S. Bach and Handel.

The year 1685 is in many ways a memorable one in musical annals, for in it were born those two great giants who have strided the stage ever since, and whose work and influence are likely to last for the ages to come: J. S. Bach and G. F. Handel. Consequently it was also the year from which we can date the rise of German music, which was to dominate the scene for the next two hundred years and to eclipse the then existing French and Italian supremacy.

Decline of Latin Music

One of the chief reasons for the decline of Latin music was the ever-growing dictation of the performers. Composers ceased to write according to their inspiration but under the tyrannical sway of the virtuoso, and more especially the singers. The Italians were particularly guilty. Their operas became mere vehicles for vocal display, and their composition literally "dictated" by the wishes, or more often the limitations, of the prima donna or tenor. The plots were reckoned to be of no account, and the action was frequently in the worst taste. The executants of the coming century had to realise that they were the servants and not the masters of music, and that it was the composers' word that was to be the law, and not theirs. There were to be no short cuts to fame with Bach or Handel, and even to-day, with our revolutionised methods of training and performance, the St. Matthew Passion and the Messiah are so difficult as to be only within the reach of the most skilled professional musicians.

A Universal Crystal Set–2

Showing How Additions Can Be Made to Increase the Volume and Range of This Simple Set By L. O. SPARKS

THE keen beginner will not be completely satisfied for any length of time with the crystal set which was described in the issue of last week. He will have the natural desire to replace the headphones with a small loudspeaker and make some attempt to increase the effective range of the circuit.

The former is not a very difficult matter, but it must be appreciated that as soon as we start introducing valves into the existing arrangement, it becomes necessary also to add such items as a 2-volt accumulator, a 60-volt or 120-volt dry high-tension battery and, if the valve is used as an L.F. amplifier, a small dry grid-bias battery, together with, of course, such additional components as the proposed valve circuit requires.

Apart from the batteries, it is highly possible that the other parts can be secured at a very low cost, bearing in mind the surplus components which are now offered by many advertisers in these pages. At this stage of the beginner's activities, it is not essential to buy expensive new parts, as such procedure can be left to later constructional efforts.

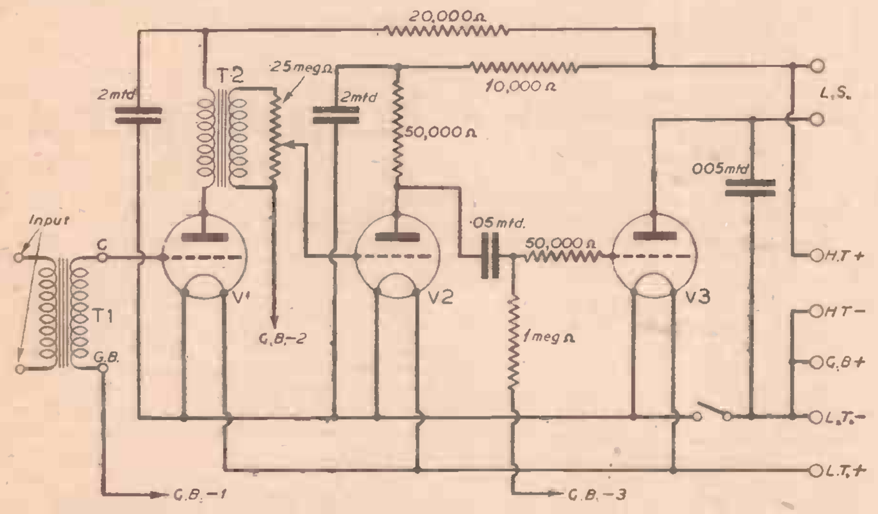


Fig. 3.—A circuit capable of giving ample loudspeaker results from a crystal set input.

Increasing the Volume

The quality of reproduction obtained from a crystal circuit is very good and it is this particularly good characteristic which renders the output so ideal for amplification. If reasonable care is taken with the design of the amplifier and the selection of the parts, including the loudspeaker, the resultant output will be satisfying to all, including those with a most critical musical ear.

The amount of apparatus required will depend on the requirements of the constructor; therefore the following remarks should be noted. If it is desired to increase the volume for headphone use only, then the simple circuit shown in Fig. 1 can be employed in conjunction with a triode valve of the H.L. or L.F. type. If the headphones are to be replaced by a small loudspeaker, for use in a small room and with medium volume, it will be advisable to substitute a power or a steep slope pentode valve, such as the Cossor 215P or 220 H.P.T., respectively, in place of the triode previously mentioned. Such an arrangement, especially if the transmitting station is within 30 or 40 miles, will give most pleasing results.

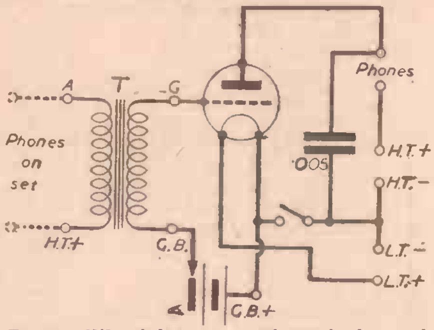


Fig. 1.—When 'phones are to be used, this single valve amplifier will give adequate output.

Before passing on to the more powerful circuits, a word or two about Fig. 1, together with Fig. 2 which shows the practical arrangement of the same circuit, will not be amiss for those making their first venture in this direction.

The Circuit and Layout

The component marked T represents an ordinary low-frequency intervalve transformer. These are made with different ratios, i.e., generally speaking the ratio can be taken to denote the relationship between the number of turns forming the primary winding to those forming the secondary, and the values vary between 1.5 to 1, written 1.5 : 1, to as much as 7 : 1. An average ratio is in the neighbourhood of 3.5 : 1. In this instance, however, the ratio is not critical, but in view of the fact that the signal from the crystal is on the weak side and we wish to obtain as much amplification as possible from the one valve, it will be advisable to use a component having a high ratio rather than the reverse. If you can obtain one having a ratio of 5 : 1 or 7 : 1, so much the better.

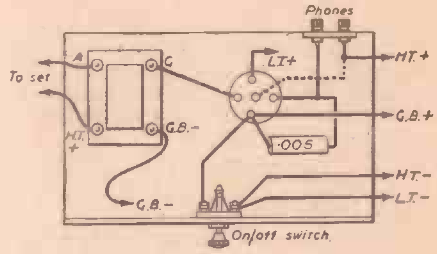


Fig. 2.—The practical arrangement for Fig. 1. A pentode valve can be used if desired.

The primary is connected to the 'phone terminals of the set, and it will be seen from Fig. 1 that the secondary conveys the signal to the grid of the valve, but at this point a certain amount of amplification has already taken place, due to the ratio or step-up effect of the transformer. The valve itself provides further magnification, with the result that the 'phones or loudspeaker connected in its anode circuit, receive sufficient power, depending on the type of valve used, to produce a greatly increased replica of the original signal.

The whole layout is shown in Fig. 2. The transformer is fitted to the left of the small

(Continued on next page)

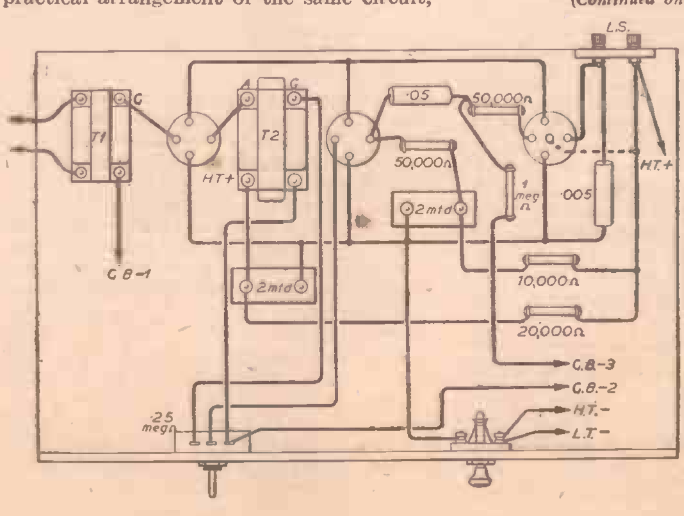


Fig. 4.—The complete wiring and layout for the three-valve amplifier shown in Fig. 3.

A UNIVERSAL CRYSTAL SET—2

(Continued from previous page)

baseboard (7ins. by 7ins.), so that easy connections are possible with the 'phone terminals of the set. The necessary voltages for the filament, anode and grid-bias are provided from the appropriate batteries via flexible leads, all of which are clearly indicated on the plan view. An on-off switch is wired in series with the L.T. negative to control the filament supply while the *new* 'phone terminals are connected in series with the anode of the valve and the positive H.T. supply. With an H.L. valve, quite good results can be obtained with 60 volts H.T. when 'phones are used, but with the other types mentioned, using a L.S., 120 volts are really essential for complete satisfaction. If a pentode valve is used, a five-pin valveholder will be necessary and its *fifth terminal* should be connected as shown by the *dotted line*.

To enable this unit to match up with the crystal set, it is advisable to fit a panel 7ins. by 7ins. to the baseboard, although at this stage the only component to mount on it will be the on-off switch, but if so desired, a volume or tone control could be added at a later date.

A Larger Amplifier

For those requiring a more powerful output, sufficient to provide reasonable reserves under all conditions, the circuit shown in Fig. 3 is recommended. This arrangement makes use of three valves employing transformer and resistance-capacity couplings. The input is the same as the single-valve circuit, but in place of a high-ratio transformer, it will now be permissible to use one of a more average ratio, say, **3.5** : 1.

The output from the first valve, a Cossor 210HF, is fed into V2 by means of an L.F. transformer having a ratio of 3 : 1 or 3.5 : 1, and it should be noted that a volume control is connected across the secondary winding. This is provided to enable the signal at this point to be adjusted to the most satisfactory value for V2, and to prevent the possibility of overloading when a powerful signal is received. The volume of the output from the complete circuit will also be controllable by this adjustment, thus allowing the listener to suit his own requirements.

The second valve should be of the L.F. type—the Cossor 210LF is ideal—while the output valve, V3, is of the power or super-power class. One having a similar characteristic to the Cossor 220P will be found most satisfactory.

Although three valves are used, no difficulty should be experienced with the layout or wiring, as these are clearly indicated in Fig. 4.

Components

The components used in both of the circuits described are standard parts, and the writer has purposely avoided specifying any particular makes or types as the layout is *not* so critical that various makes cannot be used. The only request made is that the constructor takes the precaution of satisfying himself that all the parts he gets together for the constructional work are above suspicion, from an efficiency point of view, and that they are of the *values specified* in the diagrams.

LATEST PATENT NEWS

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

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 1/- weekly (annual subscription, £2 10s.).

Latest Patent Applications.

8689.—Cole, Ltd., E. K.—Device for arresting a turn-table control knob, etc., in a predetermined adjustable position. May 14th.

8524.—Crowther, B. M.—Cathode-ray tubes. May 11th.

8345.—Garrard Engineering and Manufacturing Co., Ltd., and Offen, F. J.—Pick-up control mechanism for automatic gramophones. May 9th.

8525.—Fabbrica Italiana Magnet Marelli.—Radio-receiving apparatus. May 11th.

8461.—General Electric Co., Ltd., and Biggs, A. J.—Wireless receiving-sets comprising dial lamps. May 10th.

8654.—Hammond Instrument Co.—Electrical musical instruments. May 14th.

8655.—Hammond Instrument Co.—Electrical musical instruments. (Cognate with 8654.) May 14th.

8656.—Hammond Instrument Co.—Electrical musical instruments. (Cognate with 8654.) May 14th.

8596.—Radio Corporation of America.—Sound recording systems. May 13th.

8324.—Rusch, H. L.—Method and apparatus for recording the broadcast station to which a radio-receiver is tuned. May 9th.

8432.—Russell, E. W. R.—Radio-transmitting, etc. aerials. May 10th.

8453.—Standard Telephones and Cables, Ltd., and Wolfson, H.—Cathode-ray tubes. May 10th.

Specifications Published.

520941.—Garrard Engineering and Manufacturing Co., Ltd., and Offen, F. J.—Record-delivery mechanism for gramophones and the like.

520915.—Kolster-Brandes, Ltd., and Smyth, C. N.—Sound-reproducing apparatus such as radio-receivers.

521028.—Jones, W., and Pye, Ltd.—Television and like systems.

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

The "Radio Training Manual"

Letters of Congratulation

"I HAVE received my copy of the 'Radio Training Manual,' and must say it seems a real mine of information. Considering these days of paper shortage, I was impressed by the quality of the paper in this book. I would sincerely recommend all would-be service enthusiasts to apply for this manual. Please accept my congratulations on a fine book at such a low price."—GEO. B. COTTON (Liverpool).

"I HAVE just received my copy of the 'Radio Training Manual' and I wish to thank you very much for such a handy, well-printed book, the quality of paper being very much above the average for this style of book.

"I have your 'Everyman's Wireless Book,' also your 'Wireless Constructor's Encyclopædia,' and have always wished for a smaller edition that contained all the main principles of radio, and I have got it now.

"I am a service engineer, and it will be the book of books for me, as there does not seem to be a thing missing from it.

"Also, may I thank you for your recent articles on the type of questions likely to be asked at the examinations for radio engineers for the R.A.F.? One of my friends (not a reader of PRACTICAL WIRELESS) wished to go in for this branch, and asked my advice. I gave him all the articles of this series that had appeared, and as it turned out there was only another one to come. He studied them all, and was the only one to pass out of his batch. I thank you again for him!

"I am really a 'reader from No. 1,' and I congratulate you on keeping up its publication during these difficult times. Carry on! Your 'Radio Engineer's Note Book' is also much appreciated, and I already have one book full of those handy 'What's What' tables."—R. G. HARRISON (Newcastle-on-Tyne).

RADIO CLUBS & SOCIETIES

ASHTON-UNDER-LYNE AND DISTRICT AMATEUR RADIO SOCIETY

Headquarters : 17a, Oldham Road (near Free Library).
Secretary : K. Gooding (G3PM), 7, Broadbent Avenue, Ashton-under-Lyne.
Meetings : Wednesdays, 8 p.m. and Sundays 2.30 p.m.

ACTIVITY is still high, particularly with regard to superhet construction, and for the benefit of new members and beginners a special Morse class is held every Monday at 8.30 p.m. This is in addition to the practice given at the commencement of the Wednesday evening meetings, and the instructors (Messrs. J. Partington (G5PX) and F. Bottom (G3FF) report that good progress is being made. Mr. Harold Hattersley now holds the dual positions of social-secretary and librarian.

At a recent meeting Mr. J. Cropper (G3BY) gave an excellent lecture on "The Principles of Class A and Class B Audio-amplification," which was much appreciated, and at the close a keen discussion took place amongst the members.

At an early date Messrs. J. Cropper and W. P. Green are to recommence their popular series of lectures on "Principles of the Superheterodyne."

Letters from members serving with H.M. Forces were read, and it was resolved that all members on active service become honorary members for the duration. The secretary was also asked to give publicity to the fact that any radio amateur in the district, whether O.H.M.S. or not, would be welcomed at the clubroom.

CHRIST'S HOSPITAL WIRELESS SOCIETY

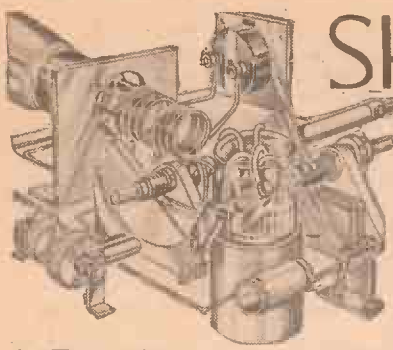
Hon. Sec. : R. L. Denyer, Lamb.B. Christ's Hospital, Horsham, Sussex.

OWING to the large number of wireless enthusiasts throughout this school, the above wireless society was formed on February 11th this year.

Since then the society has been meeting twice a week. One of these meetings is devoted to the encouragement of members to build their own sets. Since these meetings are held in the science laboratories here, members have at their disposal almost every kind of meter and testing instrument needed.

At the other weekly meeting lectures are given regularly by members. Mr. H. D. Sills, the president, gave an interesting lecture concerning the theoretical side of transmitters. R. L. Denyer, the secretary, lectured on "Headphones and Loudspeakers;" K. V. Roberts on "The Elementary Principles of Wireless;" D. Millar on "H.F. Coupling;" T. R. Munro on "Components" and "Short-wave Receivers;" J. A. Bladon on "Valves;" J. B. C. Bennett on "L.F. Amplification," and G. S. Tucker on "The Electronic Theory."

The society has recently purchased a recording apparatus, but owing to the present international situation, has found difficulty in obtaining the necessary blank discs.



SHORT-WAVE SECTION

EXPERIMENTAL SHORT-WAVE DETECTORS

A Few Circuit Arrangements which are Worthy of Trial

By THE EXPERIMENTERS

IN any "straight" short-wave receiver the detector is by far the most important stage, but it does not always receive the attention which it deserves. The value of a good detector circuit is shown by the fact that many experimenters who have specialised in the single-valve, or Det.-L.F. type of short-wave receiver often obtain better results than those given by more elaborate superhets.

Our experience indicates that, in general, an H.F. pentode used in a standard regenerative circuit proves the most satisfactory short-wave detector, but nevertheless there are many other systems that deserve attention and which provide ample scope for experiment. One of these is illustrated in Fig. 1. The arrangement is by no means novel, but there are probably many readers who have not tried it. As may be seen, there are two triode valves, and these are virtually in parallel.

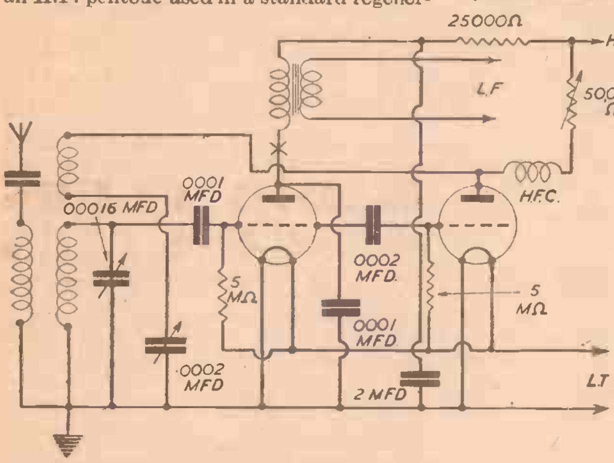


Fig. 1.—A double-detector arrangement where one triode acts as a leaky-grid detector, and the other provides reaction.

Separate Detector and Reactor

The main object of this circuit is to separate the functions of detection and regeneration, or reaction. Thus, the valve on the left acts purely as a detector and feeds into the L.F. stage. The right-hand valve does not detect, but is used to feed back H.F. into the common grid circuit. Most of the values are standard, and a receiver with this type of detector is used in precisely the same manner as one with the usual single triode. It will be noticed that a small by-pass condenser is connected between the anode of the detector valve and earth. Because of this, it may not be necessary to insert an H.F. choke in the anode lead; if any instability or reaction difficulty is experienced, however, a choke can be inserted at the point marked with a cross.

A variable resistor is shown in the anode circuit of the "reactor" valve, and although this is not essential it provides a convenient means of obtaining the best setting for smooth reaction control. Another component which deserves mention is the .0002-mfd. grid condenser used to feed the second valve. This is not essential but it is generally found to improve results—probably because it prevents the "grid-leak bias" from being applied to the reactor and also reduces the damping effect on the tuning circuit. In general, it will be found that the voltage applied to the detector can, with advantage, be rather higher than usual.

S.G. Reaction

A modification of the circuit given in Fig. 1 is shown in Fig. 2, but in this case an H.F. pentode is used as both detector and reactor. The anode proper is employed as detector anode, while the screening grid serves as anode for reaction. It will be seen that the reaction circuit shown is unconventional, although a standard arrangement could equally well be used. Throttle-control is illustrated, and therefore the reaction winding is in series with the H.T.-anode supply and the reaction condenser is wired between the reactor anode (screening grid) and earth. The condenser is therefore in the nature of a variable by-pass. Consequently, reaction coupling is reduced as the capacity of the condenser is increased. This form of reaction is entirely optional in any regenerative detector circuit, and is shown to add variety to the experiments which may be carried out.

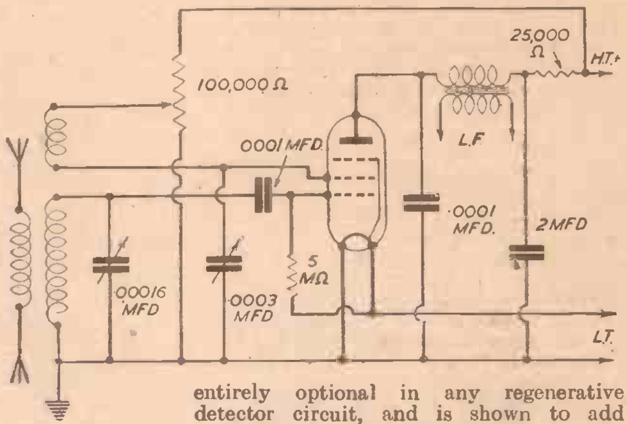


Fig. 2.—This circuit is comparable with that shown in Fig. 1, but an H.F. pentode acts as a double triode valve.

Additional Reaction Control

Another small point about the reaction circuit is the method of feeding H.T. to the reactor anode. A 100,000-ohm potentiometer is used, and is connected in almost the same manner as it may be if the valve were used as an H.F. amplifier. The potentiometer is not an essential feature of the circuit, and could be replaced by a variable or fixed resistor. It is, however,

(Continued on next page)

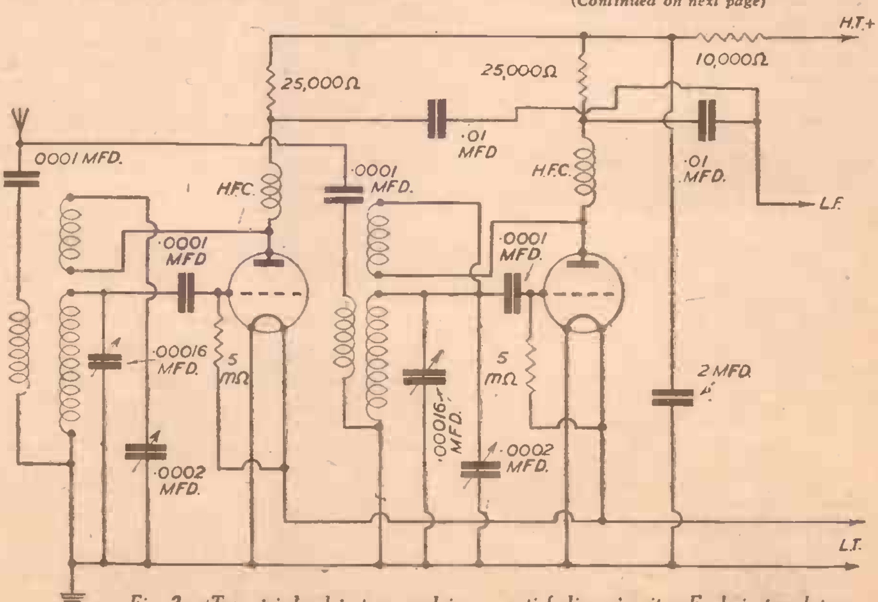


Fig. 3.—Two triode detectors used in an anti-fading circuit. Each is tuned to a different wavelength on which the same programme is being radiated.

SHORT-WAVE SECTION

(Continued from previous page)

very useful in practice since it can be set very accurately and—if a good, "silent" component is used—it can be used as the main reaction control, the variable condenser serving only for final adjustments. Should the potentiometer be used in this manner it may be found better to replace the .0003-mfd. reaction condenser by one of about half this capacity.

Connections are shown for a doublet aerial in Fig. 2, but ordinary aerial and earth leads can be used in the ordinary way.

Double Detectors

An entirely different detector arrangement is illustrated in Fig. 3. It is one which we have used in experimental form for a number of years and which is also used in modified form in many special receivers intended to provide reliable long-distance reception. It will be seen that there are two complete detector valves and circuits; that is, in addition to there being two triodes, each has its own tuning and reaction circuit, and therefore acts as a regenerative detector. Either can be used independently or both can be used together and tuned to different wavelengths. The arrangement is of chief value as a means of overcoming fading, and it is normally intended that each detector be tuned to a different transmission when the same programme is being put out on two wavelengths or by two stations.

The idea is that the two wavelengths, particularly if they are on different bands, are not likely to fade in the same way and at the same time. Thus, as one fades it is probable that the other will be at or near its "peak." And since the output from both detectors is combined and fed to the same L.F. amplifier and speaker, the two received signals will blend and provide a steady output. It does not often work out quite as well as that in practice, but the arrangement is often very effective, and is certainly worth experimenting with.

Ordinary six-pin plug-in coils may be used, and both detector circuits can be standardised, using the connections which have been found most satisfactory for a single detector. It is desirable that the coils should be mounted at right-angles to each other, and if they are not fairly well separated a screen should be placed between them. Coupling between them is inclined to produce some peculiar "beat" effects and to make the set unmanageable.

Method of Operation

It might appear that operation would be very tricky, but there is no great difficulty after a little experience has been gained. As a preliminary it is a good plan to remove one of the valves, and then to tune the other one to a few well-known stations, making a note of the dial readings. This may be done using a coil for, say, the 19-metre band. Then replace the valve and remove the other, which should then be tuned to a few stations on, say, the 31-metre band; a few dial calibrations can again be made. Afterwards, when it is wished to receive a programme which is put out on two wavelengths, one circuit can be tuned to a silent point and the other one tuned to the required signal, using the original calibration as a guide. The second circuit can then be tuned until the programme is brought in at increased strength and free from interference. Alternatively, a switch could be placed in the filament circuit of each valve, so that each in turn could be put out of use while the other was being tuned; this is a better practical method.

It may be thought more convenient to disconnect the aerial lead from each coil in turn, but this is not satisfactory because it generally affects tuning to a very slight degree. That means that both circuits may have to be re-tuned together after initial rough tuning has been carried out.

Component Values

The component values shown are simply average ones, and need not necessarily be followed. In fact, the best method is to start with a Det.-L.F. receiver which has proved satisfactory and then to duplicate the detector and tuning circuits. When this is done, do not overlook the fact that it may be necessary to reduce the value of the decoupling resistor, since the current flowing through it—and hence the voltage drop across it—will be doubled when the extra valve is connected.

B.L.D.L. The British Long-Distance Listeners' Club

AT the time of going to press we have not received sufficient support to enable us to tell you that the DX contest is proceeding satisfactorily. As mentioned in these columns last week, the failure of more members to send in their cards saying "Yes" to the idea would mean that the whole project would have to be abandoned, and as the cards have not been received we have no alternative but to postpone the contest until greater interest is shown.

Before taking this as a criterion of individual members' desire to take part in some active listening, we must undoubtedly realise that a vast number of members are either with the Services or on work of national importance, which has curtailed the time normally devoted to their hobby. It is hoped, however, that in view of these conditions, the younger members will seize the opportunity to show what they can do; therefore, we suggest that it is up to them to become more active, so that a full and interesting programme can be maintained and the club's progress continued under these difficult times.

Aerials

IT is usual at this time of the year for amateurs to start thinking about overhauling the existing aerial arrangement and trying out other types about which they have read during the winter months. In view of the fact that it is really essential to maintain any aerial system in good condition, both mechanically and electrically, it is up to all members to devote a few hours, now that the fine weather is here, to a complete examination of masts, guy-ropes, halyards, pulleys, insulators and the aerial wire itself. After a winter as severe as the one just past, it is highly probable that the time devoted to such items will not be wasted, as it is surprising what serious damage can be done to such parts as the usual aerial system incorporates. A frayed halyard, a corroded wire or pulley, can be responsible for most unpleasant results if any part of the system should collapse, while dirty insulators or damaged aerial wire can seriously affect the over-all efficiency of the installation.

Every opportunity should now be taken to experiment with the numerous types of aerial suitable for reception purposes, but when undertaking such work, tests must be spread over a prolonged period as it is impossible to judge the efficiency of an aerial by one or two evenings' results. Particular attention should be paid to the logging of the stations received during such trials and their direction with relation to the receiving station, thus enabling the operator to obtain useful data concerning systems which have directional properties.

The Byrd Antarctic Expedition

WE would like to thank member 6291 of Wembley, for his letter, and for the information he gave concerning the above expedition. He states: "The Snow Cruiser of the Byrd Antarctic Expedition (KC4, U.S.A.) can now be heard quite well round about 07.00 to 08.00, on a frequency of 14.14 mc/s (phone), using a power of 100 watts. The cruiser, at the time of the last contact, was six miles from the West Base Camp of the Antarctic, and the station is operated by Felix Ferranto (W6NDH) using an A.V. beam aerial directed to North America."

Shacks and Dens

WE would like to remind our members that we are always very pleased to receive photographs of their shacks or dens, or any interesting piece of their equipment, so perhaps those who combine photography with radio will let us have examples of their work. Glossy prints are preferred as these are better for reproduction purposes. From the many photographs received (we are not able to publish all submitted owing to poor lighting and lack of detail), it would appear that the idea of what constitutes a station varies widely. While admitting that a great deal depends on the equipment and space available, there is nothing to prevent the amateur making his installation look businesslike and arranging the apparatus and wiring in some symmetrical order or system consistent with efficient operation. One has only to look into an enthusiast's den to gain a very good opinion of the class of work undertaken, and incidentally, the abilities of the owner.

Contacts Required

THE following would like to make contacts with other members in their area. Where possible it is hoped that such contacts will result in personal meetings and the formation of groups.

Manchester.—Member 6563, 34, Sandileigh Avenue, Withingstone, Manchester. (Many thanks for your interesting letter and log.)

Scarborough.—Member 6673, c/o 112, Westborough, Scarborough, E. Yorks.

Devon.—Member 6168, Higher Swetcombe Farm, Nr. Sidbury, Devon.

Glasgow.—Member 6630, of 10, Turriff Street, Glasgow, C.5.

Bromley.—Member 6724, of 39, Lakeside Drive, Bromley, Kent.

Coventry.—Member 6248, of 89, Marlborough Road, Stoke, Coventry.

INTERMITTENT FAULTS—2

Further Notes on Locating Them. By "Service"

(*Continued from page 230, June 1st issue*)

Trimming Oscillator Tracking Condensers

A VERY useful feature of the wide frequency band, signal source is its application for trimming oscillator tracking condensers. The standard type of oscillator gives a fixed frequency signal, and the ganged condenser has to be "rocked" about that point whilst trimming is in progress. This is usually a somewhat lengthy proceeding which is greatly simplified by the type of output from the Intermittent Fault Test Device. All that is necessary to trim oscillator tracking condensers is to adjust for maximum output—no rocking is necessary.

It will be appreciated that a monitoring device as described above will not disclose the cause of an intermittent fault, but only the fact that the receiver has failed. No service instrument yet designed will do that, but mention should be made here of the Rider Chanalyst which is the nearest approach to this ideal piece of equipment that has been devised to date.

This instrument is an "Analyser-de-luxe" and incorporates electronic voltmeters, I.F., H.F., and L.F. outputs, power level indicators, etc. The features, however, which are of interest in our present considerations are those concerned with the analysis of receivers suffering with intermittent faults. The Rider Chanalyst may be connected to such a receiver so that five channels are under the influence of five separate circuits in the receiver. Tuning indicators in each channel are then adjusted and the receiver left on test. When the intermittent fault occurs, the change in one or more of the indicators from normal discloses immediately the circuit of the receiver in which the trouble lies.

A combination of this type of analyser with a monitoring device goes far in simplifying the servicing of intermittent receivers and in localising the trouble. Then a careful examination of the circuit wiring and components should disclose the actual fault.

Having localised the seat of the trouble, commence the search for the fault by attention to the simple things first, such as valves loose in their sockets, frayed leads to the loudspeaker or to grid clips on valve caps, grid clips touching the top of valve screening cans, loose screening cans (causing intermittent instability), etc. After this preliminary examination the chassis wiring and components should be visually inspected.

As stated in the early part of this article the majority of intermittent faults are aggravated by vibration, and it is obvious that movement may be applied in an effort to find the trouble, but care must be exercised in using this method of attack. Carefully prodding and pressing suspected items is the most successful way, using pressure that will move only the joint or lead undergoing test without communicating the movement to any neighbouring wiring or component.

Trimming and Wire Dressing Tool

The implement or tool used for these investigations must be of insulating material and there are types on the market which have slots in them at certain angles which allow wires adjacent to joints and connections to be pulled, pushed or twisted so as to establish the condition of the joint. Metal screwdrivers or even metal-tipped trimmer drivers should not be used as when the metal blade makes contact with bare wiring, tags, etc., noises will be created which may give rise to misleading diagnosis.

With regard to small components such as fixed condensers, resistances, etc., firm pressure on the lead or tag where it enters the casing will generally disclose any break within the component. Coupling condensers can cause aggravating trouble in this direction when they go "open circuit," as reproduction ceases, or assumes a very weak or strangled quality, but voltages and currents at the various test points are not affected, and therefore give no clue to the cause of the fault. A coupling condenser with an internal short-circuit would, of course, divert H.T. to earth and to the grid circuit of the following valve and so indicate its presence.

"Whipping" of Chassis

The "whipping" or stressing of a chassis can cause perplexing symptoms, the chassis performing or not performing according to whether it is in or out of its cabinet. Most chassis rest on supports at each end and in large chassis there may be sufficient "sag"—unnoticeable to the eye—to effect strain on a connection so that electrical contact is broken, or to cause a bare lead to just touch a nearby tag. When the chassis is on the test bench it is probably supported differently, so that the stressing of the chassis is altered and the fault "cleared." For this reason a lifting of the chassis at one end while it is switched on is worth while to see whether any intermittent reproduction results. The chassis should not be handled roughly, but just slowly raised and lowered to allow different stresses to flex the chassis and components.

Working Temperature

There is an important consideration to be kept in mind when dealing with certain types of intermittent faults, and this is working temperature. Symptoms may be that the fault only commences to manifest itself after the set has been operating a little while, in other words, not until the receiver has thoroughly warmed up. The reason for this may be due to expansion upon heating. In other cases, the increase of heat softens waxes or varnishes, the changing of which affects the contact between broken connections. Rise in temperature can also make evident faults in loudspeakers such as distorted speech-coil formers, or out-of-centre speech coils. When only cool after a short test run the speech coil may just clear the pole pieces, but when the latter get really warmed up, their increased size and that of the speech coil, although very slight, may be sufficient to give rise to distortion or buzz due to fouling of the speech coil on the sides of the gap.

When a chassis or loudspeaker unit is on the bench undergoing test, it will probably never attain anything like its normal working temperature due to the abnormal ventilation, ventilation which is not present when the units are in their cabinets. It is probable that the fault may not show up under such conditions, and in any case it will take a long time for the necessary temperature to be established. This waiting time can be considerably cut down by providing cardboard or plywood covers that can be placed in position over the chassis or speaker unit so that heat is not dissipated. The covers should not touch the units in order that they may be removed when the fault occurs without the units being disturbed in any way. Care should be taken not to run units too long under such conditions without periodic inspection, otherwise the temperature rise may be excessive, resulting in more harm than good.

Another precaution often worth adopting, whether or not covers are used, is to place a chassis undergoing a test run on its side or end so that practically all parts of it are available for inspection when the fault manifests itself; investigations may then be proceeded with without moving the chassis.

By the use of suitable equipment and working along the lines suggested in this article, the sting may be taken out of servicing intermittent receivers, and the job assume a more normal perspective among service repairs with consequent saving in time and temper.

Open to Discussion

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

A Southport Reader's Den

SIR,—Though it has been quite a time since I last wrote, I am still a regular reader of your valuable magazine, which I have been reading even before it took over *Amateur Wireless*. I would like to congratulate you on the high standard you have consistently maintained. The present series of Radio Engineer's Pocket Book are unsurpassed for their great value and guidance in helping fellow constructors in the radio field.

I enclose a photograph of my den, trusting it will be of interest to other readers. The lay out consists of three receivers: two short-wavers, home constructed through the guidance of PRACTICAL WIRELESS, and the other a commercial 5-valve set including rectifier. There is also a P.A. amplifier. These last two are not visible on photo.—ERIC A. WRIGHT (Southport).

A DX Log from W. Sussex

SIR,—I am sending this DX log I made during May. I am surprised that Mr. Kidd cannot receive Canadian stations. Certainly in the daytime it is a hopeless proposition, but I have been receiving CJCX and CHNX quite regularly from 02.00 onwards at very good strength.

My set is a 5-valve commercial superhet, and aerial is a 44ft. 6-wire cage inverted L running due E. to W. I submit the following log during last month.

Phone stations on 14 mc/s were: W1, ES5D, 2G, 1E, 2F; LY1F, 1J, 1G and LY1BF; CO6OM, 7CX; CX2CO; HA6Q, 3B, 7P; CG9BA; PY1GR; KA1ME, 1RV; CX2AY; LU5DD, 5CK, 4KZ; XU8QA.

The main broadcast short-wave stations heard during the first week in May were: WCBX, WMBI, WGEA, WCAB, WPIT, WRUL, WRUW, WRCA, WLWO, WBOS, WGEO, CHNX and CJCX, VP3BG, HP5H, VONG, HCJB, PSH (Rio de Janeiro), 10.22 mc/s; MTCY, J2I, CR7BE, VOMZ, VODQ and HP5G (very remarkable news bulletins) on 25.47 m.

All the above stations were received at very good strength between the hours of 19.00 and 03.00. I shall be very interested to hear from any short-wave listeners and guarantee to answer all letters.—R. H. GRANT-DAVIS, c/o Mrs. Coleman, The Goldings, Northfields Lane, Eastergate, W. Sussex.

An Appeal

SIR,—However clever one may be as an operator, and with the most ambitious apparatus and aerial, there are short-wave stations which cannot be received unless the date, time of the day, and reflecting conditions are favourable, so that a bare recital of stations heard really conveys very little. If published logs are to serve any useful purpose it is essential that the date, exact time to the minute in 24-hour nomenclature, frequency in kc/s (or wavelength) of any station heard should be quoted, and what is far more important to know than the apparatus employed is an accurate description of the bearing of the aerial, the lay of it in the case of a dipole or the position of the free end in the case of a horizontal aerial. An alteration in the orientation of a horizontal aerial will be found to give a variation in signal strength of as much as five to one in some instances.

In the case of American stations, of which there are thousands, there is no point in readers giving more than one from any district on a particular date.—V. S. WALLACE (Norbury).

A Light Experimental Portable

SIR,—I have read with interest the discussion on your Readers' Letters page with regard to small portable receivers.

A corner of E. A. Wright's den, showing part of his equipment.

I have an Ultra 4-v. superhet battery portable receiver at present, and it weighs in the neighbourhood of 20lbs. I find it too heavy to carry very far. Of this weight, 5lbs. is H.T. battery and 3¾lbs. accumulator. The remaining 11¼lbs. is about equally divided between speaker and set chassis. To my mind, the elimination of the accumulator does not reduce weight much—i.e. if a dry battery is used, but if H.T. could be eliminated it would effect a greater saving in weight.

With this in mind I have been working out details of a small set on the following lines and am now carrying out experiments on the design. Briefly the idea is to have a small receiver, say 3-valve superhet for headphone reception with H.T. supplied by a Bulgin vibrator and transformer (home-made as small as compatible with efficiency) and a small L.T. battery; possibly a 4-volt Varley dry accumulator of cycle-lamp size, which would give a maximum of 8-10 hours' continuous service.

A second unit consisting of trickle charger, and speaker if required, would remain at home and the set portion would stand on this and be coupled by a small plug and socket so that the L.T. accumulator would always be kept fully charged ready for use as a portable when required.

A small speaker unit—moving-iron for lightness—could be incorporated in the set, but I find that when in the open a speaker sounds very faint unless the volume control is turned well up.

I should be interested to correspond with any other readers who may have experimented on the above lines.—B. C. CLAY, 28, Scott Lane, Riddlesden, Keighley.

Listening on the 40m. Band

SIR,—I think there can be no possible doubt now that the sun-spot maximum has been passed and that the predicted effects are true. "Twenty metres" is dying and "forty" is coming to life. However, with the solid block of weak American C.W. that almost completely occupies the whole forty-metre band in the early morning, and the tremendously powerful broadcast of the daytime and evening, DX listening on that band becomes extremely difficult with simple receivers.

I think conditions seem worse than they are—so few stations operating (comparatively), and so few beams on England. I should like to compare logs with others in this district and hear their views.—J. E. Rippengal, 38, Wellesley Crescent, Twickenham, Middx.

Correspondents Required

A. COLLINS, 3 Glencoe Road, Parkstone, Dorset, desires to get in touch with a reader about his own age (16 years) who is interested in general radio work.

J. Sibley, 134, Cumberland Road, Plaistow, E.13, would like to correspond with a wireless beginner in the locality about 19 years of age.

R. E. Westover, 245, Walton Road, Woking, Surrey, wishes to get in touch with an old hand in this district who would be willing to assist in set construction.

Prize Problems

PROBLEM No. 403.

AFTER using a straight-three battery receiver for some time, Matthews thought it would be an improvement if the screen voltage of the H.F. valve were made variable. He made a rough test and found that there was certainly an improvement with different voltages and accordingly he fitted a potentiometer in place of the series resistance formerly used to feed the screen. He found this worked very well for two or three weeks, but then he noted that volume had decreased and the performance gradually deteriorated. Why was this? Three books will be awarded for the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 403 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, June 10th, 1940.

Solution to Problem No. 402.

When Temple screened the lead he unfortunately introduced a short-circuit between the lead and the screening. This short-circuited the H.T. through the choke and owing to the fine wire this was burnt out. Accordingly, when he corrected the short-circuit the set failed to function as there was no H.T. on the valve.

The following three readers successfully solved Problem No. 401 and books have accordingly been forwarded to them:

L. Edwards, 7, Coed Afon, Llangollen, Denbighshire; G. W. Nailor, 27, Oxford Street, Swindon, Wilts; H. G. Reed, 298, Malden Road, Cheam, Surrey.

In reply to your letter

Increasing Volume

"I have a 2-valve short-wave set, and I find that the output of it is very small when it is tuned to American and other DX stations. I wonder if you can let me know if there is a 2-valve amplifier or 1-valve amplifier, or a preselector I could use before or after the set, without altering the 2-valver?"—C. W. M. (Arundel).

AS pointed out in recent articles, it is possible to add an H.F. stage or preselector to increase the range of a set and also to add L.F. stages to increase volume. The points to bear in mind are that the H.F. stage will increase selectivity and will not make a great deal of difference to the volume of stations now heard, although it may bring in stations at present not heard. On the other hand, L.F. stages will increase volume (proportional to the amplification of the new stages) but may at the same time introduce difficulties due to the fact that weak backgrounds now hardly noticed may be brought up and give an apparent loss of selectivity. It is, therefore, not always a simple matter to decide what to add, but in your case we think a 2-L.F. stage would be best, or a single L.F. stage with a pentode valve. H.F. could always be added at a later date to improve selectivity.

Coils for All-waves

"I am modifying my set to 'all-waves,' and wonder if it would be possible to retain my present two-band coils, as I find they give me adequate selectivity and the dial I am using is calibrated for them. If this is so, could I add short-wave coils without upsetting the dials or coverage of the existing coils? Your advice on the best way of carrying out my idea would be appreciated."—A. I. (Hove).

ALTHOUGH it would be possible to add short-wave coils there are one or two difficulties. If a separate wave-change switch is employed at present, you could replace this with a multi-contact switch and then add coils so that very little difference (if any) should be found in the present tuning. On the other hand, if self-contained coils and switches are now being used, you will have to arrange that when switched to short waves the entire coil assembly is out of circuit and separate short-wave switches, if you need more than one short-wave band, will have to be used. We suggest you study the Bulgin catalogue, where you will see various short-wave coils and multi-contact switches which may be adopted, although, as mentioned above, your final choice must depend upon the existing arrangements.

Push-pull Working

"I have tried out push-pull, but find that it is not so good as my ordinary output valve. I enclose my old circuit and the arrangement which I tried, and if this is not good enough, perhaps you could tell me how else to try it, as I have been told it is so good."—J. E. R. (Hemel Hempstead).

YOUR scheme was not sound, as the centre-tap on the input circuit would be very erratic. A much better plan, and one which has been recommended on many occasions, is to use two resistors across the transformer secondary, taking the junction of the two resistors to G.B. Alternatively, a variable component (potentiometer) could be used and adjusted for an exact electrical centre. In your case, however, we think it would be better to use R.C. coupling, taking the output from the cathode and anode of the L.F. stage in the usual way. This valve would then act as a phase-inverter, and would give more reliable results than your present scheme.

RULES

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

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

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

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

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

Eliminator Screening

"I have just made up an eliminator from parts taken from an old mains set and when connected to my battery set I am very disappointed with results. There is bad hum, and in trying to trace this, following details given in one of your books, I find that the position of the eliminator affects the results. In one place the hum is very weak, but I have to use very long leads. Does this indicate that I shall have to screen the unit more perfectly? At present it is in a copper-foil-lined box and it is separately earthed."—S. A. (Peterborough).

ALTHOUGH movement of the unit affects hum it may not indicate that screening is necessary, as there may merely be interaction between the mains transformers and a transformer or similar item in your receiver, and therefore it may probably be placed quite close to the receiver but at such an angle that the interaction is avoided. You should, therefore, try this before making any further modifications. On the other hand, copper is not adequate for screening a mains unit, as this material is not suitable for L.F. screening, although ideal for H.F. screening. Theoretically, you need an iron screen, but this may be obtained by using an ordinary tin box and earthing this.

Meter Switch

"I tried to make use of a meter in my set as indicated on the attached sketch, but twice it has burnt out when switching on. Can you tell me how to avoid this, as I do not want to have to keep having it rewound? There does not appear to me to be any way out in this circuit."—B. G. (Radlett).

THE burn-out was due to surge, and the meter should preferably be on the other side of the condenser. A much better plan, however, in view of the fact that the meter is only needed to indicate the conditions when the set is actually working, would be to fit a switch or push-button to control the meter. You can obtain a small push-switch or temporary position push-button which could be operated when the reading is desired. Alternatively, a plan which we have recommended on previous occasions is to fit a closed-circuit jack in the circuit, and at other points where a reading may be desired, and to fit the meter with a plug which could be inserted as desired. Shunts or other devices could be included so that they are added when the meter is plugged in, and short-circuited when the plug is out.

Cleaner Interference

"Could you tell me how to prevent the noise in my set when the vacuum cleaner is switched on? There is a terrible noise in the set, and this happens no matter what part of the house the cleaner is in. Can I fit anything to the set to save interfering with the cleaner?"—N. E. R. (Manchester).

YOU can obtain a special flex-lead suppressor device which is inserted in the leads from the mains plug to the cleaner. There are two types, and the flex must be cut and the device connected to the ends of the cut leads. It is quite small and will work effectively without upsetting the action of the cleaner. You may find that condensers across the mains lead to your set would also prove effective, if the set is mains operated.

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.

H. H. (Manchester, 10). The Candler Course would no doubt be of the most use to you. We have published several articles on the subject. We regret that we cannot give, at the moment, any indication as to possibilities.

J. McC. (Devonport). We think Electradix Radios can supply the items you require.

A. M. (Glasgow). The best we could recommend would be a three-valve (Detector 2 L.F.) arrangement.

G. T. (Cambridge). The impedance offered was much too high. Try a small load, and then measure the output. You will find that it is directly proportional in the circuit in question, and a good A.C. voltmeter, calibrated accurately would be of the greatest assistance.

S. E. A. (Ashbourne). Ordinary 22 D.C.C. wire would be perfectly suitable.

T. B. (Twickenham). The details have been published several times. You will find them all collected together in handy form in "Coils, Chokes and Transformers."

W. P. I. (Llanwrst). Bind the point before soldering. It would be worth while to bend each end back before soldering, so that the wires are locked together. This will give added strength.

C. M. (King's Lynn). A secondary rated at 350 volts 60 mA would be quite suitable.

M. E. T. (Gillingham). You cannot now use apparatus of the type mentioned. You will have to wait until after the war to carry on your experiments.

H. G M. (Bantry). A full-scale of 12 volts would be most suitable. Make your tests from day to day.

A. B. (Woodford). So far as we can trace, the wavelength is 49.94 metres and power 20 kW.

The coupon on page 268 must be attached to every query

Practical Wireless

BLUEPRINT SERVICE

PRACTICAL WIRELESS	*Date of Issue.*	*No. of Blueprint.*
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG,D,P)	14.8.37	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve : Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P)	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90
Mains Operated		
Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS		
Battery Sets : Blueprints, 1s. each.		
£5 Superhet (Three-valve)	5.6.37	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	16.1.37	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model Push Button 4, A.C. Mains Model	22.10.38	PW95
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	1.10.38	PW68
PORTABLES.		
Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86
MISCELLANEOUS.		
Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE		
CRYSTAL SETS.		
Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G. 3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three: De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	*Mar.* '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minitube Three (SG, D, Trans)	*Oct.* '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans)	—	AW370
2HF Four (2 SG, D, Pen)	—	AW421
Self-contained Four (SG, D, LF Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF,D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

These Blueprints are drawn full size.

Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint*. A dash before the Blueprint Number indicates that the issue is out of print.

Practical Wireless (issues dated prior to June 1st, 1940) 4d. Post Paid

" " (issues dated June 1st, 1940, and after) 5d. Post Paid

Amateur Wireless .. .. 4d. " "

Wireless Magazine .. .. 1/4 " "

The index letters which precede the Blueprint Number indicate the periodical in which the description appears : Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.

Send (preferably) a postal order to cover the cost of the blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (HF Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	*July* '33	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May* '35	WM386
SUPERHETS.		
Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. 6d. each.		
Heptode Super Three A.C.	*May* '34	WM359
"W.M." Radiogram Super A.C.	—	WM366
PORTABLES.		
Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two HF Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans)	—	WM367
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
S.W. One-valver for America	15.10.38	AW429
Rome Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-Short Battery Two (SG det, Pen)	*Feb.* '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve : Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July* '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF Pen, D, RC, Trans)	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super	*Nov.* '35	WM397
Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
"W.M." Long-wave Converter	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans)	—	WM391
MISCELLANEOUS.		
S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM392 (1/-)	*Nov.* '35	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	*Mar.* '36	WM403
New style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	*May* '36	WM405
Wilson Tone Master (1/-)	*June* '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408

IMPRESSIONS ON THE WAX

A REVIEW OF THE LATEST GRAMOPHONE RECORDS

FOLLOWING on an amazingly successful album devoted to the complete musical score of "Gulliver's Travels," the Decca Company have now issued one of Walt Disney's latest sensation, "Pinocchio," featuring Cliff Edwards, Julietta Novis, The King's Men and Victor Young and his Orchestra.

Faced with the problem of whether to follow the film exactly or whether to provide the maximum of graphonic entertainment, it was wisely decided to follow the latter. A record (sound track) made to sound "natural" in a large cinema tends to sound unbalanced in the average home. The new Decca album, therefore, contains all the "Pinocchio" music, but recorded not for the cinema but for your home. Wherever possible, the original film "voices" have been used, but even here there has been some recording licence. Cliff "Ukulele Ike" Edwards, whose vocal doubling is responsible for so much of Jiminy Cricket's appeal, is used to great advantage. *Decca F* 7436/9.

A recording contract of great importance was signed recently when it was arranged that future recordings by both the orchestra and the band of the Royal Artillery should be made by Decca. The orchestra has a record this month of "Toreador et Andalouse" and "The Night Patrol" on *Decca F* 7463, while the band makes its debut with "By the Waters of Minnetonka" and "The Grasshoppers' Dance" on *Decca F* 7464.

Vocal

INIMITABLE Norman Long has a comic cameo in "Nice Kind Sergeant" on *Decca F* 7461. He has coupled it with "In our Village A.R.P." Adelaide Hall revives two old favourites with recordings of "Chloe" and "Begin the Beguine" on *Decca F* 7460, while Bebe Daniels and Ben Lyon introduce several novel angles into their record of "There's a Boy Coming Home on Leave" on *Decca F* 7458. On the reverse side they sing "With the Wind and the Rain in your Hair." Vera Lynn records a broadcast success in "When you Wish Upon a Star" from the film "Pinocchio," and "I'm Praying To-night for the Old Folks at Home" on *Decca F* 7444.

Charlie Kunz records yet another of his popular piano medleys of up-to-the-minute tunes on *Decca F* 7457. Organ solos are provided by Sidney Torch with a medley of popular tunes on *Decca F* 7448.

Brunswick

A NEW song that has endless potentialities for the witty is "Confucius Says" on *Brunswick* 02957, played by Guy Lombardo and his Royal Canadians. The band couple it with "I'm Fit to be Tied." A new Brunswick record is of topical interest in that it contains the popular "Alice Blue Gown." The tune will have a renewed appeal when the film of "Irene," in which Anna Neagle is starred, is shown over here. Brunswick have chosen Florence George—she's Bing Crosby's sister-in-law—to make the record—*Brunswick* 02884. She is accompanied by Victor Young and his Orchestra, and on the reverse side she has chosen a very old favourite from "Rose Marie"—"Indian Love Call."

Classified Advertisements

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

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

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

CABINETS

A CABINET for every radio purpose. Surplus cabinets (undrilled) from noted makers. We have hundreds in stock (no catalogues). Send measurements of chassis, etc., and say what kind of cabinet required. Stamp for reply. Inspection invited.
H. L. SMITH AND CO., LTD., 289, Edgware Road, W.2. Tel: Pad. 5891.

LITERATURE

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

LOUDSPEAKER REPAIRS

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

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

MISCELLANEOUS

PRINTING.—1,000 Billheads, 3s. 9d.; Memos, Cards, etc. Samples free. — Creteway Press, 24, Buxted, Sussex.

MORSE EQUIPMENT

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

MORSE TRAINING

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

NEW LOUDSPEAKERS

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

FREE ADVICE BUREAU

COUPON

This coupon is available until June 15th, 1940, and must accompany all Queries and Hints.

PRACTICAL WIRELESS, 8/6/1940.

PUBLIC APPOINTMENTS

AIR MINISTRY.
AERONAUTICAL INSPECTION DIRECTORATE. Vacancies exist for unestablished appointments as Examiners in the General Engineering, W/T and Instrument Branches.
QUALIFICATIONS.
All candidates must have good general education, be able to read drawings, understand specifications, use micrometers and other measuring instruments.
(a) Applicants for the General Engineering Branch must have had practical experience in an engineering works. An elementary knowledge of materials testing is desirable.
(b) Applicants for the Instrument Branch must have knowledge of physics and training in light engineering or instrument making. Candidates with knowledge of optical instruments are also required.
(c) Applicants for the W/T Branch must have practical knowledge of W/T and electrical equipment with technical training in radio communication equal to City and Guilds final examination standard.
ACCEPTED candidates will undergo a period of training in inspection as applied to the above subjects, not exceeding three calendar months, and will be paid £3 10s. 0d. weekly during training. Subsistence allowance of £1 5s. 0d. weekly during training is payable to married men normally residing outside the training area. On successful completion of training, candidates will be appointed as Examiners at a salary of £246, if 25 years of age or over, with a corresponding reduction of £12 per annum for each year under 25 on joining (payable monthly in arrear) if service is satisfactory, and must be prepared to serve in any part of the United Kingdom.
NORMAL age limits 23 to 60.
CANDIDATES should indicate on their applications for which vacancy they wish to be considered—a, b or c.
APPLICATIONS must be made on Form 786, copies of which can be obtained on application, *by postcard only*, to: The Inspector-in-Charge, A.I.D. Training School (I.C.S./REC. 53), Brandon Steep, Bristol, 1.

RADIO MAP AND GLOBE

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

READERS' BARGAINS

PILOT 0-V-1. Complete. Steel cabinet, as new. Sell or exchange. Offers.—Nash, 21, Sandwell Avenue, Darlaston, Staffs.

RADIOGRAM, good tone and working order, also all-wave table receiver. Must be good and reasonable price.—Roberts, Rural Structures, Amersham.

COMPONENTS, Valves, PM22A's, FC2A's, VP2B's, VP2's, SP2's, HL2's, SG's, etc. Resistors, Condensers, OPT's, 1 Eliminator, V/C's and good portable accs., JSK2's, etc., etc.—Apply Childs, 94, Abbey Road, Warley, Staffs.

LATEST Stentorian Senior, T.M. Speaker, as new, 30s., postage extra.—Box No. 205, c/o Practical Wireless.

RECEIVERS AND COMPONENTS

BANKRUPT Bargains. Brand new 1939/40 models, makers' sealed cartons, with guarantees, at less 30% to 40% below listed prices; also Midgets, portables, car radio. Send 2½d. stamp for lists.—Radio Bargains, Dept. P.W., 261-3, Lichfield Road, Aston, Birmingham.

SOUTHERN Radio's Bargains.
ALL Guaranteed. Postage Extra.
5/- Parcel of useful Components, comprising Condensers, Resistances, Volume Controls, Wire, Circuits, etc. Value 25/-. 5/- per parcel.
15/- Service Man's Component Kit. Electrolytic Condensers, Volume Controls, Resistances, Tubular, Mica, Paper Condensers, Valve Holders, etc. 120 articles contained in strong carrying case, 9" x 7" x 7", 15/- the Kit.
21/- Small Trader's Parcel of Components. 150 Articles comprising all types Condensers, Valve Holders, Resistances, Chokes, Coils, Wire, etc. Value 85/-, 21/- the parcel.
5/- 100 Wire-end Resistances, assorted capacities. ½ and 1 watt, 5/- per 100.
ORMOND Loud-speaker Units, 2/6; Crystal Sets, 5/6; Westectors Type W2, 2/6; Crystal Detectors, 2/-; Crystals, 6d.; Marconi V24 Valves, 9d. "P.O." Microphones on Stand, for use with any receiver, 5/-; Telsen W349 Iron-core Midget D.R. Coils, 5/6; Morse Tapping Keys, 3/-; Buzzers, 1/6.
2/- Tool or Instrument Carrying Cases, ex Government Stock; Wood 9" x 7" x 7", 2/-.
SOUTHERN Radio, 46, Lisle Street, London, W.C. Gerrard 6653.

RECEIVERS AND COMPONENTS

RADIO CLEARANCE, LTD., 63, High Holborn, London, W.C.1. TELEPHONE: HOLborn 4631.

LISSEN 2v. screen-grid valves, S.G.215 and S.G.2V, 3/6 each.

LISSEN 2v. battery pentode, 4-pin side terminal P.T.2A and P.T.225, 3/11 each.

LISSEN 4v. mains screen grid A.C./S.G., 4/11 each.

LISSEN 4v. mains output pentode A.C./P.T., 4/11 each.

LISSEN rectifier valve V650, 2/11 each.

ALL-WAVE super-het. chassis, 5 valve A.C. Latest Mullard valves T.H.4.B., V.P.4.B., T.D.D.4., Pen. A.4., L.W., 4/350v. Ranges: short wave 16-48 metres. Medium wave 200-560 metres. Long wave 800-2,200 metres. Size of chassis, 14½in. long, 7½in. deep, height overall 8½in. Controls, tuning at side. Volume on/off at side, wave-change, provision for pick-up. Complete with valves and knobs, £4/17/6. Special Speaker, 1,500 ohms field, 10/6 each.

ULTRA SHORT and short-wave choke. Lissen Hi-Q. inductance, 100 microhenries. Boxed, list, 2/-. Our price, 1/- each.

ULTRA SHORT and short wave double wound low-resistance choke. Lissen Hi-Q. resistance less than .05 ohms. Boxed, list, 2/6. Our price, 1/3 each.

LOW-LOSS Ceramic valve-holders. Lissen Hi-Q. Baseboard and chassis, 5- and 7-pin, 10d. and 1/- each.

MANSBRIDGE type condensers. Lissen Hi-Q. 250 D.C. working. Moulded case with feet .1 mfd. and 1 mfd., 6d. each.

ROTARY COIL UNIT. Lissen Hi-Q. Four-band from 4.8-91 metres, can be selected by a turn of the knob. With circuit. Boxed. List, 15/6. Our price, 6/11 each.

LOW-LOSS short-wave variable condensers. Ceramic insulation. Brass vanes. Lissen Hi-Q. Minimum capacity 5 micro-micro farads. Two types. Boxed. With knobs. 160 mmfd. List, 7/6. Our price, 3/- each. 20 mmfd. List, 5/6. Our price, 2/6 each.

CONE speaker unit. Lissen. Complete with reed and chuck. Boxed, 1/- each.

PUSH-PULL switches. Lissen. 2-point, 4d. each. 3-point, 6d. each.

ROLA P.M. speakers. Latest type, 7½" cone with power and pentode transformer. Boxed. 15/- each.

CLOCK-FACED dials. 5" x 3½". With printed 3-wave scale. Ox-copper escutcheon and glass, 3/6 each. Ditto, less escutcheon, 2/6 each.

FILAMENT transformers, input 200-250v., output 4v.4 amps., 4v.6 amps., 4/11 each.

MAINS transformers. Plessey. 350-0-350v., 90 m.a., 4v. 2.5 amps., 4v. 6 amps., 8/6 each.

MAINS transformer. G.E.C. American windings, 350-0-350v., 65 m.a., 5v. 2 amps., 6.3v. 2.5 amps. Suitable for replacements in G.E.C. models, 5/6 each.

MAINS transformers. Wearite. Type R.C.1, 250-0-250v., 80 m.a., 4v. 2.5 amps., 4v. 4 amps., 9/11 each. Type R.C.2, 350-0-350v. 120 m.a., 4v. 2.5 amps., 4v. 4 amps., 12/6 each. Type R.C.3, 350-0-350v. 150 m.a., 4v. 2.5 amps., 4v. 2 amps., 4v. 5 amps., 15/- each. Type R.C.4, 500-0-500v. 150 ma., 4v. 2 amps., 4v. 2 amps., 4v. 2.5 amps., 4v. 5.6 amps., 21/- each. All above are centre-tapped windings. Type R.C.5, 100-watt auto transformer, 100-110v., 200-250v., reversible, 12/6 each. All transformers 200-250v. tapped primaries.

CHASSIS mounting valve-holders. American 4-5-6-7-pin, 4d. each. Octals, 6d. each. Loctals, 10d. each. 7-pin English type, 3d. each.

1 WATT resistances, Polar N.S.F., 4d. each; 3/9 dozen. All sizes up to 2 meg.

VOLUME CONTROLS. American C.T.S., finest made, divided spindles. Length 2½". With switch 2,000, 5,000, 10,000, 25,000, 100,000, 250,000, 500,000, and 1 meg., 2/6 each. Wire wound, 5 watt (less switch), 2,000, 5,000, 10,000, 20,000, and 25,000 ohms., 2/- each.

24 MFD. can type electrolytics, 450v. working, 1/6 each.

MAINS TRANSFORMER, type R.C.D. Drop through. Capped, 250/350v. 100 ma., C/T. 4v. 6 amps., 4v. 2.5 amp. Wire-ends, 10/6 each.

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FREQUENCY MODULATION—See page 276

A NEWNES PUBLICATION

Edited by F. J. CAMM

Vol. 16. No. 404.

Practical Wireless and PRACTICAL TELEVISION

4D. EVERY WEDNESDAY

June 15th, 1940.

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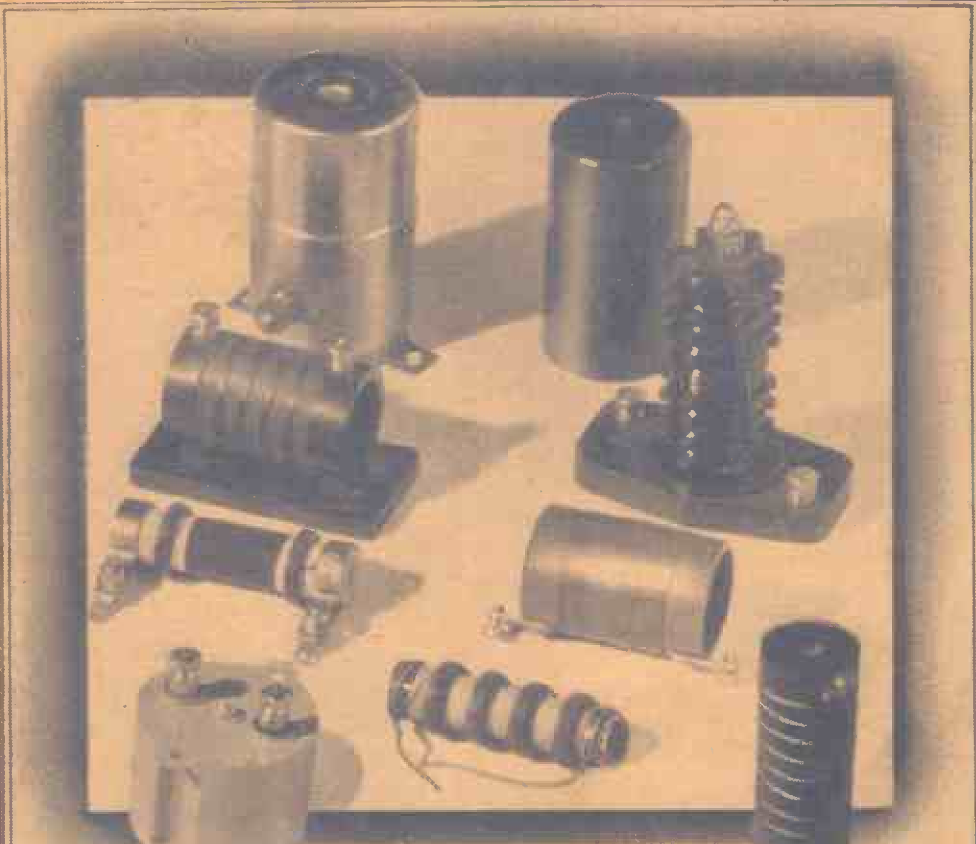

Choosing a Choke

Practical Wireless

BLUEPRINT SERVICE

PRACTICAL WIRELESS

	Date of Issue.	No. of Blueprint.
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set ..	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode) ..	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF) ..	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow) ..	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow) ..	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen) ..	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P) ..	14.8.37	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen) ..	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen) ..	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen) ..	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve : Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P) ..	1.5.37	PW4
Fury Four (2 SG, D, Pen) ..	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P) ..	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC)) ..	3.9.38	PW90
Mains Operated		
Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen) ..	—	PW18
A.C.-D.C. Two (SG, Pow) ..	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow) ..	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen) ..	—	PW35B
Unique (HF Pen, D (Pen), Pen) ..	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen) ..	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen) ..	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS.

Battery Sets : Blueprints, 1s. each.		
£5 Superhet (Three-valve) ..	5.6.37	PW40
F. J. Camm's 2-valve Superhet ..	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve) ..	—	PW43
D.C. £5 Superhet (Three-valve) ..	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4 ..	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four ..	16.1.37	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model .. / Push Button 4, A.C. Mains Model	22.10.38	PW95

SHORT-WAVE SETS. Battery Operated.

One-valve : Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen) ..	1.10.38	PW68

PORTABLES.

Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen) ..	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86

MISCELLANEOUS.

Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.		
Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
B.B.C. Special One-valver ..	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans) ..	—	AW388
Full-volume Two (SG det, Pen) ..	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G.3 (SG, D, Trans) ..	—	AW412
Lucerne Ranger (SG, D, Trans) ..	—	AW422
£5 5s. Three : De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen) ..	June '33	WM327
Economy-Pentode Three (SG, D, Pen)	Oct. '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans) ..	Mar. '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen) ..	—	WM389
Certainty Three (SG, D, Pen) ..	—	WM393
Minitube Three (SG, D, Trans) ..	Oct. '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans) ..	—	AW370
2HF Four (2 SG, D, Pen) ..	—	AW421
Self-contained Four (SG, D, LF, Class B)	Aug. '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	Feb. '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	Apr. '36	WM404
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

These Blueprints are drawn full size.

Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint*. A dash before the Blueprint Number indicates that the issue is out of print.

Practical Wireless (Issues dated prior to June 1st, 1940)	4d. Post Paid
" " (Issues dated June 1st, 1940, and after)	5d. Post Paid
Amateur Wireless	4d. " "
Wireless Magazine	1/4 " "

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Send (preferably) a postal order to cover the cost of the blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C. ..	—	AW383
Mantovani A.C. Three (HF Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	Jan. '36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen) ..	July '33	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	May '35	WM386
SUPERHETS.		
Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	Oct. '35	WM395
The Request All-Waver	June '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. 6d. each.		
Heptode Super Three A.C. ..	May '34	WM359
"W.M." Radiogram Super A.C. ..	—	WM366
PORTABLES.		
Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two HF Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans)	—	WM367
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
S.W. One-valver for America ..	15.10.38	AW429
Rome Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-Short Battery Two (SG, det, Pen)	Feb. '36	WM402
Home-made Coil Two (D, Pen) ..	—	AW440
Three-valve : Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	July '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF Pen, D, RC, Trans) ..	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super ..	Nov. '35	WM397
Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
"W.M." Long-wave Converter ..	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C. ..	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) ..	—	WM391
MISCELLANEOUS.		
S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM392 (1/-)	Nov. '35	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	Mar. '36	WM403
New style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	May '36	WM405
Wilson Tone Master (1/-) ..	June '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408

Practical Wireless and PRACTICAL TELEVISION

EVERY WEDNESDAY
Vol. XVI. No. 404. June 15th, 1940.

EDITED BY F. J. CAMM

Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Choosing a Component

MANY beginners are confused when looking through radio catalogues by the wide ranges offered in some single lines. Coils may be all classed under one heading and all modern coils are designed to cover a given range, being wound to inductance values set out by the Component Manufacturers' Federation. L.F. transformers, however, are available with various ratios and inductance values and these confuse some constructors. Similarly, there are many different patterns of H.F. choke, and this is a most important item in some circuits. Accordingly, in this issue, and also in the next, we endeavour to explain the functions of chokes in various circuits and how to determine the type of component for separate purposes. Resistances also have various ratings and this again offers some confusion. The values are, however, fixed according to the voltage to be dropped or the purpose for which they are required and the wattage may easily be calculated. It is the same with most other components, but the choke is undoubtedly the chief stumbling block and we think the various difficulties will be easily overcome when the facts are properly understood.

Thirsty Work

THE fourth in the series of Maurice Brown's "Thirsty Work" programmes is to be broadcast to the Forces on June 14th. This time, Brown has taken the B.B.C.'s mobile recording unit to a village on the borders of Northamptonshire and Rutlandshire where he found some excellent singing in the local inn. This programme will be slightly different from the three previous ones in so far as it will not be purely local. The songs listeners with the Forces will hear are of a more general character and one number includes animal noises. The artists in the programme will include a gamekeeper, a forester and farm-labourers.

Second Film Festival

ONE of the richest scores in film musicals of the last few years belongs to the recently released "The Wizard of Oz." It is possible that Jack Beaver's radio version of the score was even more colourful than the original; certainly it contributed considerably to the success of the broadcast. The revival of the radio version of this odd but successful adaptation of a classic American fairy tale will be broadcast on June 17th, within three months of its first production, and will be second in the impressive list that makes up "Film Festival." Douglas Moodie will produce and it is expected that Celia Lipton will again delight with her singing of "Over the Rainbow," in the part of Dorothy, the little girl who is whisked away on the crest of a tornado, to the wonderful land of Oz.

A modern portable field radio transmitter and receiver. Note the aerial-earth arrangement and battery supplies.

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

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

My Day's Work

SPEAKERS in the series entitled "My Day's Work," to be broadcast on June 15th, will be Albert Jennens, who will describe his job in a big glass works in North-West Worcestershire; Walter Levick, of Tamworth, who will tell how he keeps the "roads" clear in a coal mine; an interview with George Jones (the Warwickshire Miners' Secretary), and H. Van Byleveld, manager of a cycle depot in Birmingham, who will give some hints to those who, owing to the petrol control, are riding a bicycle for the first time.

"Rhapsody in Black"

"THE Music Goes Round—And Round" came to the end of a most successful run a few weeks ago, and listeners to afternoon programmes have probably missed this weekly spot of sparkle and sophistication. However, Roy Speer, its producer, and James Dyrenforth, its new-style compère, have put their heads together and already announce a successor called "Rhapsody in Black." This series, which begins on June 19th, will bring to the microphone the Negro in all his moods—from the splendid simplicity and intensity of the spiritual to the amazing rhythms and other manifestations of Harlem and New Orleans.

Maurice Winnick and His Band

MAURICE WINNICK has just finished his successful season at the Dorchester, where he has won high praise from the connoisseurs on his particular rendering of swing; and on June 16th he will broadcast as the band of the week. This is Winnick's first visit to the particular B.B.C. provincial studio from which he is to broadcast, though probably not his first engagement in the city itself, as he is a much travelled man, who had toured most of the music-halls of Britain with his own band before he was twenty-one years old. Perhaps he developed his taste for travel in his first job in a cinema orchestra, and made up his mind as he accompanied with appropriate music the exotic scenes of the silver screen before him, that he would visit those scenes himself. Anyway, Maurice took on the job as band-leader on one luxury liner after another, and his job took him three times round the world. He studied dance music in New York, and learned there to play the clarinet and the saxophone; but the violin is the instrument which he prefers, and with that he leads the first-class band he is conducting to-day.

A Simple Capacity Tester

A Handy Bridge for Measuring the Values of Condensers and Other Capacities

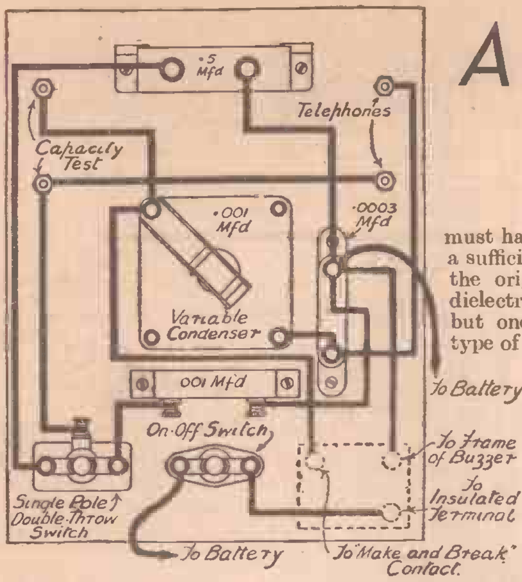


Fig. 1.—Wiring diagram of the simple capacity tester.

THE necessity for some simple form of apparatus for capacity measurement, such as that described here, must have been felt at one time or another by every wireless enthusiast. The time and labour of fault location in service work on commercial receivers may be reduced with such gear. To the experimenter, of course, there are innumerable ways in which the ability to measure capacities will prove of interest and value.

The bridge described here is extremely effective, employing as far as possible parts which constructors are likely to have on hand, or which, at any rate, may be purchased with very little outlay.

How It Works

The action of the instrument is very easy to understand. If an alternating or intermittent potential such as that obtained from a buzzer is applied across the points A and B of the bridge circuit, shown in Fig. 2, the current may be considered to take two paths—one through the point C and the two condensers in this arm, and the other through D and the two condensers in this arm. Now it is possible by so arranging the values of the four condensers to obtain a condition when the potential at C is the same as that at D.

In this case no current will flow through the telephones which are connected across these points, and no note will be heard. This is actually secured when the capacity AC bears the same ratio to the capacity CB as the capacity AD does to DB. Thus, if AC is .0003 mfd. and CB three times as much, AD could be practically any value, and so long as DB was three times the value of AD no note would be heard. By making the capacity in AC variable it is possible to calculate any unknown capacity connected in AD, provided AC has a suitably calibrated scale and the unknown condenser is within the working range. The range of measurement available by tuning AC from zero to maximum will depend upon the choice of the value of DB.

The values used here have been chosen by calculation and experiment to give two ranges of capacity measurement most useful for receiver test work while using the condensers which are most likely to be on hand. So long as the circuit arrangement and capacity values are adhered to, it matters very little as to the actual layout or form of the unit. The variable capacity must have a maximum of .001 mfd. to give a sufficiently wide range, and in the case of the original model two .0005 mfd. mica dielectric ganged condensers were used, but one of the old straight-line capacity type of .001 mfd. would be equally suitable. These are very often to be had from wireless stores.

Use a "mosquito" or high-note buzzer for preference, and one which is not too noisy mechanically, otherwise the note in the earphones will be drowned by the vibration of the armature.

Construction

Wiring and construction should present no difficulties, since there is surprisingly little complication about the unit. It should be possible to assemble and complete the whole job in an hour or two. When the bridge is ready for work the scale must, of course, be calibrated on both ranges, and while this presents no difficulties, suitable fixed condensers of marked capacity must be available. For the first range two or three or more condensers between .0001 mfd. and .004 mfd. are required. These should be connected in turn to the "capacity test" terminals, starting with the smallest capacity and increasing in steps. Switch on the buzzer and set the single-pole double-throw switch for the right range (the .001 mfd. in circuit for the lower range, and the .5 mfd. for the higher), then tune the .001 mfd. variable for minimum signals.

Each zero position obtained should be marked accordingly. For the second range values between .1 mfd. and 2 mfd. are required. It should be noted that with three or four condensers practically the whole of the range may be covered by series and parallel connections. For example, a .0002 mfd. and a .0003 mfd. will give readings for the individual values, and also for .0005 mfd. when joined in parallel. Two .5 mfd. condensers will give .25, .5 and 1 mfd. readings, and so on.

The scale may be calibrated directly, that is, the actual capacity values written on the scale, or, alternatively, a scale divided into degrees can be used and the readings plotted in the form of a graph. The first method is somewhat simpler and quicker to read, while the second method enables intermediate values to be estimated from the curves plotted with three or four points. Where the first method is used it is a good idea to make the pointer double ended, in which case one half of the circle may be used for the lower range, and the opposite half for the higher range, thus avoiding confusion between the two sets of figures.

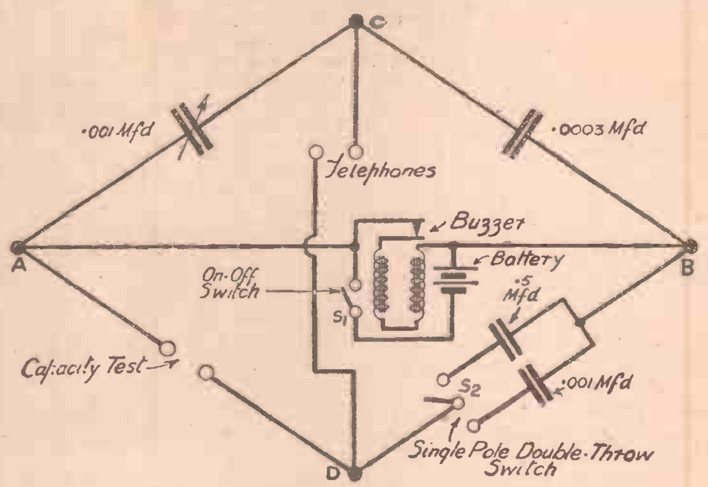


Fig. 2.—Theoretical circuit diagram.

For The Beginner

CHOOSING A CHOKE—1

Details of Various Chokes, and Their Importance in the Circuit

AMONG the various types of components which go to make up a radio receiver, there is one class which seems to be rather neglected—namely, chokes. This may be due in part to the somewhat insignificant form of its diagrammatic representation, and in part to the fact that in many cases—though not in all—the exact value of its electrical properties is not so critical, so far as circuit efficiency is concerned, as those of, say, a tuning coil or a variable condenser.

But, however this may be, chokes of one type or another do play rather important parts in the receiving equipment of to-day, and when it is desired to purchase one it is well worth choosing a type which is in every way suitable to the job in hand and likely to give long and satisfactory service.

Functions of a Choke

In order to be able to make a wise selection, however, it is necessary to understand exactly what a choke is, and what are its functions in a circuit, as well as the different kinds of chokes, which have been evolved for different purposes. To begin with, then, a choke is, essentially, a coil of wire, and its principal property, on account of which it finds application in radio circuits, is impedance. This at once calls for further explanation.

You all know that when a direct current is passed through any piece of apparatus, the value of the current flowing is limited by what is known as the *resistance* of the apparatus, resistance being the opposition which the apparatus offers to the flow of current. If, instead of passing a direct current through the apparatus, we apply an alternating current, the apparent resistance may, or may not, be the same as when a direct current was applied. If the apparatus consists of or contains a coil of any kind, the apparent resistance to alternating current will be much greater. In fact, it is possible to design a coil which has a very small resistance to direct-current flow, but a very large apparent resistance to the passage of an alternating current—and such a coil is called a choke.

Impedance

Now why should a coil offer a higher opposition to alternating current than to direct current? The answer is, because it possesses the property of inductance. As the alternating current grows from its zero value to its maximum value, a magnetic field is built up in the coil and its neighbourhood, and the growth of the magnetic field within the coil *induces* another electromotive force in the coil, in opposition to that originally applied, and thus tending to prevent the original current from flowing. Similarly, when the alternating current is dying away, a back "E.M.F." is self-induced, tending to maintain the flow. The coil thus presents a different form of opposition from that due to pure resistance, although its effect is precisely similar, that is to say, it limits the value of the current. This opposition is termed "impedance," and it is measured in ohms in the same way as resistance.

One point must be made clear—every choke has, in addition to its impedance, which is only operative on alternating current—a certain amount of resistance, which is effective with both direct and alternating current. The resistance, apart from any increase owing to high-frequency effects, is unvarying in value, and depends entirely upon the length, diameter and material of the wire. The impedance, on

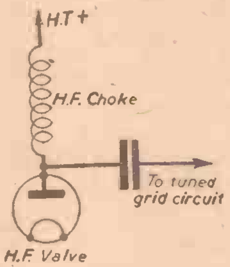


Fig. 1.—The position of the choke in a standard H.F. stage.

the other hand, is not constant in value—it varies according to the frequency of the alternating current, being higher at high frequencies than at low frequencies. This is because the "back E.M.F." depends upon the rate at which the magnetic field changes, and the rate of change is, of course, greater when the frequency is higher.

It is for this reason that a choke should never be specified as a choke of so many ohms impedance, because although it is possible to measure the impedance, it is necessary to state at what frequency the measurement is made. It is customary, therefore, to specify a choke as of so many henries or microhenries inductance, for, knowing the inductance, it is possible to calculate the impedance at a given fre-

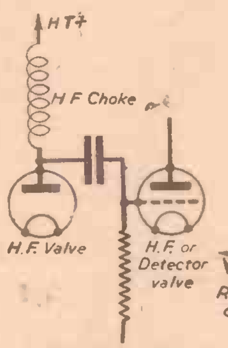


Fig. 2.—Aperiodic H.F. coupling includes a choke as shown here.

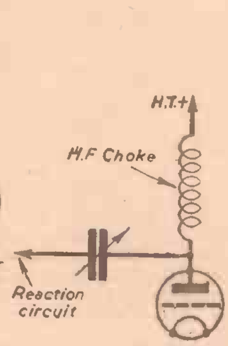


Fig. 3.—The standard reaction H.F. choke.

quency. This is, however, seldom necessary on the part of the constructor, as in most set designs the correct inductance is quoted.

H.F. Chokes

Now let us see in what ways the special properties of chokes are employed in radio circuits. Chokes are used for various purposes in both the radio-frequency and low-frequency portions of receivers, as well as in power supply units. We will begin with high-frequency chokes. Their applications are many, but in all cases they are used primarily to "choke back" or block the passage of high-frequency currents—hence their name. For example, a choke is frequently inserted in the anode circuit of a high-frequency valve, between the anode and the H.T.+ terminal (Fig. 1), its object being to permit the flow of the mean anode current, but to oppose the flow of the radio-frequency variations, which are by-passed via the coupling condenser to the tuned grid circuit of the detector valve. Of course, it is not absolutely necessary to use choke-fed tuned-grid coupling—the older tuned-anode circuit is just as effective, but tuned-grid coupling has the advantage that the moving plates of the tuning condenser may be earthed because the coupling condenser isolates the tuned circuit from the H.T. supply.

Then a high-frequency choke is often used in the anode circuit of a high-frequency valve without a tuned-grid coupling, in such sets as portables (see Fig. 2). Its action is very similar to the first application except that the extra amplification obtainable with the tuned circuit is not achieved. A third use for a high-frequency choke is in the anode circuit of a detector valve, as indicated in Fig. 3. Here its function is to pass the direct current component of the anode current and also the low-frequency modulation, at the same time, due to its high impedance at radio frequency, choking back the radio-frequency component which is thus diverted through the reaction coil.

Special H.F. Chokes

It is clear that chokes for any of these purposes should have as high an impedance as possible at the frequencies at which they will be operated. As the range of frequencies to be covered in radio reception is very wide, it has been found impossible to design one type of choke which can be used indiscriminately on all frequencies. There have, therefore, been developed what may be termed "general purpose" high-frequency chokes, suitable for use on either the medium or long broadcast bands. These are the chokes usually specified in normal broadcast receivers. For short-wave working, special short-wave chokes are marketed.

On the other hand, for use in superheterodyne receivers, on the intermediate-frequency side, owing to the lower frequency, it is necessary to employ chokes of higher inductance than for ordinary straight broadcast receivers. For use in the anode circuit of a detector valve as in Fig. 3, a choke of the standard type is correct.

The first point to make certain when choosing a high-frequency choke, therefore, is that it is of a type suitable for the frequency upon which it will be used—or rather the band of frequencies. This will be clearly stated by the maker, and you can hardly go wrong on this score if you tell your dealer for what purpose you require to use the choke. Practical values for H.F. chokes are given in the table overpage.

Next, we must pay attention to the design of the choke. In order to obtain

(Continued on next page.)

CHOOSING A CHOKE

(*Continued from previous page.*)

the necessary amount of inductance, a large number of turns of wire have to be wound on the choke. These turns act as the plates of small condensers, so that there is a tendency for the high-frequency current to pass from turn to turn through this self-capacity, thus defeating the object of the choke, which is to block off one circuit to the passage of the high-frequency current and shunt it along another path. The higher the frequency the easier it is for the radio-frequency current to take this short cut past the choke; so another feature of a good high-frequency choke is low self-capacity—or what is termed low-loss construction. This is particularly important in the case of short-wave chokes.

Purpose	*Inductance*	*Self Capacity*	*D.C. Resistance*
Coupling for S.G. valves ..	200,000/500,000	1/3 mmfd.	200/500
Standard H.F. Coupling ..	100,000/200,000	2/4 mmfd.	300/800
Ordinary reaction ..	50,000/200,000	1/3 mmfd.	200/700

The next point calling for attention is the matter of interaction. It is obvious that a choke comprising a number of turns of wire will produce a considerable magnetic field of its own, and the magnetic effects may cause unwanted coupling with other parts of the circuit, resulting in instability. Conversely, the windings of the choke may in their turn pick up either by magnetic or electrostatic coupling, impulses from some other part of the set, which again might introduce unstable operation.

Reducing Interaction

The self-field of a choke can be reduced by winding the coil in binocular form, i.e., as two coils side by side. This results in a much more concentrated field, having very much smaller external influence. For many purposes, however, especially in modern sets, it is desirable to screen the high-frequency chokes by enclosing them completely in metal cans or covers. Here, however, a further risk may be introduced, for if the screen is so designed as to be close to the choke winding, the screen and the choke will in their turn act as the plates of a condenser, and valuable high-frequency energy will be by-passed to earth and lost. Hence in selecting a screened H.F. choke, choose one in which there is generous spacing between the windings and the case.

Finally, the general mechanical design of the choke should be sound. We must usually trust to the maker to see that all internal connections are well made, and the winding properly insulated between sections and between the wire and the case. But we can select types which have sensible terminals or connecting-lugs, and fixing holes which are in convenient positions, and will take screws or bolts of reasonable size, and we can see to it, too, that the choke we buy is of a general design which will withstand normal usage without damage.

Converting or Adapting?

Clearing Up a Present-day Problem

By H. J. BARTON CHAPPLE, B.Sc.

In Practical Wireless, dated May 25th, some interesting practical notes were furnished concerning the use of a short-wave converter, and at the same time mention was made of the use of an adapter. There always appears to be a certain measure of confusion existing concerning the exact functions of these two units, and as at the present time there are many people who are turning their attention to the short-wave end of the spectrum it is useful to examine the position in regard to the two ways in which the home receiver may be made to function, although the normal range is only medium and long waves. There is little doubt that for the very best results it is preferable to employ a short-wave or ultra-short wave receiver designed solely for this purpose, but questions of expense arise, and provided the home set would normally be inactive during those periods when short and/or ultra-short wave listening is to be indulged in, then on the face of it there seems no reason why this set should not play its part.

Different Functions

Regarding the two units themselves an adapter is usually a short-wave detector which is designed to cover the short or ultra-short wave band, or both, and is plugged into the detector stage of the ordinary broadcast set so as to adapt it to its new purpose. The term converter, on the other hand, is used when the device functions as a result of changing one frequency into another frequency which comes within the scope or range of the home set. The double combination then becomes a superheterodyne receiver, the high frequency side of the home set working as the intermediate frequency amplifier.

With these two facts clearly in one's mind it is now a much simpler matter to see which method is better suited to meet individual requirements. Turning to the adapter first, since only the low frequency side of the home set is to be brought into commission, the quality of the results obtained will depend very much on the degree of audio gain existing, and also the frequency response. One thing that must be guarded against is insensitivity in the adapter unit. If long range working is not desired then a straightforward detector circuit alone, similar to those which from time to time have been featured in these pages, will suffice. A series of plug-in coils may be used to cover the necessary band, but it is neater and less troublesome to use a multi-range coil, provided it has efficient switching incorporated, and is properly screened. So many of these units fail because of poor switching, so be sure to obtain a coil from a manufacturer of repute.

Increasing Range

When it is felt desirable to increase the listening range of the adapter, then a stage of high-frequency amplification can be made to precede the detector valve, and this two-valve combination can then work in conjunction with the audio-frequency side of the home set. Give the adapter a good chance to prove its efficiency by using a satisfactory aerial installation, and if working on the ultra-short waves study the notes published recently in Practical Wireless in order to ensure that any dipole arrangement falls within its correct category. Pay particular attention to the disposition and length of interconnecting leads between the adapter and set, otherwise instability will mar the working. If the home receiver is A.C. mains driven, remember that by cutting out the normal H.F. and detector loads the volts from the rectifier unit will rise. This may cause trouble, and if the same rectifier unit is not employed to feed the adapter, then it may be found advisable to introduce a dummy load to equal the watts consumed by the non-working part of the home set.

Converter Unit

Coming now to the converter unit, it must be remembered that this functions by making the high frequency section of the domestic set into an intermediate frequency amplifier of a superheterodyne set. This part of the home set should therefore be very efficient, and as a general rule the receiver itself is left tuned at some position on the long-wave band—the best setting is found by experiment—and all ordinary tuning is undertaken with the converter unit. This can be a first detector only, or when higher sensitivity is desired, and more distant listening is necessary, then the detector stage can be preceded by a high frequency stage. For useful working details the reader is referred to page 218 of Practical Wireless, dated May 25th, where a typical H.F. and detector converter unit circuit was described.

On the score of cost it is generally found that the adapter is cheaper, but when performance is of the greatest importance the converter is usually capable of providing the better results. Very useful operating knowledge of the short and ultra-short wave bands will be acquired, and this will pave the way to the ultimate desire of constructing a special complete set which can be used independently of the one doing duty for domestic listening.

ON YOUR WAVELENGTH

By Thermion

Car Radio Taboo

THE Postmaster-General has announced that a Defence Regulation dated May 29th provides that apart from certain authorised exceptions, no person shall use, or have in his possession, or under his control, any wireless receiving apparatus installed in any road vehicle. Any wireless receiving apparatus, even if it is not fixed in position—for example, a portable set —will be deemed for the purpose of the regulation to be installed in a vehicle if it is in the vehicle in such circumstances that it can be used or readily adapted for use. On May 31st the Postmaster-General cancelled all ordinary wireless receiving licences for the installation and working of wireless apparatus in road vehicles. In the absence of special authority, therefore, all persons who have wireless apparatus in motor-cars, or other road vehicles, must take immediate steps to remove all such apparatus, including aerials, from these vehicles. As the time limit set was June 2nd, no doubt all motorists have complied with this new regulation by this time.

The regulation applies whether the vehicle is in use or laid up, but the wireless licences in respect of these vehicles should be retained by the owners. No refund of licence fees can be made, but the question whether any allowance can be made in respect of their unexpired periods will be considered when the time comes to remove the present embargo, and to issue fresh licences for the use of wireless apparatus in road vehicles.

I am surprised, however, that the Minister has ignored the possibility of bicycles carrying portable transmitting and receiving apparatus. Such vehicles should have been included in the Order, in my view. Also, it seems to me that it will be highly dangerous for a member of the public to purchase a portable set and carry it home by car. I do not know whether this will restrict the sale of portables, because people will be apprehensive that the possession of such an instrument may land them into trouble. Obviously, a picnic party seen strolling towards some fields with a hamper and a portable wireless set would be suspect.

Reserved Occupations

THERE seems little likelihood that the schedule of reserved occupations will impose higher age limits on those engaged in the skilled sections of the wireless industry. I mention this because some newspapers have been indulging in wishful thinking, and spreading false information about the intentions of the Ministry of Labour.

Licence Figures

THE U.I.R. (Union Internationale de Radiodiffusion) recently published a table giving the number of licences for wireless receivers issued in each country. Here it is: Belgium, 1,148,659; Denmark, 834,565; Dutch East Indies, 90,385; Estonia, 90,876; Germany, 13,945,022; Hungary, 511,410; Iceland, 16,755; Ireland, 169,392; Italy, 1,135,000; Japan, 4,666,058; Latvia, 154,106; Lithuania, 79,081; Palestine, 43,777; Portugal, 90,856; Rumania, 319,708; Switzerland, 605,574; Yugoslavia Belgrad, 107,785; Ljubljana, 22,151; Zagreb, 35,433.

Radio Engineers' Manual

THE "Radio Engineers' Manual" which we are publishing in pocket-book form will be issued very shortly. I make this statement in reply to those readers who are anxious to obtain a copy. When it is ready the usual announcements will be made in this journal.

Fourpence a Week

THERE has been a gratifying number of letters from readers thanking us for increasing the price to 4d. rather than adopting the alternative of reducing the number of pages. All readers seem aware of the difficulties with which publishers and editors have to contend at the present time.

An All-dry Receiver

HITHERTO all-dry valves have not been available to members of the public. I understand, however, that they are now released, and that the Editor is designing a receiver incorporating them. Such a receiver will be of immense use to our readers in the Army, to air-raid wardens, and to others who for one reason or another are without accumulator charging facilities.

Newly-trained Citizen Airmen

SOME months ago a Second-Class Aircraftman arrived at an R.A.F. Initial Training Wing. He was then merely a transported civilian; to-day he is a transformed Service man. He is a finished product of the "I.T.W.," and as a Leading Aircraftman awaits his posting to a Flying School.

What has happened to this man since the day he walked into the Service? He has learned the new and improved foot drill syllabus. He is no guardsman, perhaps, but he is a smart airman and that, in itself, is a credit both to himself and his instructor. He has completed a physical training course from which he has learned that the business of maintaining a healthy body can be effected under the guise of thoroughly enjoyable exercise.

He has revised his mathematics up to matriculation standard. He has learned to receive and transmit morse code messages at useful working speed. He has become thoroughly acquainted with the operation and mechanism of the more widely used Service armaments. He has learned the rudiments of air navigation. And, more practical than any of these, he has completed a course on the visual Link Trainer, and so has a theoretical knowledge of the proper handling of an aircraft.

Moreover, he has been imbued with a spirit of discipline which has not robbed him of his individuality, or his initiative, but has brought home to him a keener realisation of the trust that has been placed in him. At the same time he has been taught Service etiquette and the *modus vivendi* of Service life. He is not an automaton; he is one of the thousands of new citizen-airmen of the British Empire.

Air Force Require Radio Men

MEN up to 50 can now serve in the Royal Air Force provided they have experience in radio work. A new class of entry has just been created to provide personnel for the maintenance of Air Force wireless equipment of various types. The age limits for radio trade entrants are from 18 to 50.

Large numbers of pilots, air observers and wireless operator/air gunners are required for the R.A.F. at the moment. Young men of good education, with dash and initiative—especially those in age groups which have not yet been registered—are asked to volunteer now.

Application can be made at any Combined Recruiting Office; or to any local Labour Exchange.

Jamming Haw-Haw

I SEE that one of the daily papers has worked itself into a fine frenzy over the amusing broadcasts of Lord Haw-Haw. The daily paper seriously suggests that the time has come for the ruthless and continuous jamming of Haw-Haw. This, they think, will choke the pestilential lies thrown so glibly into the air by Goebbels. They go on to suggest that even if the Germans retaliated by jamming our radio, we could still, through our telephones, listen to our own broadcasts. This suggestion is too ridiculous to need much comment. Haw-Haw broadcasts in English, and as I have yet to discover any Englishman who takes the slightest serious notice of him, except when we want a little light entertainment, I cannot see why we should run the risk, even if that were possible, of retaliatory jamming measures. To suggest that we should listen over our telephones to our own broadcasts is just too absurd. In the first place, less than half of the listeners have telephones, and in the event of air attacks, we should not be able to listen in, as all telephonic communications will be suspended, as of course, will be the broadcasts. I suggest that newspapers should investigate the possibilities of their suggestions before they make themselves, as well as this country, look ridiculous. As most of them have a radio expert on the Staff, why are they not permitted to advise? Is it because some of the alleged experts themselves propound these amusing theses?

Comment, Chat and Criticism

Musical History—4

The Music of Bach and Handel, by Our Music Critic,
MAURICE REEVE

AT the close of the seventeenth century, music had "attained its majority"; it was now about to reach its maturity. It was to be launched on a course which it has followed down to our own day, only diverting from it to its own peril. Many of the writers already mentioned had produced works which have since achieved immortality. Harmony and melody of ineffable sweetness were at composers' command. The forms they fashioned in were for the most part small, and it was in this sphere that the coming century was to mark the greatest advance and achievement. The Beethoven Symphony had still a hundred years to wait, and Don Giovanni and the Chromatic Fantasy almost as long.

Range of Colours

The musician's palate had acquired a wide range of colours. The modern diatonic scale had reached its definitive form though chromatics were sparingly used. The dominant seventh, without preparation, was common in modulation, and figured bass was brought into practical use. Monteverdi is credited with being the inventor of the perfect cadence, and other writers as well as himself used the diminished triad. The orchestra did not yet include the violin, which may sound rather like talking of strawberries and cream only to find that there is no cream! But it was taking an ever larger part in things with the growth of opera, and the erection of opera houses and their permanent orchestras. The madrigal declined, and with its eclipse came that great wave of church music so indissolubly linked with the two names of Bach and Handel. But once the works of Couperin, Monteverdi, Scarlatti, Purcell, etc., had been assimilated, music could look forward with confidence and assurance to producing the men capable of leading it up to the heights which were so apparently destined for its occupation. It was not to be disappointed.

Bach and Handel were two such men. By the greatness of their vision and their grasp of the problems before them, they created work, far in advance of anything previously fashioned, or even conceived. Bach, in particular, was a most daring harmonist, and he has, to this day, remained the greatest of contrapuntists, and his organ works are still the pride and glory of all that instrument's repertoire, never having been surpassed in grandeur, nobility or technical resource.

Handel's Music

Whilst much of Handel's music remains unknown to all but the connoisseur, the "Messiah" has obtained such a unique position in the hearts and affections of the English-speaking peoples that Sir Henry Hadow does not exaggerate when he says that it might almost be regarded "as a part of Holy Writ." Whilst Bach was the great master of elaborate and complicated texture, Handel was one of the greatest melodists who ever lived. This is not meant to suggest that the one could not write fugues, nor the other beautiful melodies; far from it. But, broadly speaking, that is where their two styles lay. Both men's work is on the loftiest imaginative plane, Bach's perhaps especially owing to his lifelong association with the Church.

Although so closely associated in the minds of most people, and always thought of together and analysed as a pair, neither man ever met the other. In fact, there is no record of either having ever heard of the other or of the other's music!

Speaking idiomatically, these two great masters may be said to have conquered the musical world for Germany. It was certainly a conquest that lasted far longer than most of Germany's conquests in other domains! Actually, a dynasty of German giants followed them right down to Wagner and Strauss, and only to-day does German music show an appreciable decline from this supreme standard. The sequence of great names that Germany produced from Bach to Strauss is extraordinary, and not even the great lines of Italian or Dutch painters, or of English men of letters, surpasses it. The German musicians of the eighteenth century rescued music from the disgrace that was rapidly overtaking it at the hands of unworthy men elsewhere. As almost all of them were associated with the Church, it was but natural that their work should lay chiefly in the domain of church music or of music with a "churchy" flavour such as Bach's organ masterpieces.

Although this led to extremes of conservatism at the other end of the scale, it was just what music wanted to free it from the base and impure elements that had entered into it. After the pendulum had swung with equal violence in both directions, the even greater masters of the late eighteenth and early nineteenth centuries were to restore the equilibrium with a series of master works each containing a perfect amalgam of all that was best from the past plus their own genius and prophetic visions, balanced to an exact nicety, and to remain supreme for all time.

Of even greater importance to the future of music than the mere writing of magnificent works was Bach's insistence on "equal temperament" of the strings of the harpsichord. We have noted the establishment of major and minor keys, and the great increase and variety of modulation which they rendered possible. But a great difficulty still remained to be overcome. If a diatonic scale is exactly in tune, only the most closely related keys can be blended with it; any remoter relationship would sound intolerable. If you play on your piano these notes: C, E, G sharp, and the octave of C, you will notice that, on your keyboard, the top C is the exact octave of the bottom one, and that the intervals between each two notes is the same. But the true major third from G sharp is *B sharp* and not C, which are not one and the same note as you can prove by singing the notes instead of playing them. Furthermore, if you begin the sequence with B sharp instead of with C, you will get further and further away from the original tonality until any combination with it becomes impossible. Therefore, to modulate from D major to D flat major is impossible if both scales are accurately in tune, as one requires F sharp and the other G flat, which are not one and the same note.

Perfect Intonation

In Bach's day there were two ways of facing this problem. One was to merely accept "perfect" intonation together with the many restraints that it imposed on musical thought and development. The other was to abandon exact purity in order to obtain the enormous benefit of being able to employ every key within the framework of the one piece. Very much in the same way as in "summer-time," where we call twelve-o'clock eleven, in order to enjoy certain advantages which are denied us otherwise,, so "equal temperament" calls G flat and F sharp one and the same thing, for the sake of increasing the range and scope of musical composition. By "flattening" here and "sharpening" there—by telling a few "fibs," as one might say—everything that music has to offer is brought within the range of those big enough to use it. The rules governing whether a note shall be deemed G flat or F sharp are very strictly observed grammatically. But both are now combined in the one string, and the same key on the piano keyboard.

Bach took the side of the reformers, and proved his wisdom by writing his immortal "48 Preludes and Fugues in All Keys for the Well-tempered Clavier," works which display a range and variety of harmony, modulation and contrast that would have been impossible of achievement under the old rules, but which set the standard for all future ages.

Frequency Response

A Simple Explanation of Response Curves and Their Meaning, With the Methods of Drawing Them

by The Experimenters

RESPONSE, as applied to a receiver or amplifier, is generally understood as the variation in output for an input of given voltage over a range of frequencies. Thus it is customary to give a response curve or graph on which the output (or a factor representing variation in output) is plotted against the frequency of the input signal. It would be possible to show the output in milliwatts and the input in cycles per second, but it is more usual to plot frequency against a decibel scale. The graph would then be of the form shown in Fig. 1, which would indicate that the receiver or amplifier was in the "quality" class, since the output remains constant over a wide range of frequencies.

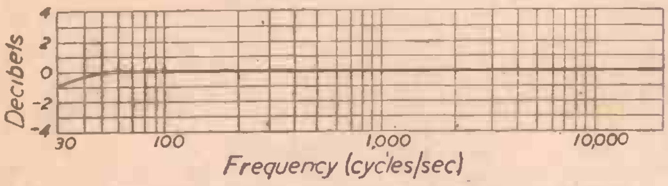


Fig. 1.—Response curve (practically "straight line") for a high-fidelity amplifier.

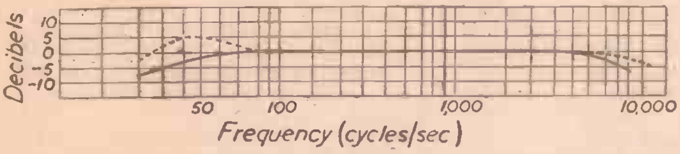


Fig. 2.—Curve for a well-known parallel-fed L.F. transformer. Broken lines show how the curve can be modified by changing circuit constants as explained in the text.

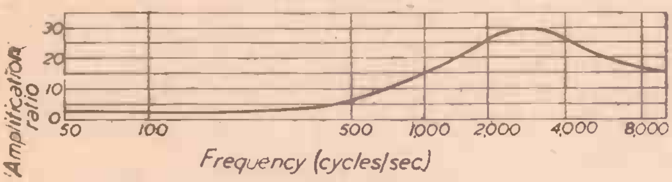


Fig. 4.—This transformer curve is of different form from that shown in Fig. 2, since frequency is plotted against amplification ratio.

The input is provided by means of a modulated oscillator, which must be a precision instrument if useful results are to be obtained, while the output may be read on an accurately calibrated output meter or valve voltmeter.

In addition to the complete set, individual components such as transformers, pick-ups and speakers can be tested for response, and curves drawn. Here again, it is now customary to plot frequency against a decibel scale.

Frequency Compensation

For present purposes it is not essential that the decibel system be fully understood (it was explained in our issue dated May 11th), for we are mainly concerned with the variation in output over the range of audible frequencies. Theoretically, a "straight-line curve"—consisting of a straight horizontal line—would indicate a perfect receiver, amplifier or component. In practice, however, that may not represent the ideal, since measurement of output might be made without the use of the speaker to be used with the set. And if the response curve of the speaker "dipped" below, say, 150 cycles and above 2,000 cycles the audible output would fall below and above these points.

On the other hand, if the output from the receiver went up below 150 and above 2,000 cycles, the sound output may remain constant over the whole frequency band, due to the receiver compensating for the losses in the speaker. This principle can be applied to almost every component used in a receiver, for it is obvious that if losses in one component are evened up by corresponding gains (or negative losses) in another the output may still be "straight line."

There is another important point which should be considered. This is the scale to which the graph is drawn; if the scales are "open," variations in response are far more pronounced than if the divisions are "crowded." It is customary to use a logarithmic scale for frequency. This means that the distance from zero to 100 c/s is equal to that from 100 to 1,000 c/s, and from 1,000 to 10,000 c/s. Thus, the scale is more "open" at the lower frequency end.

Fig. 2 shows a response curve for a well-known L.F. transformer of the parallel-fed type. It will be seen that it gives uniform amplification to audio frequencies between approximately 110 and 12,000 c/s, but that the amplification falls off at either end of this range. That is usual in all transformers in the lower-price range, but it is possible to obtain transformers which give "straight line" output from as low as 50 cycles to well over 10,000 cycles. Although components of this type are excellent when used with valves for which they were designed they may be no more satisfactory than others costing far less if used in conjunction with any other valves or in a circuit other than that for which they were primarily intended.

Aural Effects

In considering frequency response it is also necessary to bear in mind that, for practical purposes, the ear plays an important part. Its sensitiveness is comparatively low at frequencies below about 100 cycles and above about 6,000 cycles. The importance of this is especially pronounced at the low-frequency end of the audio range. Because of this, frequencies below 100 cycles are almost inaudible to many people, and particularly when accompanied by harmonics. For example, the frequency range of a piano is from 70 to 6,500 cycles, but few people would recognise any difference if, in reproducing piano music, a receiver did not respond to frequencies outside a range of about 100 to 5,000 cycles.

There is another important aspect of the question, which is concerned with the setting of the volume control. If the volume seemed (to the ear) to be constant over the frequency band between, say, 50 and 10,000 cycles with the volume control turned full

(Continued on next page)

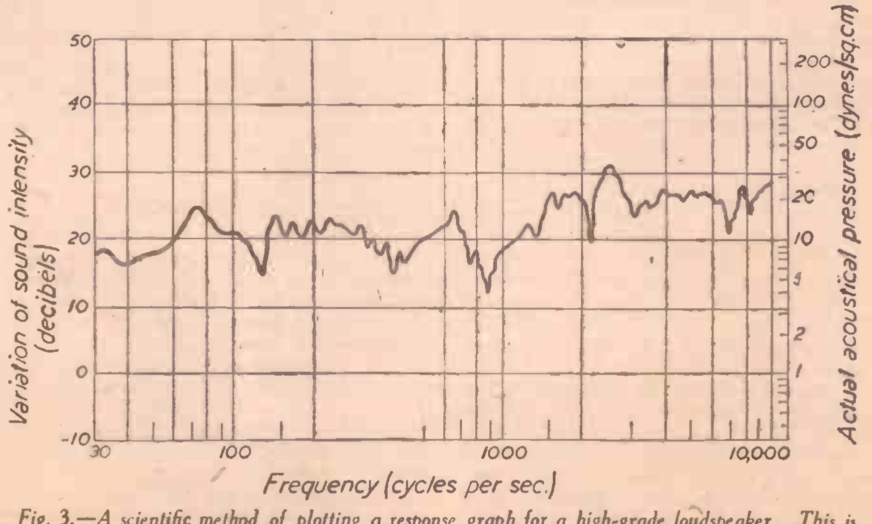


Fig. 3.—A scientific method of plotting a response graph for a high-grade loudspeaker. This is more "detailed" than usual, for in most cases the graph is drawn as a smooth curve.

FREQUENCY RESPONSE

(Continued from previous page)

on, this condition would not apply when the control was turned down. In fact, if volume were reduced so that a 1,000-cycle note (to which the average ear gives maximum response) were just comfortably audible, frequencies below 25 cycles would probably be completely inaudible, whilst frequencies over about 3,000 cycles would scarcely be heard. This is the reason why various methods have been employed with "quality" amplifiers to combine a tone control with the volume control. It also helps to explain why it is often claimed that good quality reproduction is impossible when the output is less than 5 watts, even for a receiver used in the home.

Sound Output as Air Pressure

It is not an easy matter to measure output in terms of sound, or rather in terms of air pressure, which is a measure of sound as it strikes the ear drum, but by the use of special apparatus such measurements can be made. Thus we may have a graph similar to that shown in Fig. 3, which is a copy of one prepared by the National Physical Laboratory for a certain loudspeaker. It will be seen that variation in sound intensity is plotted against a frequency scale, whilst on the right of the graph there is a scale referring to the acoustic pressure. Despite the fact that the response curve in this case is a very wavy line the speaker to which it refers is a high-grade instrument. This becomes more evident if a mean or average line is drawn through the wavy one, or if it is noted that the variation in acoustic pressure does not fall below 5 or rise above 35 dynes/sq. cm. The latter expression, by the way, is simply a measure of pressure corresponding to the much larger units of lb./sq. in.

Modifying the Response

As another sidelight on frequency response it is interesting to refer to Fig. 2, where broken lines are shown as "offshoots" of the main curve. These show how the frequency response of the parallel-fed transformer represented can be varied by changing the capacity of the feed condenser. The full line shows the response when using a condenser having the usual capacity for this position of .5 mfd., whereas the broken lines at the bass end of the scale shows the change brought about when the capacity is reduced to .1 mfd. This means that, in this case, the use of the lower capacity gives a "bass lift." The broken line extending to the right of the curve shows the effect of connecting a .5-megohm resistor across the secondary terminals.

Another method of drawing a transformer response curve is shown in Fig. 4, where it will be seen that the vertical scale represents the amplification ratio, the base line showing frequency, as before. Fig. 4 actually refers to a poor transformer. The curve rises steeply to about 3,000 c/s and falls almost to zero at 50 c/s. A curve for a good transformer, correctly used drawn to this scale would be very similar, in shape to that given in Fig. 2.

How Frequency Modulation Works

A Simple Explanation of the New Transmitting System

MANY listeners have heard that a system of broadcasting has been tried out and adopted in certain parts of the U.S.A. which is claimed to be a great improvement on existing systems. This new arrangement is known as frequency modulation, and in view of the increasing interest which is being shown in it the following details will, no doubt, prove of interest. They are taken from a talk by Lee McCanne, of the Stromberg-Carlson Mfg. Co., and are reprinted from the American publication "Radio To-day."

Just what *is* Frequency Modulation? And how does it differ from Amplitude Modulation, the kind of radio broadcasting we have all been hearing up to now? It is simply a different method of superimposing the programme on to the carrier wave. Let us see what it looks like on the charts on these pages.

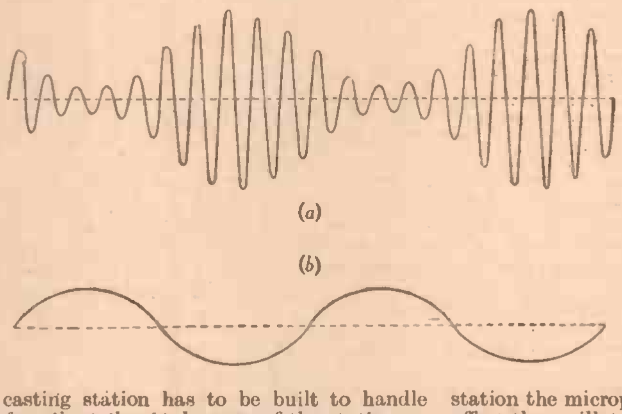
Now whether we are dealing with Amplitude Modulation or Frequency Modulation, we start with the same kind of radio carrier wave, and also the same kind of telephone current "programme wave" as picked up by the microphone. With Amplitude Modulation, the programme wave is combined with the carrier in such a way as to change the *power* of the resultant wave. It adds to the power part of the time, and subtracts from the power another part of the time so that the wave radiated by the broadcasting station appears as shown at (c).

Broadcast Advantage

In Frequency Modulation the same programme wave does not change the power of the carrier at all but is made to change its *frequency*, speeding up the carrier-wave part of the time and slowing it down another part of the time so that the resultant wave from a Frequency Modulation station looks like (d).

The chart shows you immediately the advantage which Frequency Modulation offers to the broadcasting station. The programme is superimposed on the carrier without changing its power. In other words, the broadcasting station operates at full power all the time. That means that it can be much more efficient, use less valves, less current and even save man power—because the management can let the transmitter run "wide open" all the time and does not have to have an engineer who is also a trained musician constantly watching a volume indicator, ready to turn the volume up when the programme level gets lost in the background noise, and to turn it down when a soprano hugs the microphone or the orchestra plays too loud.

In Amplitude Modulation, the broadcasting station has to be built to handle *four times the rated* power of the station on volume peaks. The Stromberg-Carlson station WHAM, for example, is rated at 50,000 watts but it has to be built with a large enough power supply, valves, tuning system, and aerial to handle 200,000 watts, and it would even go above *that* if the engineer was not there to turn the volume down when he sees his volume indicator needle swinging too high. This compressing of the "dynamic volume range" in itself affects the musical quality of the programme. Suppose that an orchestra has enough instruments to make a maximum noise equivalent to "100 decibels" volume level when everyone is playing his hardest; an Amplitude broadcasting station might have to squeeze that volume range down to, say, 50 decibels, in order to keep the quiet passages up above valve noise and studio noise, and to bring the loud passages down within the capacity of the transmitter. In Frequency Modulation there are no volume peaks as regards the power being radiated; all that volume does is to swing the carrier frequency. So a 50,000 watt Frequency Modulation transmitter can be built to deliver 50,000 watts all the time, and handle the full dynamic volume range of the music.



(a) Is a radio carrier wave of constant amplitude; and (b) is a programme or audio wave for modulating (a).

"Limiter"; "Discriminator"

In a Frequency Modulation broadcasting station the microphone amplifier is made to affect the oscillator valve directly, changing the frequency of the carrier rather than being indirectly added to it by a mixer. At the receiving set you have the same six valve functions and two more; the detector circuit in a Frequency Modulation receiver uses *three* valves instead of one. One of these extra valves is called a "limiter" valve, and its purpose is to fix upon and assign control to the *strongest signal coming in* at the particular wavelength or frequency to which your receiver is tuned. Thus the strongest signal gets control.

The other extra valve is called a "discriminator," its function being to *wipe out any noise or signal* other than the strongest signal coming in. The discriminator also wipes out rather effectively any Amplitude Modulation station that might be broadcasting on the same wavelength to which you have tuned your Frequency Modulation receiver and, since most static is essentially an Amplitude Modulation signal, the discriminator wipes that out, too. The effect is to eliminate natural static, man-made static, in fact, practically any kind of noise. A good Frequency Modulation system eliminates the carrier "hiss" and most of the valve noises from the broadcasting station as well as any hum modulation and valve noise in your receiver. You do not even know a Frequency Modulation radio is turned on until the music plays.

Static-free

That shows how little residual noise there is in this system. As one writer put it, this kind of radio can "transmit silence." (Of course, noise in the studio may still be picked up by the microphone. Also when Frequency Modulation stations are broadcasting gramophone records there may be some needle noise.) But in eliminating most of the noises and distortion that might occur, Frequency Modulation brings radio—from a tone quality standpoint—down to a simple static-free long-distance telephone system.

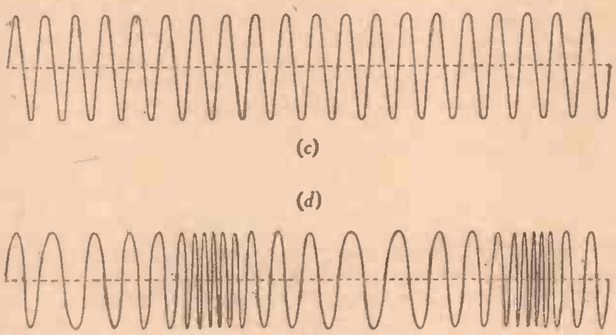
To show you how quiet and clear and static-free this new system is let me say that movie producers are interested in Frequency Modulation to give better sound recordings on their films. Under this plan, rather than taking portable sound-recording apparatus out "on location," which may be miles away from Hollywood, they will use the best sound recording equipment at the studio and will transmit the programme to that point by Frequency Modulation radio.

Before leaving this subject, let me point out why a Frequency Modulation receiver must be a little more expensive than an ordinary radio. Remember there are two more valves in the detector circuit, and a tuning eye is also desirable, so that a good Frequency Modulation should have eight or nine valves minimum. To take full advantages of the better FM tone, the audio amplifier stage must be a good Class A distortionless amplifier. The loudspeaker must be designed to respond to high tones and overtones beyond the range of many of the loudspeakers being produced to-day, and it must have a suitable baffle.

In Frequency Modulation, if the broadcasting station is an Armstrong wide-swing transmitter sending out high fidelity, then the *tuning system* of your receiving set must be designed to admit or *accept the full frequency swing* of that transmitter. Up to the detector valve, that receiver has to be good. Otherwise the whole reception is distorted. The receiver ought to be selective, too, against interference from the next FM channel, but it must accept the wide band of frequencies on each channel. That means, if you want a cheap FM receiver, the maker can economise on the cabinet, on the loudspeaker, and on the audio amplifier, but the *tuning system* must be good. And, since the tuning system is one of the most expensive parts of the whole receiving set, you might as well make the rest of it good enough for eight-octave reception.

No Station Clashes

Moreover, an eight-octave FM receiver is *worth* the extra cost because you will be able to get the full high-fidelity programme *without* static and *without* interference. That is the odd thing about FM. Frequency Modulation transmitters broadcasting *on the same channel* just do not interfere with each other unless possibly you are on the fringe area of both stations, right on the ragged edge of their service range. Otherwise, the strongest signal takes control and the other one is wiped out. To prove this, *three* FM transmitters all broadcasting different programmes on the *same* channel were set up. One was at Albany, another at Troy, the third at Schenectady—all 12 to 17 miles apart. Engineers went out with a receiver on a truck, trying to find a place where they could get interference—bring in two of these stations at once. They could not find it. In fact, that got down to a space of a few *inches*, that outside this space they would get only Troy or Albany or Schenectady—depending on which direction they moved the truck, while inside this small area the programme would flop back and forth from one station to another.



(c) is the carrier and audio wave combined in Amplitude Modulation, whilst (d) is the same combination in Frequency Modulation.

Two to Four Horizons

In the ultra-short waves, Frequency Modulation radio acts like light, and acts much like television as regards the range of the transmitters. Given enough power and a high aerial, Frequency Modulation stations seem to have a fairly reliable range up to two horizons and a possible service range (to listeners not located behind buildings or mountains or in valleys) up to four horizons. Height of the receiving aerial is important, as well as the height of the broadcasting aerial. This distance limitation is the one limitation to good Frequency Modulation broadcasting; it will be necessary to erect transmitters in every large population centre before we can all be assured of this new and better kind of reception.

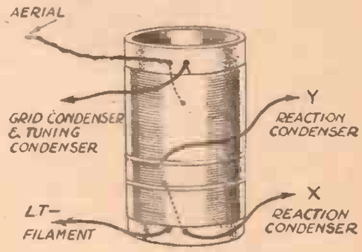
On the other hand, within its service range, a Frequency Modulation station gives *reliable* reception, day or night, even through thunderstorms. Listeners located at a distance from the city but within range of its FM transmitter will probably get better and quieter reception than they would from an AM transmitter in that same city. Listeners located beyond the range of the FM transmitter will, of course, have to rely on the AM station the same as heretofore. High-power cleared channel AM stations will probably always be needed, as will the International short-wave AM stations. For that reason the system proposed to the Communications Commission by the FM Broadcasters, Inc., is a combination of AM and FM stations whereby the cleared channels on the regular broadcast band will be used for long-distance and rural coverage, and FM channels will be used for reliable local service.

Coil for the Gas-mask Box Receiver

OWING to the fact that the constructional details of the coil used in the Gas-mask Box Receiver (which was described in our issue of May 11th, 1940) were given in our issue of September 30th, 1939, and that a great number of our readers appear to be without this particular copy, we reprint below the essential details. It will be noted that we have varied the original specification to suit the receiver mentioned above, by increasing the diameter of the coil former from 1⅝in. diameter to 2in. The length should be 2½in. A piece of ordinary postal cardboard tubing, or, better still, a length of paxolin tubing, can be used for the former. If cardboard is used, it is absolutely essential to see that it is perfectly dry; in fact, it is advisable to impregnate the tube after drying it in a slow oven for a few minutes. Ordinary shellac may be used for the impregnation.

Winding Details

The actual winding is carried out with 22-gauge enamel wire, winding this with 70 turns close wound, that is, each turn lying close up to its neighbour. After 23 turns have been put on a tapping loop has to be made for the aerial and this is accomplished by doubling a length of the wire and pushing it through a hole in the former. It must be kept taut whilst the rest of the coil is wound. After the winding has been finished a length of paper or Empire Tape ½in. wide should be wrapped round the lower end of the winding, its position being about ½in. from the lower end of the coil. On this insulator 20 turns of the 34 S.W.G. enamel wire are wound, and these must be in the same direction as the first winding. One way of anchoring the ends of this additional winding is by means of sealing-wax or Chatterton's Compound, whilst another way is to pierce holes through the former, between the turns of the first winding. In this case great care must be taken not to scrape off the insulation where the wires cross.



Coil connection details for the Gas-mask Box Receiver.

SHORT-WAVE SECTION

S.W. SET IMPROVEMENTS.

Modifications to Existing Apparatus: Using a Mains Unit and Other Details for Obtaining Better Short-wave Results. By W. J. DELANEY.

MANY amateurs, when looking round to find some means of improving their apparatus, start to buy new parts or change components, generally without any idea as to the ultimate result of such modifications. It is worth while in such a case to start by thinking out the lines upon which one wishes to work, so that any changes which are made will lead to improved results and not to some doubtful working which may lead to further difficulties. For instance, a change in valves may be thought to give an improvement, but such a change may result in the need to modify a coupling or to use some different H.T. value, and this in turn may lead to inefficient working of another stage. These facts are more important in the case of short-wave apparatus as there is not so much latitude in this type of equipment. Furthermore, as it is desirous always to obtain the maximum performance from short-wave apparatus it is not possible to make do with what might be termed "makeshifts." Such ideas as fitting band-spread tuning have been mentioned many times in these pages, but there are other directions to which the keen experimenter may turn in an endeavour to improve, or "hot up" his apparatus, and the following will give some ideas upon which to draw.

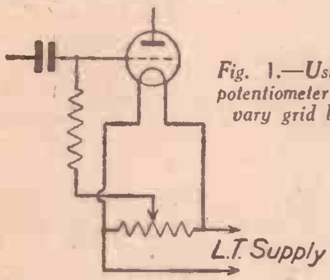


Fig. 1.—Using a potentiometer to vary grid bias.

New Components

In the way of new parts, modern short-wave apparatus may always be taken as an improvement upon old parts, especially those which have been primarily designed for normal broadcast use, but which have been included in a short-wave set. Tuning condensers, for instance, will be found in the modern short-wave sphere to have improved insulation, and this is one of the most important factors of short-wave apparatus. Insulation everywhere should be of the highest, and in addition to this, heavy gauge wiring should always be employed. If, therefore, your set is wired with fine wire, especially if this is capable of a fair degree of movement, it should be replaced by rigid wiring, and the leads should be kept as short as possible. Certain by-pass condensers could also be replaced by mica components if you are using those of the paper type. This, of course, would come under the heading of improved nsulation. Better quality valveholders would also be a worth-while change, whilst if terminal connections are employed it might also be desirable to make use of good solid soldered contacts wherever possible.

New Arrangements

The above details concern mainly modifications in parts, but there may also be found that a change in circuit design may be employed. Many amateurs have a circuit which they have found tried and tested, and are not on this account keen to make changes. There are, however, one or two small changes which may be made without affecting the general performance, although leading to an improvement. For instance, the average type of short-wave detector will have the grid leak taken to the L.T. positive leg of the valve. This is a standard arrangement, but it may be found that in certain circumstances it is preferable to vary the bias which is thereby applied to the valve. For this purpose an old idea, but one which works very well, is to use a potentiometer connected across the filaments, and to return the grid leak to the arm of that potentiometer. A value of 400 ohms is quite satisfactory, and in use it may be adjusted so that the reaction is as smooth as desired. Other modifications of this nature, which do not in any way involve drastic changes, are the parallel feeding of the L.F. transformer, differential in place of ordinary reaction condenser, or the fitting of extension controls.

Mains Units

A form of query which is often being put to us is "How can I use a mains unit with my short-wave set?" It is found that when a standard type of mains unit is connected to some short-wave apparatus (and in some cases to ordinary broadcast equipment) results are very unsatisfactory. It is even found in some cases that the unit cannot be used, mainly on account of instability. As a short-wave receiver is more susceptible to hum than ordinary broadcast equipment the problem is more intense, and it is usually found that the unit is quite satisfactory if another form of feeding the receiver is adopted. The standard type of mains unit is provided with three or four H.T. positive outputs. In some cases one or more of these may be of the variable type, provided either with alternative sockets, or a variable control. It is in the form of voltage dropper which is incorporated inside the unit that the trouble arises. Even if the receiver is provided with decoupling devices the trouble may still arise if two or more of the unit outputs are fed to the receiver. The most satisfactory way of overcoming the trouble is to ignore all the positive outputs except the maximum, and thus to connect only one positive lead to the receiver. This means that you will have to include decoupling circuits in all parts of the receiver so that the appropriate H.T. feeds are decoupled, and the correct or appropriate voltages are applied to each stage. If you do not wish to go to the trouble of modifying the set wiring there is another way out, and that is to make up a small unit consisting of the appropriate decouplers and voltage droppers and to connect this between receiver and mains unit. The advantage of this arrangement is that at any time the unit may be disconnected and ordinary battery supplies used to feed the receiver. For the benefit of those who are not familiar with decoupling arrangements we show in Fig. 2 a three-valve skeleton circuit with battery or separate H.T. feeds, and in Fig. 3 the same arrangement with decouplers added. In Fig. 4 are shown the separate decoupling components wired up for connection between the unit and receiver. In this case, of course, the maximum H.T. tapping or socket is used on the unit. To ascertain the correct values of the resistances it is necessary to obtain a good milliammeter and voltmeter. The batteries are connected to the receiver in the usual way and the milliammeter connected in each positive lead in turn. The current flowing is carefully noted, and then a good voltmeter is connected between the anodes or other points fed by the H.T. line and earth. Next, the voltage supplied by the H.T. unit must be measured, and a slight drop taken into account to compensate for the fall when a load is applied to it. Then by subtracting the required voltage from that given by the unit, and dividing this by the current in milliamps, you will have the value of the resistance required in thousands of ohms. As an example, suppose you calculate that the unit will deliver 120 volts, and you need 100 volts for an L.F. stage. If the current at that anode is 5 mA, then you would need a resistance of 120−100 divided by 5, or 4,000 ohms.

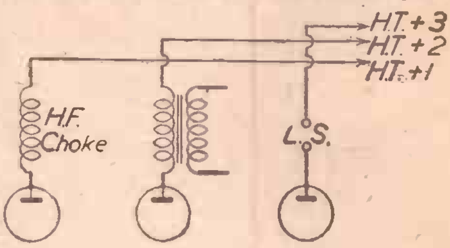


Fig. 2.—A skeleton standard 3-valve circuit showing normal anode connections.

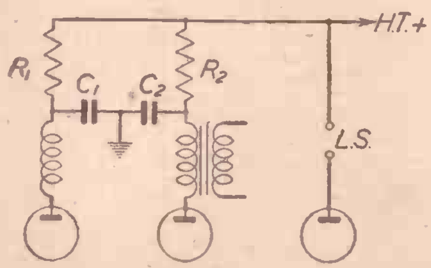


Fig. 3.—The arrangement of Fig. 2, plus decouplers

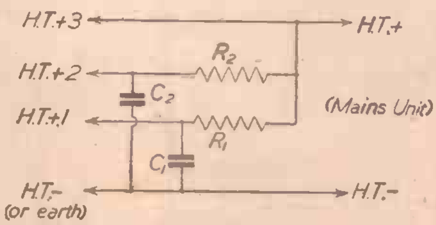
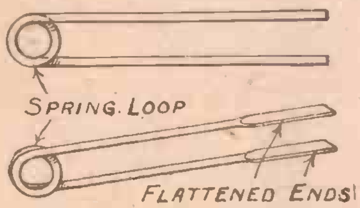


Fig. 4.—How to arrange for the decouplers shown in Fig. 3, so that they may be included between the receiver and mains unit.

Practical Hints

Easily-made Tweezers

SCREWS and other small parts often drop into awkward corners in a radio chassis that cannot be reached with the fingers, or anything else handy. In such cases a pair of tweezers, like those shown in the sketch, would be found very useful. To make them, take a piece

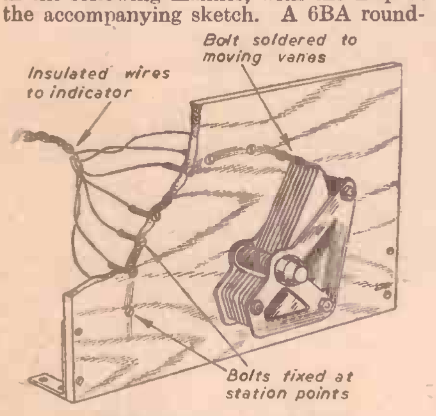


A handy pair of tweezers made from a piece of springy wire.

of hard springy wire about 12in. long, and bend the middle part of the wire round a ⅜in. bolt to form a loop to give the teeezers an opening spring. Flatten out the ends with a hammer, and file the ends square.—R. JENKINS (Caterham).

Illuminated Map Tuning

WHEN tuning on the medium-wave band on a home-made set, it is very convenient to know quickly to which station the set is tuned. This can be done in the following manner, with the help of the accompanying sketch. A 6BA round-



An illuminated map tuning dodge.

headed bolt of about 2in. in length is soldered to the end of the tuning vanes of a tuning condenser, as shown in sketch. A piece of 3-ply wood 4½in. wide and the height of the tuning condenser's highest point when open, is temporarily fixed behind the tuning condenser, so that when the condenser is tuned right through, it describes an arc of 180° on the plywood. The stations wanted are then marked, where the head of the bolt is just touching the plywood. The wood is then removed and drilled where marked. 4BA bolts (flat-headed) are inserted. The plywood is then permanently fixed by brackets behind the tuning condenser, in the exact position as before, so that when the condenser is tuned right through 130° the bolt on the condenser makes contact in turn with each bolt in the plywood. Each bolt has a corresponding bulb, which should preferably be coloured to give an even luminous effect. The bulbs are then inserted in a named cardboard map (either home or ready made) in their right places; connecting wires are joined, one each from these bulbs to their corresponding bolts in the plywood. All the + sides of the bulbs are joined. A switch may be inserted in the + lead if desired. Only one lead will connect to the accumulator as the negative is already joined via the moving vanes of the tuning condenser.—D. ZEID (Bournemouth).

THAT DODGE OF YOURS!

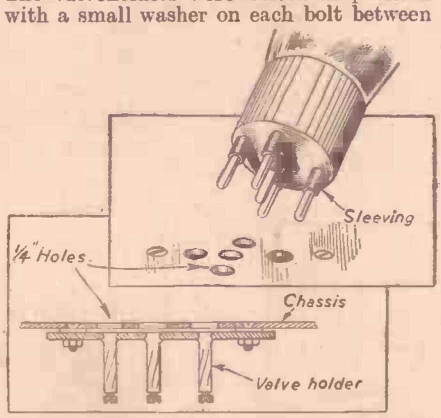
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending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

SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page 288.

Fitting Sub-chassis Valveholders

HAVING no facilities for drilling 1in. holes for the valveholders in an aluminium chassis, I devised the following method of overcoming the difficulty. The valveholders were bolted in position with a small washer on each bolt between



A novel method of fitting sub-chassis valveholders

the valveholder and chassis, then the holes were marked out on the underside of the chassis. These were then drilled ¼in. diameter. Although the valve legs did not touch the chassis, I took the further precaution of slipping a ⅜in. length of insulating sleeving over each valve leg. —N. DAWTRY (Sheffield).

L.F. Instability

AFTER an H.T. battery has been in use for several months a set may develop a high-pitched whistle and reception becomes distorted. The reason for this is, in the majority of cases, that the H.T. voltage from the battery has dropped, due to a breakdown of one or more of the cells with a consequent increase in the internal resistance of the battery. These defects are sufficient to produce instability in the circuit, particularly in the L.F. portion. Many constructors endeavour to overcome the dropping voltage by connecting a new battery in series with the old one, but, unfortunately, this does not overcome the trouble as the high resistance of the old battery still remains the same. The only satisfactory remedy is to use a new battery.

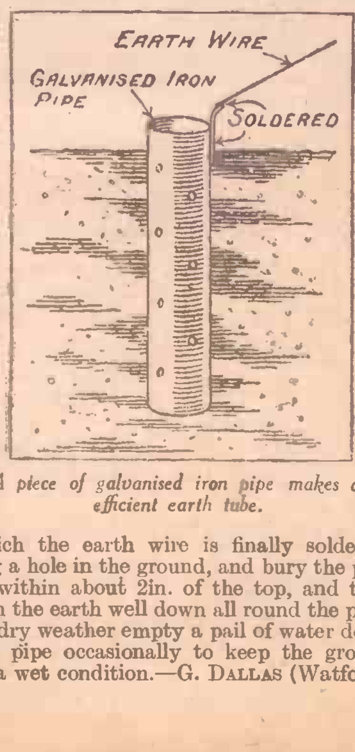
H.F. Choke Losses

A POPULAR method of coupling between a screen-grid valve and a detector is a tuned circuit connected to the detector via the usual leaky-grid arrangement and to the anode of the S.G. valve through another small fixed condenser, the anode of the valve receiving its H.T. through a suitable H.F. choke.

An important point to bear in mind is that there must be few losses in this choke if the full amplification of the S.G. stage is to be obtained. In quite a number of the early H.F. chokes, which were often constructed down to a low price, insufficient wire was employed to provide the required value of inductance, while in many instances the insulation of the wire was often too poor to give adequate insulation. If the utmost efficiency is required, it is absolutely essential to make sure that an H.F. choke of reliable make is employed.

An Efficient Earth

AN efficient substitute for an ordinary earth tube can be made as follows: Obtain a 3ft. length of galvanised iron stove-pipe, about 4ins. in diameter, and round it drill a number of ½in. holes. Solder on a strip of brass or copper, to the end of



A piece of galvanised iron pipe makes an efficient earth tube.

which the earth wire is finally soldered. Dig a hole in the ground, and bury the pipe to within about 2in. of the top, and then ram the earth well down all round the pipe. In dry weather empty a pail of water down the pipe occasionally to keep the ground in a wet condition.—G. DALLAS (Watford).

From Crystal to Valve

How to Use a Valve as an H.F. Amplifier for a Crystal Set, or as a replacement for the Crystal Detector.

By L. O. SPARKS

THE addition of a valve or valves for amplification of the signals after rectification by a crystal detector has already been explained, therefore alternative arrangements are discussed in this article so that a very efficient crystal/valve combination can be constructed.

After a reasonable period of experimenting with the original circuit, plus the L.F. amplifier, the constructor will, no doubt, wish to make further progress towards increasing the effective range of the apparatus. This can be achieved in two ways: a valve can be used as an H.F. (high-frequency) amplifier, between the aerial and the crystal set, or an alternative arrangement would be to replace the crystal with a triode valve acting as a simple reacting detector. The first method would increase range and selectivity while still retaining the pure reproduction qualities of the crystal, and, for these reasons alone, many music lovers will be tempted to model a circuit along the following lines. A stage of H.F. amplification, using a modern variable-mu H.F. pentode, a crystal detector, and a good L.F. amplifier employing one, two or three valves according to individual requirements. The second method, i.e., replacing the crystal with a valve detector, will appeal to those who wish to reach out to the more distant stations, and experiment with something more alive and more active than a crystal. The advantages to be gained are these: greater sensitivity, chiefly due to the wise use of reaction, improved selectivity, which can also be put down to the reaction circuit, and considerable increase in output. Against these items we have the possibility of introducing distortion, slight extra drain on the batteries, that is assuming these have already been secured for the L.F. circuits previously described, and the cost of an extra valve. The question of distortion is, in the majority of cases, closely connected with *unwise* use of reaction, unsuitable detector valve and incorrect operating conditions. It will be seen, therefore, that as all these items are within the control of the operator, the whole problem of faithful reproduction becomes far less serious if a little knowledge is applied.

H.F. Amplifier

A suitable circuit for this stage is shown in Fig. 1 where it will be seen that a variable-mu H.F. valve is recommended. In practice, it can be of the ordinary S.G. or pentode type, the latter being more satisfactory if powerful signals from a local station are to be received. Many readers might have a "straight" or non-variable-mu valve on hand, and wish to make use of it. That is quite permissible, although the very fine volume control provided by one of the specified type will, of course, be lost. The only modifications to the circuit shown, to enable a "straight" S.G. or pentode H.F. valve to be used, are the following. Ignore the potentiometer, fixed condenser C.3 and G.B. battery, and their associated connections, and connect the bottom end of the aerial coil direct to the common negative earth line.

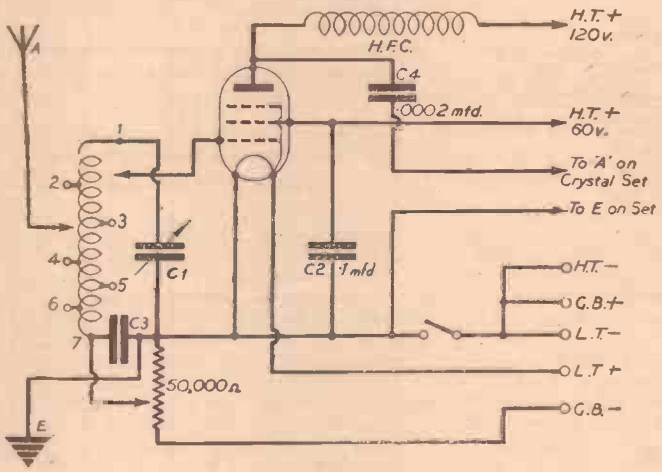


Fig. 1.—An efficient H.F. stage having a wide range of application. An ordinary S.G. valve can be used if so desired.

Aerial Coil

This can be wound in the same manner as that described for the original crystal circuit but, as there will be no need to make provision for a reaction winding, the total number of turns can be reduced to, say, 60 and the number of tapping points consequently reduced to five. The method of connection will be clear from the diagram.

An additional .0005 mfd. tuning condenser will be required, together with a four- or seven-pin valve holder, according to the type of valve used, a .1 mfd. and a .0002 mfd. fixed condenser, and a reliable make of H.F. choke. For those who wish a valve to be specified, I would suggest a Cossor 210VPT.

The circuit shown is the simplest arrangement; it is known as a "tuned-grid" H.F. coupling and, apart from being easy to construct, it is capable of giving very satisfactory results. The output from this H.F. stage is fed into the crystal circuit

(*Continued on next page*)

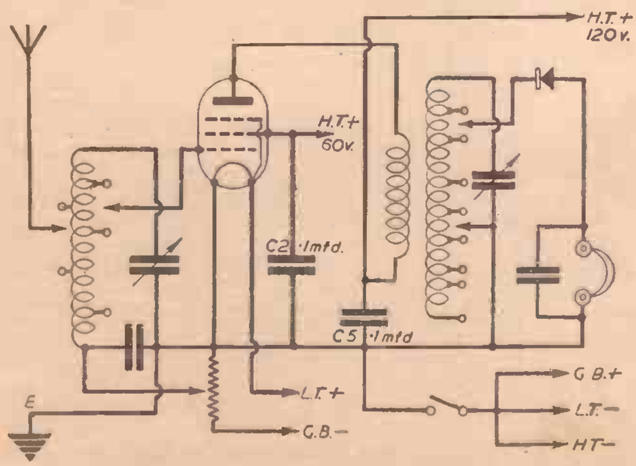


Fig. 2.—The H.F. transformer system of inter-valve coupling is shown in this circuit.

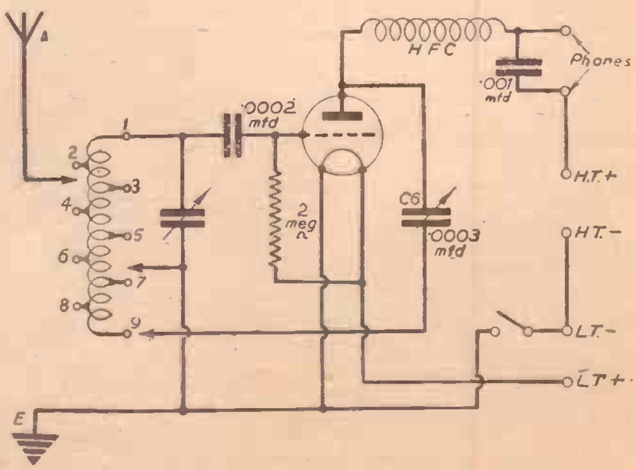


Fig. 3.—How the original coil can be used to form a very efficient one-valver.

FROM CRYSTAL TO VALVE

(Continued from previous page).

via the original aerial terminal and the output condenser C.4. The actual aerial now being connected to the new aerial terminal as shown.

H.F. Transformer

This form of H.F. coupling requires two windings on the inter-valve coil, namely, a primary and secondary. The theoretical circuit is shown in Fig. 2, and it will be noticed that the H.F. choke and coupling condenser of the former system are no longer required. The additional winding, the primary, is connected between the anode of the H.F. valve and its positive H.T. supply, the fixed condenser C.5 being used for decoupling purposes. The winding can consist of, say, 25 to 35 turns of 32 S.W.G. insulated wire wound over the original coil, preferably at the upper end. Between the two windings, two layers of thin, dry paper or other insulating material should be placed, and to this the ends of the primary winding can be anchored with small blobs of sealing wax or Chattertons compound.

An alternative method of making the H.F. transformer is to make a coil former, from two or three layers of stiff, dry paper, having a diameter slightly *less* than the *inside* of the existing former. The coil is then wound on it, the same number of turns as mentioned above, and the completed coil slipped inside the larger one. This, perhaps, is the neater and stronger arrangement.

Valve as a Detector

For those who wish to dispense with the crystal detector, the tapped aerial coil described can be used to good advantage in the circuit shown in Fig. 3.

The majority of connections, and the method of adjusting them, are practically identical with those used for the crystal set, but in place of the crystal a grid condenser is employed to feed the signals to the grid of the valve. The additional connection to the coil is to provide reaction in conjunction with the reaction condenser C.6 which is connected between the anode of the valve and the end of the winding. It should be noted that while this condenser, which is of the variable type, provides the required control of the reaction, the amount of reaction effect obtainable with the condenser specified will be governed by the number of turns of the coil used in this part of the circuit, therefore, by means of the crocodile clips, it is possible to adjust matters until the most satisfactory results are obtained.

A suitable valve would be the Cossor 210HF.

The British Long-Distance Listeners' Club

Receivers

THE analysis of members' receivers makes very interesting reading, especially in view of the minor controversy which is still going on between the communication receiver enthusiast and the 0-v-1 men. On actual score there is no doubt that the latter are well in the majority, and judging by some of the splendid logs they send in, there can be little doubt that the simple receiver in the hands of an experienced and capable operator can pull in the DX signals.

So many amateurs are inclined to confuse volume with signal intelligibility, and overlook such things as signal-to-noise ratio. For long-distance work it is absolutely necessary to consider the readability of the signal rather than the amount of noise which can be reproduced via the headphones or loudspeaker. Bearing this in mind, it is not usually advisable to add L.F. stages in a haphazard manner, otherwise unwanted noise will be amplified beyond all proportion to the signal. It is in this direction that the simple 0-v-1 scores, and if a member using a circuit of this type is tempted to add another stage of L.F. amplification, he would do well to pause and consider whether the actual gain as regards signal intelligibility will be all that one might expect. Although the untuned stage of H.F. amplification is often treated with contempt by those who have failed to appreciate its true worth, there is much to be said in its favour, especially when one is considering any additions to an 0-v-1 circuit. It is usually far better to employ an additional valve as an untuned H.F. amplifier than as an L.F. stage, as the former will improve the over-all efficiency of the detector by reducing aerial damping, eliminating aerial resonant peaks and likewise allowing the maximum efficiency to be obtained from the reaction circuit.

These remarks are not intended to start the old controversy off all over again; they are only given with the hope that those who have despised the small sets will at least put in a certain amount of active work with them before making a sweeping condemnation.

Correspondence

NOW that the practice of sending reports to transmitting stations overseas is no longer permitted, one has naturally to turn to other items of interest associated with our work, and Member 6732, of Hull, shows us in a very definite manner what great interest he is obtaining. His own words can best explain his activities. "Since the war started I have been keeping an accurate record of the weather each day—i.e., temperature, whether sunny or dull, etc.—and I also maintain a daily log of all the short-wave stations received, noting such things as signal strength, time, frequency and atmospherics. The weather records, and the station log can be compared with most interesting and illuminating results. For example, I have found that certain frequencies and areas are more affected by weather conditions than others. Last Easter, during the aurora borealis, VLQ was received exceptionally well."

Another very interesting letter has been received from Member 6443, of Lisburn, North Ireland, who states, amongst other things: "About a month ago I built an R signal-strength meter. It is composed of a transformer, valve, and an 0-7 moving-coil milliammeter. After spending some time calibrating it I have now got it going very well, and it proves of great value when writing up my log."

We certainly agree that an instrument of this type is most useful, and should certainly form part of the equipment of every member. Why not send us more details, 6443, so that we can pass on the benefits of your experiments to other members?

Member 5767, of Bromley, Kent, also gives details of some of his practical work relating to his aerial experiments. "The aerial here is a half-wave Windom for 20 metres, running N.N.E. by S.S.W. The north end is 37ft. high and the south end 30ft. The Windom is quite a good arrangement for short-wave working once the correct tapping point has been found. When bare wire is used for the aerial, it is a comparatively simple matter to connect a crocodile clip to the feeder and determine the correct tapping point by adjusting the clip until the desired results are obtained. When, however, insulated wire is used, the matter is rather more difficult, but by adopting the following idea the trouble was overcome. I soldered the feeder to a safety-pin, and was thus able to pierce the insulation and make contact with the conductor, and then when I had determined the correct point I was able to make an efficient weather-proof connection."

Member 6232, of Colwyn Bay, writes: "The sudden lack of interest shown by members towards the proposed DX competition stirs my own interest to a wider degree. As yet I have been a 'silent' member, but now I feel that I must have my say on the subject. It is very disappointing that members who have so many times asked for such a competition back out at the crucial moment. Why this state of affairs should exist in such a flourishing club as our own is beyond me. I quite realise that the new drive to increase our industrial output will probably necessitate many of our members having to work overtime; but if they were really keen this would not damp their ardour.

"In the issue of 'P.W.' dated June 1st it is suggested that members could keep in touch with each other by forming different groups in their own area. Personally I would be only too glad to act as a 'go-between' for this district. I shall be here until about the end of July, and during that time I will place myself at the club's service to whip up enthusiasm.

"Wishing you and the club all the very best."

Change of Address

WILL all members please note that Member 6172 has now changed his address to 93, Kinfauns Road, Goodmayes, Essex. His previous QRA was 64, Nicholas Road, Dagenham, Essex.

Stationery

WE are getting so many requests from new members for details of the B.L.D.L.C. stationery available for their use, that we make no apologies for giving the complete list below.

- Pad of 50 verification forms, 1s. 6d.
- Pad of 50 log-book sheets, 1s. 6d.
- Packet of 50 sheets headed notepaper, 1s. 3d.
- White manilla folder for log-book sheets, 7½d.
- Membership badge, 1s.

A Remote Control System

Constructional Details of a Novel Apparatus

By Cecil Andrew, A.M.I.R.E.

WHEN amateur transmitting was closed down, there remained a "void" for many readers as far as experimenting was concerned. This led the writer to turn his attention to the development of apparatus he had been using for the remote control of his transmitter.

It was found that this method of control can be applied to many uses, from transmitting gear to receivers, telephones, fire alarms, bell circuits, television, A.R.P. requirements, and practically every branch of electrical science.

The basis of the arrangement can be seen in Fig. 1, and is constructed from second-hand parts obtained for a few shillings from the many vendors advertising such components. In the first place a number of automatic telephone dials were obtained for about 2s. 6d. each second-hand, as well as what is technically termed a "uniselector switch" sold second-hand for about 7s. 6d. This switch was so adapted to have 50 separate double line circuits, "step by step," any one of which can be selected by choosing the number on the "dial." Upon releasing the last number, a relay automatically switches out the selecting device and places the line calling through to whatever relay or apparatus is connected to that number, thus allowing the operator to control any instrument or, if preferred, place himself in telephonic communication with that point.

Constructional Details

At the bottom of Fig. 1, on the left, can be seen the dialling box, placed there only for the convenience of photographing. Attached to this is a flexible lead connected to a valve base with 3 or 4 pins. This can be taken from point to point, and plugged into a valve-holder, so that the "exchange" can be controlled. Nearly all the relays are home-constructed from old bell coils, etc., with the exception of the bank of relays, seen in the top left-hand of the illustration, which were purchased for about 2s. each. These contain multiple contacts which allow any combination of circuits. The writer used to control his transmitter from any number of points connected to the "exchange" by a pair of line wires and earth connection. By dialling a number the mains were first switched on, another number would light the filaments, another number would bring in the H.T. to any stage, and, finally, any "mike" required could be brought in by dialling the appropriate number. It was found that home-made polarised and "latchet" type relays were the most suitable for this purpose, as one number would hold the circuit closed, and another number dialled would then release it. Fig. 1 also shows two "mercury switches" for heavy mains work.

Several of the home-constructed polarised relays were made from old type loudspeaker magnets, between the poles of which moving from side to side soft iron arms are pivoted. These were wound with a coil connected by flexible leads to terminals. When the current was sent in one direction this arm moved across to one side contacts, and when in the other across to the other contacts.

This relay rack is at present used to remote control one or two communication receivers, and by dialling a prearranged number a small induction type electric motor is operated through very slow worm gearing to move the tuning dial of the receiver. Then another number will connect a morse recorder to the output, and so on.

No doubt there are many other readers who prefer to keep all their apparatus and experimental receivers in their own "den" away from the risk of domestic damage, and it is in this case that remote control is so convenient, enabling one to operate from any room or fireside without loss of time. Further, a simple telephone in workshop and other rooms was found to be very useful, the interconnection being self-controlled.

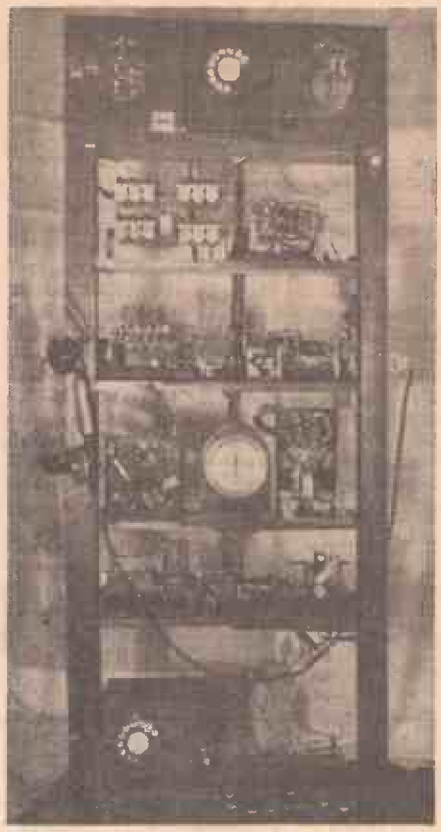


Fig. 1.—The general arrangement of the complete remote control apparatus.

The dials are purchased with contacts normally closed, but these were altered so that they remain open when the dial is at rest, and close as it is rotated. This avoids the need of extra relays, and is much more simple for the purpose. The bottom two rows of contacts on the selector switch are all connected together with the exception of the last one, and this arrangement is used as a self-restoring device. By pressing the white button on the control box, this switch returns to "zero" ready for the next selection. Inside the box is a 4½ volt battery connected to a D.P.D.T. switch so that the polarity can be reversed on the "line" to operate the polarised relays in either direction.

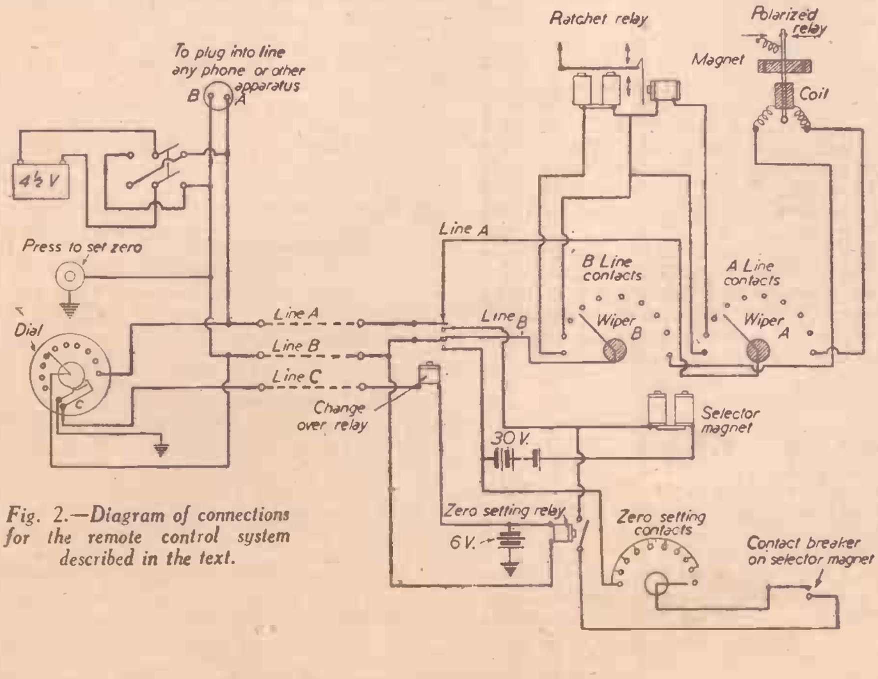


Fig. 2.—Diagram of connections for the remote control system described in the text.

Operation

In the normal position when all relays are at rest, the "A" and "B" lines (Fig. 2) can be traced right through from the D.P.D.T. switch and the line plug sockets to the "A" and "B" contacts upon which the two wipers are resting, so that any current sent through the line or apparatus connected to it will have a through connection to any relay on those pair of contacts on selector switch. Immediately the dial is operated and leaves its normal position, the contacts marked "C" will earth the "C" line through the 6-volt battery and operate the change-over switch, thus pulling the two contacts off the "A" and "B" wipers over to the selector switch circuit, and every time the dial passes a contact number the selector switch is operated once, and moves the wiper on to the next pair of contacts. This cycle of movements takes place for the number dialled, and therefore the selector wipers always move to correspond to the number required. If we want 18 we dial 10 and 8, and we shall find the line through to the No. 18 pair of contacts, which will allow us to operate the relay connected to this number by turning the D.P.D.T. switch which sends a current through the line, or we can plug into the line any apparatus such as a telephone, or radio, etc.

When the use of this number has been completed the zero set button is pressed, which "earths" the "B" line, and by holding down this button for a few seconds, the bottom zero set contacts, which are all connected together except the last one, pass a current through the selector magnet which now has the contact breaker on this selector in circuit. This keeps the rotary wipers moving around until they rest on the last unconnected contact when the circuit is broken, and the selector comes to rest ready for the next dial operation.

There will be found on the "uniselector switch" usually five rows of 25 contacts. The top two rows are used for the line contacts and the bottom row used and connected for zero set. If more than 25 lines are required, it will be necessary to employ the top two rows for "A" line and the third and fourth rows for "B" lines, cutting off the wipers on one side only. This will give 50 lines. All this seems very complicated but is really quite simple in practice with the apparatus described. A ratchet relay is shown connected to numbers 1 and 2. When No. 1 is dialled, and a current passed through the line, the armature is drawn down under the latch which holds this down against the bottom contacts. By dialling the next number this latch is pulled back to release the armature against the top contact. The polarised relay moves from side to side on one number only, according to the direction of the current. The writer has so arranged his relays that only two lines and earth are required for full scale operation, but three lines are shown in Fig. 2 in order to simplify the diagram, but the reader will soon discover many variations for himself.

It might be mentioned that the selector switch can be operated from an old H.T. battery, but the writer uses old wet high-tension accumulators for economy.

LATEST PATENT NEWS

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NEW PATENTS

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Latest Patent Applications.

8972.—Amalgamated Wireless (Australia), Ltd.—Biasing circuits for electron-discharge tube circuit arrangements. May 20th.

8762.—Philco Radio and Television Corporation.—Electron-beam deflecting circuits. May 16th.

9077.—Philco Radio and Television Corporation.—Automatic volume control system. May 22nd.

8836.—Philips Lamps, Ltd.—Control mechanism of wireless receivers. May 17th.

Specifications Published.

521278.—Cole, Ltd., E. K., and Shackell, A.—Tuning of radio-receivers.

521209.—Kolster-Brandes, Ltd., and Beatty, W. A.—Radio-receivers.

521350.—Cole, Ltd., E. K., and Robertson, N. C.—Method of making electric connections in radio-receivers or the like.

521367.—Jones, W., and Pye, Ltd.—Television and like systems. (Cognate Application 143539.)

521330.—Philips Lamps, Ltd.—Superheterodyne wireless receiving-sets.

521183.—Philips Lamps, Ltd.—Radio receiving-sets.

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

New Cossor Transportable

THE recent introduction of "all-dry" valves has led to some interesting transportable and portable receiver designs, the latest of which, from the Cossor factory, is illustrated on the right. The new valve dispenses with the need for an accumulator for the L.T. supply, and as a result a more compact and lighter type of receiver is possible. The L.T. supply is obtained either by a small separate dry cell, or by a section of a special type of H.T. battery designed for the purpose. This is the arrangement used in the Cossor receiver, the battery being of the 90-volt type. A self-contained frame aerial is fitted, and there are four valves in the receiver. The output stage is a pentode, and the circuit is of the superhet type with permeability-tuned I.F. transformers. Automatic grid bias and A.V.C. are included in the circuit refinements, whilst the output is fed to an 8in. P.M. moving-coil speaker. There are three controls, the centre being a slow-motion tuning with concentric tone control, the others being wave-change and volume controls. Normally no earth is required with the receiver, but sockets are provided so that when desired an external aerial and earth may be employed. There are also sockets for the inclusion of an external loudspeaker, these sockets being provided with switching.

The wavebands covered are from 190 to 560 and from 830 to 2,000 metres, and the cabinet measures 20in. by 16in. by 10in. deep. The price of the receiver is £9 17s. 6d.

The new Cossor transportable.

PROGRAMME NOTES

Wedding Group

PHILIP WADE, well-known member of the B.B.C. Repertory Company, is also familiar to listeners for his work as an author and an adapter of works for broadcasting. It will be recalled that a recent adaptation of his was of scenes from "Pickwick Papers." One of his plays, which is to be produced in the Home Service programme on June 14th, by Howard Rose, is "Wedding Group." This is a revival of a work which was originally produced five years ago. The story begins with a modern setting on the eve of the wedding of the young couple. The bride-to-be's mother shows the young couple an old family photograph album in which there is a family wedding group which dates back before the Crimean War. In a delightful way Philip Wade brings this wedding group to life and tells the story of the romance behind it.

Cabin No. 3

THE cruises of luxury liners have not provided such a spate of romance and crime stories as might have been expected, but Florence A. Kilpatrick has used the subject as the peg on which to hang an exciting play which is to be produced by Peter Creswell on June 13th. This is a story of a trip from Rio de Janeiro to Tilbury, and the main characters are a wealthy woman globe-trotter, her pretty young companion, and a stowaway who appears to be mixed up with a gang of emerald thieves who are after the globe-trotter's jewels. There is both crime and romance in the play, for the pretty young companion manages to save the designing stowaway from his worst self and the story has a happy ending.

BOOKS RECEIVED

DEFINITIONS AND FORMULÆ IN RADIO AND TELEVISION ENGINEERING. By A. T. Starr, A.M.I.E.E. Published by Sir Isaac Pitman and Sons, Ltd. 50 pages. Price 6d.

THIS useful pocket handbook, intended for students of radio engineering, contains a large number of definitions, formulæ and circuits, covering many phases of radio, and based on standard practice. The book contains sufficient information for refreshing the memory as occasion requires.

Open to Discussion

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

A "Quality" Equipment

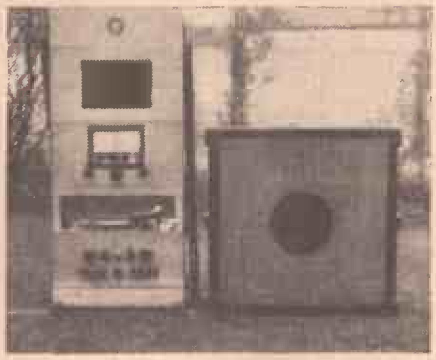
SIR,—I enclose a photograph of my equipment which I have built with the aid of the knowledge obtained from your excellent paper.

The top of the rack contains an 8in. Epoch speaker (P.M.), which I use for DX work, though this was only put there to take the place of a low-power C.W. transmitter which I was going to put in the rack if transmitting had continued.

The middle rack contains the H.F. portion of the rig, and this consists of a VP215 R.F. amplifier which is tuned on all bands, which are fed into a triode detector. This part takes care of the DX. and it has a S.W. range of 12-60 metres, while the usual broadcast bands are also included.

A turntable is next, and this is fitted with a crystal pick-up for quality work with records. The bottom rack holds the most interesting part of the gear, which is the L.F. amplifier.

When on the radio the valve line-up is LP2 (transformer coupled to the detector), which is in turn transformer coupled to a 19 (Class B) valve, which has an output of over 2 watts. When over to the gramo. the line-up is HL2 pre-amplifier resistance coupled to an LP2, which is transformer-coupled to the output valve. The quality with this line-up is exceptionally good, and the output of the Class B valve is fed into a Celestion (P.M.) 10in. speaker. Switching for the L.F. amplifier is done by a multi-cut-out switch, while the two D.P.D.T. switches are for cutting out the Class B valve when working on 'phones, or the DX speaker. The speaker case may interest some quality "fans," as it consists of a strong box 2ft. 6in. square by 1ft. deep. The inside is lined with felt ½in. thick and corrugated paper on the outside. The front is 5-ply wood, and perforated zinc was used over the speaker aperture. This greatly improves the quality, which was good before, but this extends the frequency range greatly in both directions. The whole rig is built primarily for quality work, though it is also good on DX. The aerial used is a 20 m. doublet, and the rig is entirely run from batteries with 180 H.T. Here's wishing your magazine all the best in the future.—C. HEYNE (Britton Ferry, Glam).



Mr. C. Heyne's equipment for quality work with records, and for DX work.

A Simple S.W. One-valver

SIR,—I enclose a short log of stations received with a simple single-valve short-wave set I have built, which may be of interest.

Aerial tuning condenser is .00001 mfd.

Coil: Grid winding 6 turns No. 16 standard gauge bare copper wire on 3in. ribbed former. Reaction winding 5 turns No. 20 D.C.C. wire. Grid condenser is .002 mfd.; grid leak, 2 mΩ. Ordinary broadcast valveholder. Tuning condenser and reaction condensers, .00015 mfd. These I made by removing half the plates and double spacing ordinary air-spaced .0003 condensers. An ordinary short-wave H.F. choke is used.

With this set and an aerial consisting of 10in. of No. 16 copper wire connected vertically to the grid terminal of the coil, I have logged the following stations: EA7BA, W2ECR, EK1EF, W1CRW, W1DLM, LY1J, ES1E, ES4G, I1JKV, K4END, W4XDK. With an aerial of approx. 15ft. No. 20 enamel-covered wire hung round the room, the following commercial stations came in: W2XAD, 2RO6, DJD, GSQ, WIXAL.

I am a regular reader of your journal, and have always found it a great help to me.—W. G. MORRIS (London, S.E.).

Prize Problems

PROBLEM No. 404.

KENT had a three-valve battery receiver which gave splendid results on 'phones, but when he connected a loudspeaker he was disappointed with the results. He was assured that the speaker was in good condition and capable of good results, so he decided that perhaps results would be improved if he did not use a direct output feed. He accordingly decided to parallel feed the speaker, but as he had not got a suitable L.F. choke available he used a 50.000-ohm fixed resistance (bearing in mind that the effect is similar to resistance-capacity coupling). He fed the speaker from the anode through a .1-mfd. condenser, but the results were worse than ever. What was wrong? Three books will be awarded for the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand. London, W.C.2. Envelopes must be marked Problem No. 404 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, June 17th, 1940.

Solution to Problem No. 403.

When Matthews added his screen potentiometer he overlooked the fact that this was joined between H.T. positive and H.T. negative, and accordingly a switch should have been included to isolate this when the set was switched off. Failure to do this resulted in the battery discharging continuously with the results which he experienced.

The following three readers successfully solved Problem No. 402 and books have accordingly been forwarded to them:

M. Dullington. Yorktown Road, Sandhurst, Berks.
W. Brown, 46, Blantyre Street, S.W.10.
D. McLean, 49, Newark Drive, Glasgow, S.1.

"Radio Training Manual"

SIR,—May I take this opportunity of expressing my complete satisfaction with the "Radio Training Manual"?

I have studied this unique book from cover to cover, and have found that it fully explains a number of points which are extremely valuable, and yet are passed over lightly in most text-books.

In particular, I was highly interested in the chapters on the design of the detector stage and the principles of receiver design.

Many radio constructors, with a flair for the technical side of things as well as the constructive, would, I am sure, appreciate a series of articles in PRACTICAL WIRELESS incorporating such interesting subjects as high-frequency transformers, stability in high-frequency circuits, separating the three electrical current components; and oscillatory circuits.

To be brief, a series embracing the whole of the modern radio receiver, and dealing with it in detail, as you have done with the detector stage in the "Radio Training Manual." Most enthusiasts wish to know *why* this, that, and the other must be of such a value, instead of being told that it should be so.

PRACTICAL WIRELESS is certainly doing its bit 100 per cent. in keeping the wireless-minded public informed of all the latest developments in this ever-expanding field.

May it long continue to do so!—J. T. JACKSON (New Barnet).

Station CR7BE

SIR,—In a recent issue of PRACTICAL WIRELESS, R. Scotten, of Leyton, states that he picked up a Portugese East African station broadcasting on 30.8 metres. This station would be CR7BE Lourenço Marques, Mozambique, on 30.8 metres (9.71 mc/s). This station can be heard broadcasting in English from 20.00 to 21.00 B.S.T. every night.—C. MERRETT (Evesham).

Correspondent Wanted

H. TOBIAS, 56, Reginald Road, Crosby, Scunthorpe, Lincs, would like to get in touch with any reader who has built the "Midget S.W. Two."

RADIO CLUBS & SOCIETIES

EDGWARE SHORT-WAVE SOCIETY
Headquarters: Constitutional Club, Manor Park Gardens, Edgware, Middx.
Chairman: P. A. Thorogood, 35, Gibbs Green, Edgware.

ON Saturday, June 29th, from 4 to 10.30 p.m. there will be an exhibition of apparatus by well-known mannfacturers; a demonstration of their new pick-up and loudspeakers by Messrs. Voigt Patents, Ltd.; an unusual junk sale; Morse speed competition; discussion by the secretary of R.S.G.B.; competitions, and in the evening a social and dance. Admission sixpence.

ROMFORD AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: H. G. Holt, 5, Butts Green Road, Hornchurch.

DURING April, and the early part of May, many members demonstrated apparatus they had made and queries were duly settled.

On May 28th we had a very enjoyable evening with Mr. Voigt, and his loudspeaker. Using his new experimental pick-up he gave a demonstration which far exceeded our expectations. Reproduction was the best we had ever heard, and everybody enjoyed it.

In reply to your letter

Tone Improvement

"I have a four-valve battery set which, whilst good so far as all normal requirements are concerned, could, I think, do with some improvement in the quality of its reproduction. This is particularly applicable to the gramophone side, and I append a circuit and would be glad if you would suggest a good tone-control device which would be guaranteed to give good results. I have tried several schemes without appreciable improvement."—K. M. (Wokingham).

YOUR circuit modifications may have been effective, but your speaker, the cabinet, or other acoustic details may have prevented the effects from being noticeable. Have you tried a "constant" tone-control device? This might give the desired improvement and it should be included across your volume control used with the pick-up. It consists of a 50 millihenry choke and a .15mmfd. condenser in series. The condenser is joined to the earth end of the pick-up volume control and the end of the choke is joined to the arm of a variable resistance having a value between 5,000 and 10,000 ohms. The resistance is connected to a tapping on the pick-up volume control, the best point being found by experiment. About one-fifth of the winding is generally satisfactory. The tapping is, of course, on the earth end. If you cannot tap the volume control you can obtain a similar effect by connecting a fixed resistance in series, but it is preferable to tap the control as this then enables the resonant circuit to be cut out at low settings and this gives the desired compensation.

Economy Amplifier

"I wish to build an economy amplifier, capable of giving a really good output for domestic purposes. I do not want dancing volume, but something a little above the ordinary for good music, and with good quality. What arrangement and circuit would you recommend?"—D. F. (Colchester).

THE 2½-watt battery amplifier which we described some time ago would, we think, be the most suitable for your purpose. This consisted of a single L.F. stage with parallel-fed transformer feeding two pentodes in push-pull. The current consumption is fairly high, but by using a really good H.T. battery this should not be a difficulty. The amplifier is economical to operate and not expensive to build. Full details were reprinted in our issue dated December 23rd last.

S.W. H.F. Stage

"I have been using a detector-L.F. short-wave combination, but a friend has told me that I could improve my results by fitting an untuned H.F. stage in front of the detector. I do not see how an untuned stage can give any appreciable advantage and should like your advice on this before making any change."—J. E. T. (Cambridge).

ALTHOUGH an untuned stage may not give as much improvement as a tuned stage there are advantages to be gained by its inclusion. Firstly, the inclusion of the valve before the detector will result in a slight increase in amplification. Secondly, the inclusion of the stage between aerial and detector tuned-grid circuit will overcome erratic effects due to the damping of the aerial, and probably result in smoother reaction and consequent increase in the strength you may obtain on some distant stations. Another point is that on the lower wavelengths the gain obtained by using a tuned H.F. stage is not appreciable and thus there is no object in using the tuned circuit. The buffer stage, as the untuned arrangement is called, is, however, always worth while.

RULES

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

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

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

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

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

Noisy Controls

"I am finding it difficult to adjust my volume control without a noisy background. I am afraid, however, that the control itself is not responsible for the noise, as I have examined it very carefully and the arm is making good contact all over the element. Is it possible to get noise with good contact? Failing this, is there any way in which I can find out the cause of my present trouble?"—A. E. (Isleworth).

IT is possible to get noise from a control which apparently has good contact. But this would only occur if H.F. was present, and then a poor H.F. resistance would be responsible. In some cases this could be overcome by shunting the control by a fixed condenser. If the control is on the L.F. side of the receiver there should be no H.F. present and faulty H.F. filtering would therefore be the thing to overcome. You may find, however, that the control itself is not responsible, but that when volume is turned up the increased vibration causes a poor contact to be jarred in some other part of the set and that this gives rise to the noise.

L.F. Transformer Design

"I have been looking into the question of improving my set and have come across a small problem which I should like you to solve. I have two transformers, at least five years old. They are substantially constructed, and I have always understood that this is one of the most important features of an L.F. transformer. It now seems that modern transformers are extremely small and I am not certain that by purchasing one of these I shall obtain any improvement from the quality point of view. I wonder if you could confirm this?"—H. E. R. (Colindale).

YOU have apparently overlooked the fact that modern transformers do not always employ the old form of core. In the early types of transformer ordinary Stalloy stampings were employed, but many modern transformers make use of special alloys, such as nickel-iron. This permits a high inductance to be obtained in a much smaller space, and therefore, it may be possible in certain circumstances to obtain better quality with a modern small transformer than with an old pattern large transformer of poor design. It is, of course, still possible to obtain high-quality transformers of substantial design, such as the Ferranti.

S.W. Oscillator Coil

"In reading about superhets I see that the oscillator section has to tune to 465 kc/s. From tables I find that this is equivalent to about 600 metres. Now I have a short-wave set tuning down to 9 metres, and on looking at the oscillator coil I find it only has a few turns of wire and is tuned by a very small variable, so I fail to see how it can go up to 600 metres. Perhaps you could explain this point to me."—S. L. (S.E.14).

THIS is a point where thinking in metres, rather than in kilocycles, has helped to confuse you. You have also overlooked the principle of the oscillator stage. It is true that the I.F. stages are tuned to 465 kc/s and that this frequency has to be developed in the frequency-changer stage. However, if you think in kilocycles you will see that the required frequency is obtainable, even down to 1 metre. Take, for example, a station working on a wavelength of 15 metres. This is a frequency of 20,000 kc/s. Now to obtain a beat of 465 kc/s you must tune the oscillator circuit to either 20,465 kc/s, or 20,000 minus 465 kc/s, or 19,535 kc/s. A frequency of 20,465 kc/s corresponds to a wavelength of about 14.65 metres and 19,535 kc/s corresponds to about 15.5 metres, and thus, you see that there is very little difference between the actual tuning circuit and the oscillator circuit, and you do not need a large coil to cover 600 metres. We trust the above explanation clears up your difficulty.

Midget Coil Connections

"I built up your small receiver some time ago, with a Bulgin midget coil in it. I dismantled the set and now wish to make up a similar one, but I have lost the code for the coloured leads of the coil. Is it possible to give me the wiring for this component?"—R. T. (Edinburgh).

THE coil in question had a fixing bracket on it and you should not have removed this in dismantling the set, as it is in contact with the lower end of the grid winding and must be earthed. The tuning condenser should be joined to the red lead and the on-off wavechange switch should be joined between earth and the blue lead. The grid condenser may be joined either to the green lead or to the red one which is already connected to the tuning condenser (the other side of which is, of course, earthed). The primary winding is between grey and yellow, the latter being the earthy end.

The coupon on page 288 must be attached to every query

Reducing Adjacent Channel Interference

Details of a New Type of I.F. Transformer

THE sensitivity of modern superheterodyne receivers is such that, when they are tuned to the frequency of any given broadcast channel, they respond to some extent to signals in an adjacent channel, and it is desirable to provide some means for reducing the adjacent channel interference. Such reduction is best effected in the intermediate frequency circuits because in these circuits the currents to be transmitted are of the same frequency for all signal channels and, as the broadcasting wavelengths are spaced apart by 10 kilocycles, the currents corresponding to adjacent channels to be attenuated are also of fixed frequency of 10 kilocycles above and 10 kilocycles below the intermediate frequency respectively.

The coupling arrangement about to be described provides an inexpensive means for the reduction of adjacent channel interference, and has the advantage that it requires a minimum of adjustment.

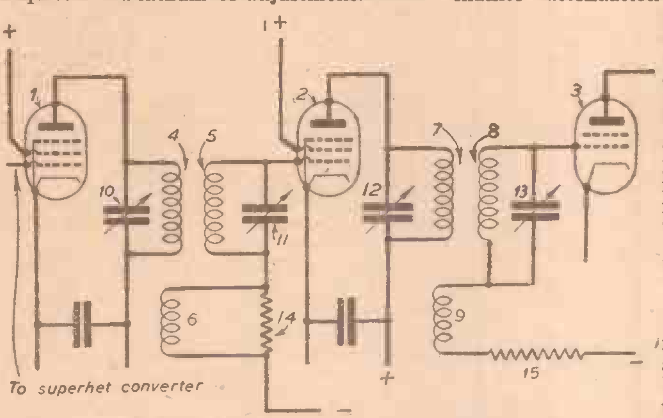


Fig. 1.—The early stages of a standard superhet.

Fig. 1 shows three cascade-connected valves, 1, 2 and 3, the first of which is a frequency changer, while the others are intermediate frequency amplifiers. The anode circuit of the valve 1 includes the primary winding 4 of a coupling transformer which has secondary windings 5 and 6, connected in series in the input circuit of valve 2. Similarly, the anode circuit of valve 2 includes the primary winding 7 of a coupling transformer which has secondary windings 8 and 9 connected in series in the input circuit of the valve 3.

The primary windings 4 and 7 and the secondary windings 5 and 8 are tuned to the intermediate frequency by condensers 10, 12, 11 and 13 respectively, these condensers being adjustable, in the manner of the usual trimmer condenser, for the purpose of initial adjustment. When so tuned, the voltage in the secondary of each transformer is displaced in phase with respect to the voltage of the primary winding by 90 degrees when the intermediate frequency is correct. When this frequency shifts, however, from the correct value, this phase relation changes and the secondary voltage becomes more nearly in phase with the primary voltage, or more nearly opposed to it, depending upon the direction of the shift in frequency and, of course, the magnitude of the phase displacement is dependent upon the magnitude of the frequency shift. The secondary winding 6 of the first transformer and the secondary winding 9 of the second are untuned, but these windings are coupled to their respective primary windings to have induced in them a voltage which is at a fixed phase relation with respect to the primary winding, and which therefore constitutes in the secondary circuit a replica of the primary voltage. Accordingly, this voltage may be made exactly to equal and oppose the voltage in the secondary winding 5, or 8, when the frequency has shifted from the intermediate frequency by the amount of 10 kilocycles. The voltage of the secondary winding 5 may be adjusted to be equal and opposite to the voltage of the winding 6 at a frequency of 10 kilocycles above the intermediate frequency, and similarly the voltage of the winding 8 may be made equal and opposite to the voltage of winding 9 at a frequency of 10 kilocycles below the intermediate frequency. Thus, at these two adjacent channel frequencies, infinite attenuation in the system is produced, the adjacent channel above the intermediate frequency being infinitely attenuated in the coupling device 4, 5, 6, and the opposite adjacent channel being infinitely attenuated in the coupling device 7, 8, 9.

Voltage Adjustment

The voltage adjustment producing infinite attenuation can best be obtained by the use of resistors as shown at 14 and 15, one of these resistors being in circuit with winding 6, and the other in circuit with winding 9. These resistors may be either in series with the respective windings or in shunt, and the diagram illustrates both methods of connection. Both resistors may, of course be connected in the same way, and their values are selected to assist the securing of the desired phase relations between the voltages in the secondary circuit.

Since the voltage on winding 5 is displaced in phase from the voltage on winding 6 by 90 degrees at the intermediate frequency, it will be observed that windings 4 and 5 may comprise the normal transformer coupling coils, since at the intermediate frequency the coupling is not appreciably affected by the winding 6. For this reason manufacturing variations in the coils 4 and 5 do not seriously affect the frequency at which infinite attenuation occurs, with the result that adjustment to take care of such manufacturing variations to secure the infinite attenuation of the adjacent channels is not necessary. In fact, it has been found that the adjustment of the coupling between coils 4 and 5, and similarly 7 and 8, to secure infinite attenuation at the adjacent channels is not more critical than the adjustment for critical coupling in the conventional intermediate frequency transformer.

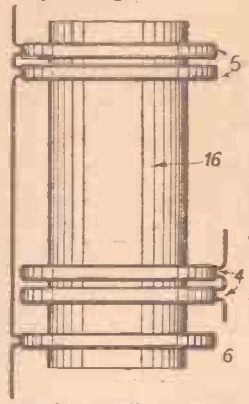


Fig. 2.—Method of winding the type of I.F. transformer described in this article.

Fig. 2 shows the structure of the transformer comprising the windings 4, 5, 6, in Fig. 1. While the arrangement of the windings and the structure of the transformer may vary widely, in the construction shown the secondary winding 5 comprises two coils mounted at one end of a coil support 16, and the primary winding 4 comprises two coils arranged near the opposite end. The winding 6 is arranged on the opposite side of winding 4 from the secondary winding 5 and is more closely coupled to winding 4 than is winding 5.

This system was developed in the laboratories of the G.E. Company of America.

NEW RECORDS

Dance Music

AMBROSE and his Orchestra have made two new records this month. They are "You Made Me Care" with a vocal by Vera Lynn and "In an Old Dutch Garden" on *Decca F* 7451, and "Indian Summer" and "My Capri Serenade" on *Decca F* 7452. Jack Payne and his Band also supply dance music with "Walkin' Thru' Mockin' Bird Lane" and "Me and the Moke and Liza" on *Decca F* 7454 and "Let the Curtain Come Down" and "Rainbow Valley" on *Decca F* 7453. Alex Moore presents Mantovani and his Music for Dancing on *Decca F* 7455-6. On the first record is a slow fox-trot "No Souvenirs" and a quick-step "Dancing is Another Name for Love" and on the other a quick-step "There's a Boy Coming Home on Leave" and "You Made Me Care," which is a waltz.

Rex

VOCAL recordings are supplied this month by that popular radio star Elsie Carlisle, with her version of "Walkin' Thru' Mockin' Bird Lane" and "A Little Rain Must Fall" on *Rex* 9775; Joe Peterson, who sings "I'm Praying To-night for the Old Folks at Home" and "You Made Me Care" on *Rex* 9771, and George Eldrick with "Arm in Arm" and "Light up Your Face with a Smile" on *Rex* 9773.

Dance music is supplied by Billy Cotton and his Band with "The Navy's Here" and "Let the Curtain Come Down" on *Rex* 9770, and "In an Old Dutch Garden" and "Rainbow Valley" on *Rex* 9766. Another popular dance band—Jay Wilbur and his Band—have also recorded this month. They play "Indian Summer" and "Dancing is Another Name for Love" on *Rex* 9767.

Notes from the Test Bench

Metal Panels

THE present shortage of metal has resulted in some difficulty in obtaining aluminium or copper for panels, chassis, etc. It may therefore be worth while remembering that a solid sheet of metal is not essential for the average receiver where screening is required. A very good substitute for a metal panel is an ebonite or wooden sheet, backed by ordinary perforated zinc. This is still available in fair quantities and as a screen is quite effective. Another alternative is to use fine mesh wire-netting. This is obtainable with ⅜in. mesh (used for bird aviaries) and on most apparatus, when earthed, offers a satisfactory H.F. screen. This material is, in fact, often employed in factories and test-rooms for screening off a section of the area for test purposes. A chassis could be made from perforated zinc, which solders nicely and offers only the difficulty that it is not rigid. Strengthening pieces may, however, be placed at corners or along edges, and ordinary plywood or angle strip from the popular constructional toy may be used for this purpose.

Test Apparatus

A DIFFICULTY which often besets the designer of an all-purpose type of test instrument is the selection of various voltage or other tappings. There is usually a range of outputs available at each type of test and it is often found that the most satisfactory plan is to use one or two flexible leads in conjunction with a number of sockets. Whilst this is a good plan there is the difficulty that should the plug be in a wrong socket the instrument may be damaged by connecting the test leads to, say, a high voltage for test purposes. Such a difficulty may be overcome by fitting a fuse, but this generally affects the range of the instrument or its accuracy. A better plan is to make use of a multi-contact selector switch, or a bank of such switches, so arranged that all that has to be done is to turn the indicator to the range desired and the internal switching is automatically carried out. This, of course, still leaves the human element, namely, that one must watch that the instrument is correctly indicated before making the test, but it simplifies this procedure as there will only be one indicator to attend to.

Classified Advertisements

ADVERTISEMENTS are accepted for these columns at the rate of 2d. per word (minimum charge 2/- each paragraph). Series discounts of 5 per cent. for 13, 10 per cent. for 26 and 15 per cent. for 52 insertions are allowed. All advertisements must be prepaid.
EACH paragraph will commence with the first word printed in bold face capitals. Additional words in bold face capitals are charged at 4d. per word.
ALL communications should be addressed to the Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

CABINETS

A CABINET for every radio purpose. Surplus cabinets (undrilled) from noted makers. We have hundreds in stock (no catalogues). Send measurements of chassis, etc., and say what kind of cabinet required. Stamp for reply. Inspection invited.
H. L. SMITH AND CO., LTD., 289, Edgware Road, W.2. Tel: Pad. 5891.

LITERATURE

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

LOUDSPEAKER REPAIRS

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

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

MORSE EQUIPMENT

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

MORSE TRAINING

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

NEW CHASSIS

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

NEW LOUDSPEAKERS

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

WE SUPPLY LATEST MODELS OF
ARMSTRONG
QUALITY CHASSIS ON
EASY TERMS
★ WRITE FOR FULL DESCRIPTIVE LIST & TERMS. PROMPT DELIVERY. CARR. PAID.
LONDON RADIO SUPPLY CO.,
"WINDEN," ARDINGLY RD., BALCOMBE, SUSSEX *(Evacuation Address).*

FREE ADVICE BUREAU
COUPON
This coupon is available until June 22nd, 1940, and must accompany all Queries and Hints.
PRACTICAL WIRELESS, 15/6/1940.

PUBLIC APPOINTMENTS

MINISTRY OF AIRCRAFT PRODUCTION
AERONAUTICAL INSPECTION DIRECTORATE
Vacancies exist for unestablished appointments as Examiners in the General Engineering, W/T. and Instrument Branches.
QUALIFICATIONS.
All candidates must have good general education, be able to read drawings, understand specifications, use micrometers and other measuring instruments.
(a) Applicants for the General Engineering Branch must have had practical experience in an engineering works. An elementary knowledge of materials testing is desirable.
(b) Applicants for the Instrument Branch must have knowledge of physics and training in light engineering or instrument making. Candidates with knowledge of optical instruments are also required.
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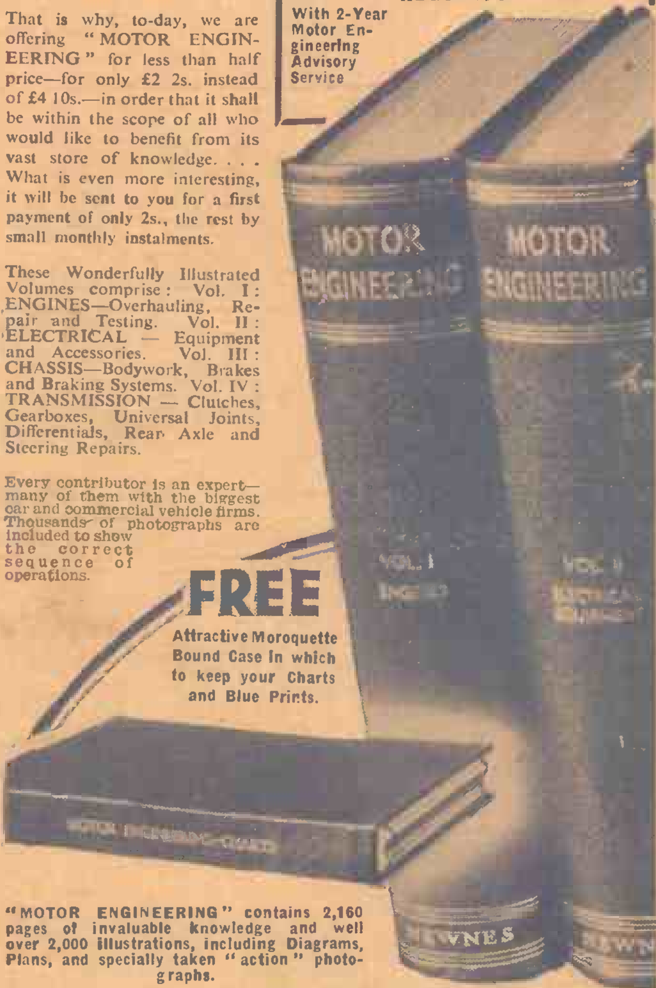

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Vol. 16. No. 405.

Practical Wireless and PRACTICAL TELEVISION

4D. EVERY WEDNESDAY

June 22nd, 1940.

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F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve : Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P) ..	1.5.37	PW4
Fury Four (2 SG, D, Pen) ..	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P) ..	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC)) ..	3.9.38	PW90
Mains Operated		
Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen) ..	—	PW18
A.C.-D.C. Two (SG, Pow) ..	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow) ..	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen) ..	—	PW35B
Unique (HF Pen, D (Pen), Pen) ..	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen) ..	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen) ..	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47
SUPERHETS.		
Battery Sets : Blueprints, 1s. each.		
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F. J. Camm's 2-valve Superhet ..	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve) ..	—	PW43
D.C. £5 Superhet (Three-valve) ..	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4 ..	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four ..	16.1.37	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model .. } Push Button 4, A.C. Mains Model }	22.10.38	PW95
SHORT-WAVE SETS. Battery Operated.		
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Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen) ..	1.10.38	PW68
PORTABLES.		
Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen) ..	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86
MISCELLANEOUS.		
Blueprint, 1s.		
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AMATEUR WIRELESS AND WIRELESS MAGAZINE

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One-valve : Blueprints, 1s. each.		
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The W.M. A.C. Short-wave Converter (1/-)	—	WM408

Practical and Wireless
★ PRACTICAL TELEVISION ★
EVERY WEDNESDAY
Vol. XVI. No. 405. June 22nd, 1940.
EDITED BY
F. J. CAMM
Staff:
W. J. DELANEY, FRANK PRESTON,
H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Servicing

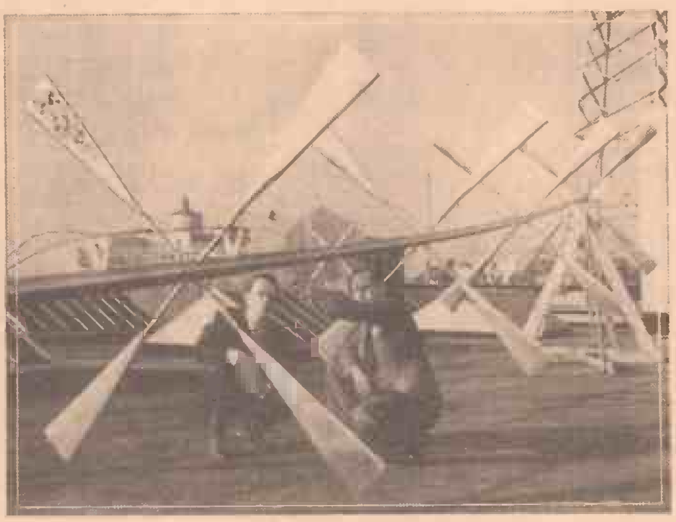
THE demands made upon the civilian population by the Military Service Act have resulted in a shortage of service engineers, and it is important to bear in mind that it is quite possible that many listeners will, for reasons of national economy, make their receivers last longer. This means also that service problems will undoubtedly be more acute and thus there will be a great demand for service men and others capable of dealing with the problems which will arise. We have in the past given great prominence to questions of servicing and therefore continue in this issue with some further details on the subject. There are many young readers who have been taking a very keen interest in radio construction and who would like to enter the service field, but who are not fully aware of some of the methods which may be adopted. It is not, of course, essential to have elaborate test equipment, although it is highly desirable if really comprehensive work is to be carried out. As an instance of what may be done with home-made apparatus we give in this issue details of a tester in which an ordinary beehive "night-light" type of electric lamp is employed. There are many other similar devices which may be made up and these will be dealt with from time to time.

H. V. Morton on Palestine

ON June 21st H. V. Morton is to tell the schools about the people of Palestine. "The life of the village people," he says, "has not changed very much since the time of Christ. Shepherds still watch their flocks on the hillsides . . . and the Arabs with their flocks and herds are still living like Abraham."

"Moonlight and Splash"

JAMES DYRENFORTH was recently responsible for the script of a crazy show called "Nuts in May." This was so successful that Tom Ronald, its producer, immediately asked Dyrenforth to get to work on another piece of madness. The result will be heard on June 20th, when "Moonlight and Splash" (not "Nuts in June") will be broadcast with Joyce Grenfell, Billy Milton, Dick Francis, Helen Clare and Dorothy Summers in the cast. Joyce Grenfell, renowned for her impressions in the Farjeon revues at the Little Theatre, London, will play the part of a rather eccentric housekeeper, but there will be opportunities for her to be heard in some of her own sketches, too. Billy Milton, lately playing in "Meet the Arrow" in "Crime Magazine," will broadcast some of his own songs, as well as having an important rôle in the main action of the show.



An unusual type of television aerial which was experimented with in America. It was claimed that better definition could be obtained by means of the paddle-like elements.

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

Ayrshire Brass Band

DARVEL BURGH BAND will broadcast on June 22nd under its conductor, Frederick Rogan. The band will play the ceremonial march, "Royal Progress"; a selection from "A Country Girl"; the dainty Heykens Serenade and a fantasia, "Ten Minutes wi' Burns," which means much to the players, because they all come from the Burns country in Ayrshire.

"Values"

ONE of the loveliest little plays ever broadcast from Wales was "Values," by D. T. Davies. This play, which was originally written in Welsh, was translated into English by the author and was broadcast in the Home Service programme last January. Judging by correspondence and people's comments the play helped them greatly in these troublous times. It will be broadcast again on June 23rd.

Children's Miscellany

THE Children's Hour from Scotland on June 22nd has something for children of all ages and tastes. Christine will read "The Handkerchief Hero," a story by Mary Manners Simpson for very young listeners. A talk for stamp collectors will be given by A. K. Macdonald, an old favourite of children, and Summer Saturday Variety will include songs by Kathleen and Elliot Dobie.

"Film Festival" (3): "Shall We Dance?"

THE third production in Douglas Moodie's "Film Festival" will be a revival of the radio version of "Shall we Dance?" which was first broadcast in December, 1938, and is to be heard again on June 24th. This is surely one of the best of the Fred Astaire-Ginger Rogers series, and contains one of George Gershwin's loveliest scores. Some of the best and most typical Gershwin numbers come from this show. "Let's Call the Whole Thing Off," for instance, is an excellent example of his light comedy work; while "You Can't Take That Away From Me" has the wistful, nostalgic quality for which he is celebrated. It is expected that Diana Ward will take the Ginger Rogers part in this broadcast.

All-dry Receivers

Details of the New Valves and Receivers which May be Built Round Them

By W. J. DELANEY

IT was announced some time ago that special valves were to be produced which dispensed with the accumulator, and thus simplified receiver construction and brought into real use the portable type of receiver. These valves are now available for the home-constructor, and as a result a new field of experiment is opened to him. The ordinary type of "battery" valve is designed for a filament supply of 2 volts, and the current taken is generally of the order of .1 amps. This means that when three or more valves are used a fairly substantial accumulator has to be employed or only a very short period of listening may be indulged in before the accumulator has to be recharged. When real long-distance reception is desired it is necessary to adopt a superhet type of circuit, and this means that at least four valves have to be employed. This adds to the filament current, and when the normal H.T. battery also is included (remembering that battery valves are designed for H.T. voltages from 100 to 150 volts), the overall weight as well as size becomes rather unwieldy for real portable use.

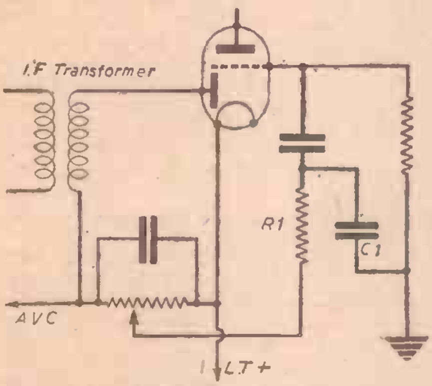


Fig. 1.—Skeleton diagram of second-detector stage with minimum of components.

Valve Characteristics

The new "all-dry" valves, as they are called, are designed with a filament rated at 1.4 volts, and there are five types, four having filament current ratings of .05 amps. and one a .1 amp rating. The standard dry cell is rated at 1.5 volts compared with the 2-volts of a wet cell or accumulator as it is more properly termed. It will thus be seen that the new filaments are all right for a single cell, and it is thus possible to use four such valves with a total current consumption of only .2 amps. Although this is rather on the high side for simple small cells, it is quite within the bounds of a properly-designed single cell, and these are obtainable now incorporated in an H.T. battery. In some cases a number of the ordinary cells are connected in parallel, and these are, of course, then deducted from the total H.T. voltage, leaving in many cases only 90 volts or so for H.T. This combination of 1.5 volts and 90 volts is now more or less in general use, and the battery is thus no larger than the ordinary type of 100-volt H.T. which is normally employed, although various ideas are incorporated to permit the overall dimensions to be reduced. For instance, instead of flexible leads or terminal connections, spring strips are sometimes fitted so that when the battery is pushed home into the receiver the L.T. circuit is automatically completed. In other cases, two of the very small 45 volt H.T. units are connected in series. These units have been produced for deaf aids, and similar small receivers, and accordingly are not only very light in weight but also compact.

Valve Types

The new valves have been produced in six types—a pentagrid frequency changer and an H.F. pentode, both of which are available as "straight" or variable-mu valves; a single diode triode and two types of pentode output valve. It will thus be seen that the valves have been designed primarily for use in a superhet circuit, this offering the widest range of possibilities in receiver design and also in efficiency for small receivers of the portable type. The type numbers of these valves are 1A7G (or 1A7VG for the variable-mu) frequency changer; 1N5G H.F. pentode (or 1N5VG for the variable-mu); 1H5G for the diode-triode; 1C5G for the output valve and 1A5G for the other output pentode. The latter has a .05 amp filament and is rated to deliver 100 milliwatts, whilst the former has a .1 amp filament and is capable of an output of 240 milliwatts. By using 5 of these valves in combination it is possible to have a superhet with a total anode current of less than 12 mA and this, combined with a total L.T. current drain of only .2 amps, means a considerable saving in all directions, whilst still giving a remarkable output and range of reception.

Receiver Designs

The general design of receivers using these new valves is practically identical with that using ordinary valves, the only point of difficulty likely to be experienced by the average amateur being in the design of the 2nd detector and A.V.C. stage. This is on account of the fact that the valve used in that stage is a *single* diode-triode and not a double diode-triode which is more usually employed. A typical circuit is, however, given in Fig. 1 which shows that the arrangement is quite simple, the usual load resistance being eliminated and the L.F. volume control being used for this purpose. It thus acts in a dual capacity, a procedure which is quite satisfactory and which at the same time eliminates at least one component. In practice the circuit is actually simplified in other directions.

Another interesting point in regard to these valves is that they are of the octal type, which means that they are not only standardised for valve base design, but that they are also extremely small—again adding to their usefulness in the sphere of portable designs. It is almost unnecessary to indicate that grid-bias batteries are usually dispensed with in receivers employing these valves, the usual automatic biasing scheme being included. There is, however, just one point in this connection which should be borne in mind. The high efficiency output valve requires a bias of 9 volts and, obviously, if automatic bias is used, this 9 volts is subtracted from the total available H.T. As the valves are already only utilising a total of 90 volts, this loss of 9 volts might be found ill-considered in some receivers, and thus where extreme portability is not needed (as in a transportable or a standard home-receiver), the high-efficiency output pentode would be used, together with a separate biasing battery. In that case, too, one of the larger 1.5 volt cells (a small bell cell, for instance) would be employed.

Characteristics

Below will be found the general characteristics of the valves already mentioned, although it must be appreciated that there may be slight differences in the products of different firms, whilst the type numbers are also slightly modified by some makers.

We shall shortly be describing a receiver using these valves, but in the meantime for those who wish to build up their own receiver, we include a complete circuit of a 5-valve combination superhet with H.F. stage and using the 1C5 output pentode. The layout is not critical, but should follow the general lines of superhet circuits, paying particular attention to the screening of the H.F. stage and of the various I.F. leads.

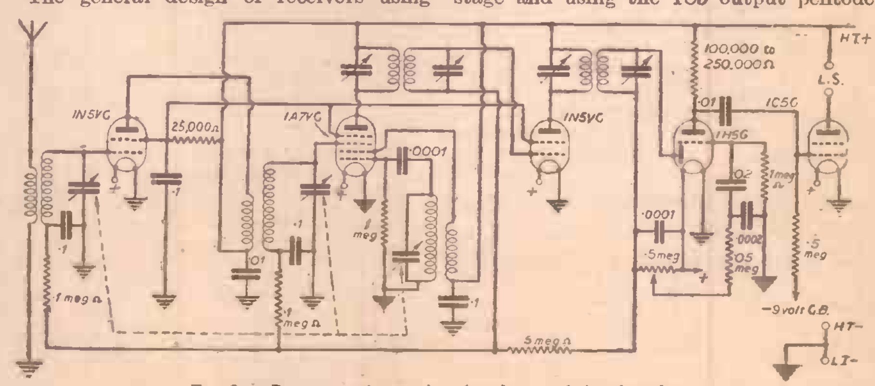


Fig. 2.—Diagram of superhet for the new 1.4 volt valves.

Type	Filament		Anode Volts	Screen Volts	Osc. Volts	Grid Bias Volts	Anode Current mA	Slope	Impedance	Amplification Factor
	Volts	Amps								
1A7G ..	1.4	.05	90	45	90	0	2.3	.25	—	—
1A7VG ..	1.4	.05	90	45	90	0 to −3	2.3 to 1.2	.2	—	—
1N5 ..	1.4	.05	90	90	—	0	1.2	.75	1,500,000	—
1N5VG ..	1.4	.05	90	90	—	0 to −4	1.2 to 1.6	.65	1,000,000	—
1H5G ..	1.4	.05	90	—	—	0	.14	.275	240,000	—
1A5G ..	1.4	.05	90	90	—	4.5	4.0	.85	—	—
1C5G ..	1.4	.1	90	90	—	7.5-9	7.5	1.55	—	—

A Neon-lamp Tester

Details of a Novel Resistance Test Instrument

Fig. 1.—The neon-lamp tester ready for use.

THE ordinary neon lamp as sold for domestic lighting has applications other than that of an "electric night light." Perhaps its greatest sphere of usefulness is as a testing device for the radio constructor. Continuity and insulation tests, condenser tests, and the determination of the values of resistances are all possible with the aid of one of these useful gadgets.

Before carrying out any work with the lamp it is just as well to mount it in a holder on a small wooden base. A small "charging" board as used for accumulator charging from D.C. mains will answer the purpose very well. Such a board is illustrated in Fig. 1 and the wiring underneath is given in Fig. 2.

A "Flashing Sign"

The usual application of the lamp by the radio constructor is as a circuit tester and indeed, in this direction it is very useful. However, the purpose of this article is to give not only these tests but to describe a further use of the lamp, namely, a means of finding out the values of grid leaks and high resistances. By a suitably arranged circuit the lamp will give a series of intermittent flashes, the speed of the flashes determining the value of the resistances under test. Besides being a very interesting experiment in itself—it provides quite a novel "flashing sign" without any mechanical "works"—it is an easy method of checking just those resistances which are usually most difficult to measure, namely, very high ones. With ordinary meters accurate results are very difficult to secure owing to the small readings obtainable.

The neon lamp does not, of course, replace meters, but may be looked upon as supplementary to the ordinary moving-iron instruments. It must be admitted that the method to be described is one of substitution, but by drawing a simple graph many different values can be determined from two or three "known" resistances.

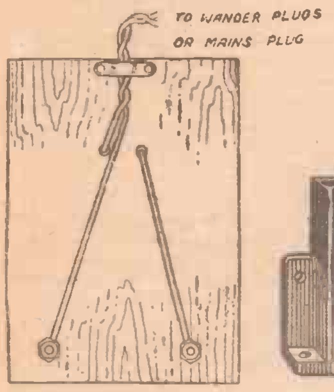


Fig. 2.—The wiring connections underneath the test board.

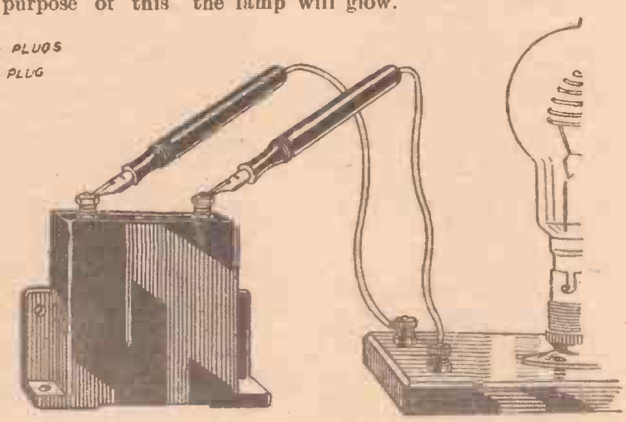


Fig. 3.—Testing the insulation of a fixed condenser with the neon lamp.

Useful Tests

Before going into details of the "flashing sign" tests here are some of the more common applications of the lamp.

By fitting two insulated test prods to the ends of a length of twin flex taken from the terminals on the lamp board the lamp may be quickly connected to any part of the circuit or component under test without fear of the conductivity of the constructor's hands upsetting the results. The prods can be bought or are easily made from pieces of vulcanite rod with the flex passing through the centre and connecting with metal contacts sticking from the end of the prod. A couple of old fountain pens will make excellent prods. A hole should be drilled in the top of each pen for the flex to pass through while the original nib or a cheap brass one will do as the contact. The wire is soldered to the nib before it is inserted in the feed, as in Fig. 4.

To make the lamp glow it will have to be either connected to an H.T. battery or plugged into D.C. mains. When buying the lamp the voltage required should be stated. On touching the two prods together the circuit will be completed and the lamp will glow.

Testing Condensers

Owing to the comparatively high voltages used the lamp will provide a very stringent test of insulation and is, therefore, particularly useful in testing condensers.

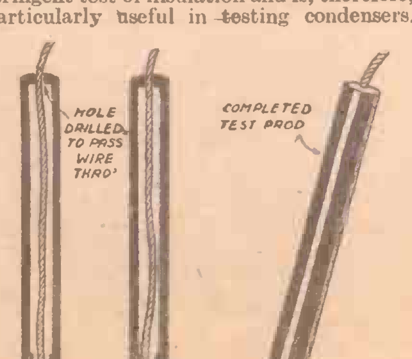


Fig. 4.—How a testing prod can easily be made from an old fountain pen.

The test prods are held in contact with the terminals of the condenser for a minute or two, as in Fig. 3. If the condenser is leaky a series of flashes will occur in the lamp, that is to say, that after a short time it will glow momentarily, and then go out again immediately, and then after a similar period of time it will suddenly flash again. If this only occurs at long and regular intervals, say once every minute, the condenser may be considered as O.K., although, of course, a perfect condenser would give no flashes at all. However, in a test of this sort allowance has to be made for any slight leakage in the lamp holder, wiring, and test prods, which would give the same effect as leakage in the condenser, so that an occasional flash does not mean the condenser is a "dud." In fact, this test is so searching that a flash every minute or half minute represents a leakage resistance of not less than several million ohms. It is when the flashes occur several times per minute or when they gradually increase in frequency that the insulation may be taken as very poor or broken down. This test may be applied equally well to fixed or variable condensers, but cannot, of course, be used for the electrolytic type.

A multitude of other insulation tests may be carried out by placing the prods across the suspected part. For instance, the insulation between the sockets of a valve-holder can be tried by placing the prods in the sockets themselves, or again, the insulation between the windings of a transformer may be checked by connecting one prod to one of the primary terminals and the other to one of the secondary terminals.

Continuity Tests

To test for breaks in the wiring of coils, transformers, etc., the prods should be connected across the terminals of the component in the same way as with a condenser. A continuous glow indicates that there is no break in the wire, but erratic glowing or no light at all means that there is respectively only a partial connection or else a complete break.

Another use for the neon tester is in determining whether a variable resistance or potentiometer is working properly. If the two terminals of the variable resistance, or, in the case of a potentiometer, the terminal joined to the slider and one of the other two, are connected to the lamp and the slider is moved slowly round, then any place where there is a faulty contact will be

(Continued on next page)

A NEON-LAMP TESTER

(Continued from previous page.)

indicated by the lamp going out at that point. If the instrument has a fairly high resistance, such as 5,000 ohms or more, then the glow of the lamp should steadily increase or decrease as the knob is turned first one way and then the other. If it flickers it means the slider is not making proper contact at the point where the flickering occurs.

In testing a variable resistance or potentiometer in this way we get a very good idea of how the lamp will behave when resistances of various values are connected in series with it, for in moving the slider we vary the resistance from zero to the full value of the instrument. Now if we look at the lamp we shall see that the glow does not gradually get paler as the resistance is increased, but rather does it diminish in area. First of all the whole of the beehive shaped electrode or the disc glows (according to the direction of the current), and then the glow becomes smaller until only a small point is illuminated. Instead of the variable resistance several fixed resistances may be tried. It will be noticed that each one will give a different amount of glow according to its value. This in itself will provide a rough means of finding out the value of an unknown resistance. As an example we may find that a grid leak of two megohms makes the lamp just glow, whereas a ½ megohm leak makes about a quarter of the total area of the electrodes light up. If a leak of unknown value is then submitted to the test and found to give a glow area smaller than that of the ½ megohm leak but more than that of a 2 megohm one, then we may fairly safely assume its value to be in the region of 1 megohm.

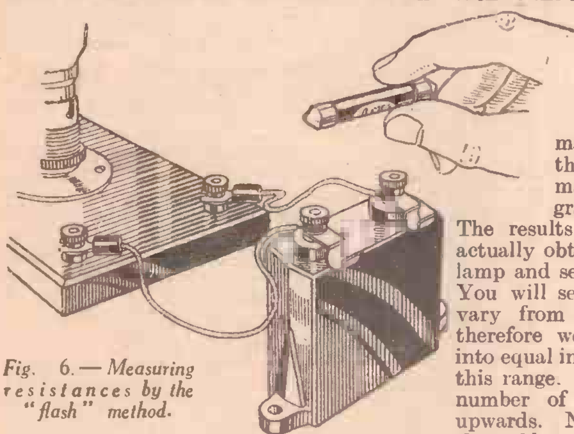


Fig. 6.—Measuring resistances by the "flash" method.

Obviously this method gives only approximate results, and has the drawback that a large number of known resistances is needed in order to be able to determine the value of any unknown one. A far more accurate and reliable method is that mentioned earlier, namely, the "flash" method.

Measuring Resistances

The circuit necessary is shown in Fig. 5. It consists simply of a large fixed condenser in series with the lamp, and an H.T. battery or other direct current source, while the resistance under test is placed across the condenser. A good idea is to discard the prods and connect the condenser with two wires to the lamp as in Fig. 6. Grid-leak clips or stiff wires can be fitted to the condenser terminals to facilitate the quick attachment and removal of the resistances. A good quality condenser of about 2 mfd. capacity should be used, and when the current is switched on there

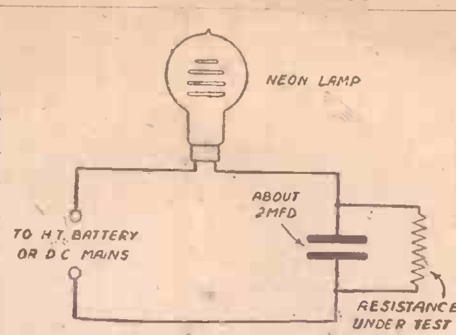


Fig. 5.—The circuit used when testing resistances by the method described in the text.

should be no glow or flashes from the lamp until the resistance is connected up. On placing a resistance in position the lamp will start flashing at regular intervals. There may be five, ten, twenty, or more flashes per minute until the lower values are reached, then the flashes become too fast to count, or else merge into one continuous glow.

Now in order to test a range of different resistances it is best to make a simple graph as in Fig. 7. By placing three or four different resistances of known value across the fixed condenser in turn a table such as the following may be compiled.

Resistance.		Flashes per minute.
3 megohms		14
2	,,	20
1	,,	26
½	,,	33

From this it is a very simple matter to make the graph. For the benefit of those readers who may not be familiar with plotting graphs, this is how one is made. The results tabulated above were those actually obtained with an "Osglim" neon lamp and several good quality resistances. You will see that the resistances chosen vary from ½ megohm to 3 megohms, therefore we divide the graph vertically into equal increments of resistance to cover this range. Along the base we mark the number of flashes per minute from 0 upwards. Now taking the first figures in the table we see that a resistance of 3 megohms gave 14 flashes. We run a pencil along the horizontal line marked 3 megs. and one along the vertical line marked 14. Where they intersect at A we put a small cross. We carry out the same procedure for the other points, thus 2 megs. meets 20 at point B, and so on. The points A, B, C and D are then joined up with a line as shown.

Once the graph is complete we can read off the value of any unknown resistance within the limits of the graph. Suppose, for instance, that we placed an unmarked resistance across the terminals of the condenser and the lamp flashed 30 times per minute. Following up from the 30 line on the graph we see that it meets the curve at the same point as the horizontal line marked ½ meg. The value of the resistance is therefore ½ meg. In the same way a resistance giving 17 flashes would be approximately 2½ megohms.

The accuracy of these results depends to a large extent on getting the lamp to flash at regular and easily countable intervals. To ensure this, a little care in the adjustment of the voltage and the capacity may be required. If the flashes occur too quickly to count then a larger condenser, say 4 mfd., should be used. This will slow up the flashes considerably. Keeping the voltage of the supply as low as possible will also help, although naturally it must not be reduced so much that the lamp will not glow at all.

There is one peculiarity in connection with neon lamps which must be mentioned here, as it is possible for it to cause slightly

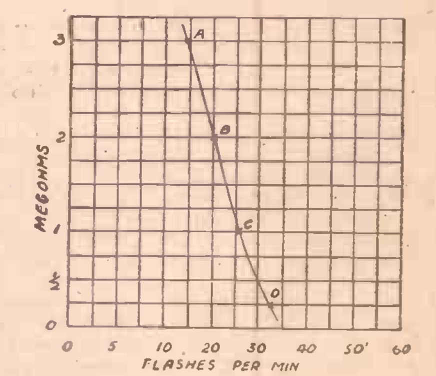


Fig. 7.—The curve used for finding the value of resistances.

erratic results, and that is there is sometimes a time lag between the flash and the voltage producing it. This means that although the upper critical voltage necessary for producing a discharge is reached, yet the discharge does not immediately take place. This is due to insufficient ionization within the lamp itself. However, it may be overcome by having a bright light, or another neon lamp glowing in the near vicinity of the test lamp, when the work is in progress.

BRITAIN'S VICTORY DRIVE

CONTINUING the new B.B.C. feature programmes describing Britain's drive on land, on sea, and in the air, and in the workshops of the country, a second series will tell the story of the part that Britain is playing in the Allied war against Nazism. These programmes, entitled "Marching On," the first of which will be broadcast on June 21st, are to be put on the air at fortnightly intervals, alternating with the "Go To It" series. They will be under the general editorship of Laurance Gilliam, of the B.B.C. headquarters staff. Among well-known B.B.C. script writers and producers who will contribute to this series are Robert Kemp, Francis Dillon, Stephen Potter, A. L. Lloyd, Denis Johnston, and D. G. Bridson.

The idea behind this second series is that of a radio magazine showing the progress of the war for each preceding fortnight, throwing into relief by dramatised presentation or narrative the outstanding events which have happened. Major military, naval, and air force events, home front and Empire news will be featured in this way and the underlying moral of these programmes will be that, although the road to victory has its ups and downs, the reverses will only serve to spur Britons on to still greater efforts which will end in the defeat of their enemies.

ON YOUR WAVELENGTH

By Thermion

Aliens and Wireless Sets

I LEARNED from the Ministry of Home Security that all Germans living in this country, irrespective of age or grade, must immediately dispose of their radio receiving sets. It does not matter whether the German concerned has been in this country for half a century or more. It is illegal for him to own a wireless set. If any of my readers know of any German who owns a wireless set he should take immediate steps to inform him that it should be disposed of at once or, alternatively, the police should be informed. In this war we cannot afford to take risks, and I have no doubt that this new order will impose hardships on many Germans living in this country who are anxious to see Hitler defeated. But fifth column activities in other countries have taught us a lesson. When the German troops have arrived, people who would never have been suspected of subversive action have guided the invaders, fed them and housed them. That must not happen here. There may be something in the suggestion that once a German always a German at heart. Do not be misled by their spoken hatred of Hitler. That may be part of the camouflage and the cunning, and is intended to disarm suspicion. It is the duty of every reader, in fact, of every citizen, to inform the police of anyone guilty of expressing pro-Hitler views.

A wireless receiving set can be used as a transmitting set, and we must make very sure that Germans enjoying the protection and hospitality of this country shall not abuse those privileges.

Car Radio Conversion

SINCE the recent order prohibiting the use of car radio, whether installed in the car or carried as a portable, I have had a number of letters from readers asking how such receivers can be operated from the mains. I have told them all that such a conversion is not worth while, for it is far too expensive. Much better, especially if the car is laid up, to remove the set with its battery indoors and operate it in the usual way. While I am dealing with the question of car radio, you will remember that I raised the point concerning the dealer who is transporting a portable to the home of the purchaser. The P.M.G. now informs me that the regulation provides that apart from certain authorised exception, no person shall use or have in his possession or under his control any wireless receiving apparatus in any road vehicle. This prohibition applies not only to wireless sets fixed in a road vehicle, but also to any wireless receiving apparatus carried in a vehicle in circumstances in which it can be used or readily adapted for use. The police have instructions to see that the regulation is obeyed. The Postmaster-General is unable to give a general exemption to persons or firms engaged in the supply or conveyance of radio sets to customers, or the collection of sets from customers for repair. In this connection no difficulty would appear to arise in regard to mains-operated receivers which could not be used in a vehicle. In the case of battery-operated sets, whether portable or not, it should be arranged, if possible, that the battery should not be carried in the road vehicle at the same time as the rest of the set. If however, this separation is impracticable, it is considered that the police will be unlikely to raise any difficulty in the case of bona-fide radio wholesalers or retailers, if the set is kept separate from the battery, and is securely wrapped up and sealed.

The military and the police cars are, I presume, exempt. Vans equipped with P.A. outfits are receiving consideration. An amplifier is not wireless receiving apparatus. Moreover, it seems that portable receivers may be carried for short distances by hand without the police interfering.

With regard to Philco car radio they state that they are evolving a scheme which will shortly be circulated to dealers. Sets which use a vibrator unit can be operated by removing it and feeding alternating current of appropriate voltage to the primary winding of the vibrator transformer. I understand that Philco will shortly introduce a transformer for the purpose. It must be noted that where an energised loud-speaker field is employed, further modifications are necessary.

Valve Standardisation

THE British Institute of Radio Engineers have formulated a policy which they have submitted to the Service Departments, the Ministry of Supply, and the Ministry of Labour. Their proposals are intended to help in the national emergency and are not made for controversial reasons. They think that if the proposals are adopted they would release from the radio industry skilled artisans, such as toolmakers, jig and tool designers, etc., as well as save valuable material including copper, iron, nickel, molybdenum, and glass. Also they would increase export trade, and simplify radio servicing.

Briefly, they propose a first step of a general adoption of the 6.3 volt 0.3A valves. This range of valves which, of course, includes a higher voltage range, is comprised by twenty types, as against the enormous number of other types. In some quarters this is thought to total nearly 1,000. They say that if receivers were designed on the use of these three types they would equal in performance any receiver at present available. They even suggest that there would be a greater all-round advantage, and at a lower cost to manufacturer and consumer. For example, such features as automatic inter-station noise suppression, automatic volume control, post demodulator automatic volume level maintainer, could with the incorporation of the screened triode-heptode, the output tetrode, and a two system rectifier, be included without difficulty, thereby proving a sales advantage in the home and export field. Obviously, all receivers would have to be of the A.C./D.C. type, thus entirely eliminating the needs for mains transformers, and in the case of smaller sets eliminating the smoothing choke, thereby saving a considerable amount of high quality Swedish iron and copper.

The technical objection that certain specialised apparatus will still require specialised types of valve is undeniable, but does not materially effect the scheme, since, of the ten millions to twelve millions radio receiver valves absorbed by the radio receiver industry, well over 80 per cent. are used in sets in which the five specified types of valves could be satisfactorily used. The other 20 per cent. is made up of replacement valve business which, if the proposed scheme is put into effect, could easily be satisfied for the next 18 months to 2 years from the existing available stocks of diverse types. The specialised types of valve manufactured have always been less than 10 per cent. of the normal receiver valve business, and the adoption of the scheme put forward will undoubtedly expedite production of the specialised types which may still be required for the Defence Departments, the B.B.C., and the G.P.O.

Our Roll of Merit

Our Readers on Active Service—First List.

Alfred Thomson
(Radio Officer, Merchant Service),
31, Fore Street, Fowey, Cornwall.

J. Herron
(Fusilier),
19, Church Street, Keswick, Cumberland.

J. Widden
(Radio Mechanic, R.A.F.),
4, Spring Gardens, Dorking, Surrey.

K. Firth
(Radio Mechanic, R.A.F.),
253, Huntingdon Road, York.

J. E. Whittle
(Private, R.A.M.C.),
2, Church Terrace, Darwen, Lancs.

T. H. Plater
(Aircraftman, 2nd Class, R.A.F.),
341, Milligan Road, Leicester.

J. Bell
(Petty Officer, R.N.),
c/o G.P.O., London.

F. W. Chambers
(Wireless Operator, R.N.V.W.R.),
51, Whitehead Road, Aston, Birmingham, 6.

G. Hazelwood
(Gunner, R.A.),
17, Staffordshire Street, Peckham, S.E.15.

T. E. Greenhalgh
(R.A.F.),
37a, Greenleach Lane, Worsley, Manchester.

Comment, Chat and Criticism

Outline of Musical History–5

Music During the Eighteenth Century

By Our Music Critic, MAURICE REEVE

THE history of music during the eighteenth century is really the story of "matters musical," rather than of music itself. Even more important than the invention of new harmonies and sounds was the discovery of new forms in which to write music; new instruments on which to play it; and new combinations of instruments for which to write it. The enormous progress in these departments of the art is what makes the century particularly illustrious; revolutions in harmony and kindred subjects were to follow in the next.

And their importance cannot be exaggerated. The great Bach's son, C. P. E. Bach, developed the first stages of "first movement," or modern sonata—binary—form, which Haydn was shortly to perfect, and Beethoven, a little later still, to transform. Gluck rescued opera from an impending ignoble death, and gave it the character and unity which Wagner crowned a hundred and fifty years later. Whilst Gluck infused it with lasting qualities by insisting on the equal importance of all its component parts, and choosing tragic and dramatic plots for his own examples, Mozart, a far greater genius, took it into the world of comedy, and with a series of incomparable masterpieces ensured immortality for himself and his works.

Haydn

Haydn's development of sonata form opened up the vast world of the sonata, symphony, quartet, etc., without which music to-day would seem non-existent. Haydn's own examples were to be greatly excelled by those of the divine Mozart, as his were, in turn, to be by those of the giant Beethoven. But it is to Papa Haydn, Beethoven's first teacher of importance, that we owe the modern symphony. Without his experiments and discoveries it is doubtful what would have happened.

Not only did the expansion of sonata form from the suites and overtures of Bach, and others, ensure the eventual arrival of the symphony, but side by side went the great expansion of the orchestra—including the introduction of violins—to ensure that when it did arrive it would be the biggest and most comprehensive form that music was to evolve for itself; and the most satisfying. Beethoven's master works set the seal on it for all time.

The Pianoforte

The invention of the "piano e forte" was a tremendous event which inspired the first of that gigantic series of compositions for the instrument, to which almost every composer of note has contributed ever since. Wagner and Elgar are lone exceptions. Only to-day does the fount of inspiration which the first hammer-actioned instrument set running, seem to be drying up. The modern virtuoso pianist is largely to blame. Unlike his predecessors he never finds time to devote to serious composition.

Not the least of the piano's claims to the gratitude of musicians is the origin of the concerto, for a solo instrument with orchestral accompaniment. Music would be infinitely poorer without the concertos of Mozart, Beethoven, Brahms and others.

Introduction of Rhythm

Coming last, but certainly not least, in the development of music at this time is the virtual introduction into big-scale works of rhythm as an integral element. The development of "ternary" form gave the word an entirely new meaning from that given it by Couperin, Bach, or Handel, working as they did in the simpler and unsophisticated "binary" mode. But rhythm, like most of the components of a piece of music, is an exhausting subject on its own, and only its historical antecedents and rise can be touched on here.

Neither can an analysis of sonata form be attempted. It is only possible to record the enormous scope it gave to the great masters in the writing of large-scale works which could embrace within their movements the whole gamut of human feeling and emotion. Works of the depth and import of the Jupiter or the Eroica symphonies had not previously been heard, because no framework had so far been devised that was capable of holding such a wealth of treasure. Once the design had been perfected, however, a series of monumental works were built up on it, and its subsequent improvement and enlargements, have proved it conclusively to be the *ne plus ultra* of musical forms.

This article can well close with a review of the two great masters who adorned the latter half of the eighteenth century, and whose work made possible the glories that were to come.

Joseph Haydn, 1732-1809, was the son of a wheelwright, and as a young man and a student was so poor that he cleaned shoes in exchange for some lessons. He taught himself theory and composition, and by the thriftiest living managed to buy a few necessary books one at a time. His particular study was C. P. E. Bach's sonatas and Fux's "Gradus and Parnassum." Then, through the influence of a wealthy friend that he met at this time, he became appointed Chapel Master to Prince Esterhazy, and never looked back.

Born twenty-four years before Mozart and outliving him by eighteen years, Haydn had the unique privilege of being both Mozart's teacher and, in the last years of his life, his pupil and disciple. It is significant that most of his best work was produced after Mozart's death.

Haydn is called the father of the modern symphony, as well as of modern chamber music, and sonata form. Although owing much to his predecessors there is no doubt that he had a great influence on the course music was to take. Although a lot of his enormous output was lost in a fire, 125 symphonies, 77 string quartets, 4 oratorios, and masses of sonatas, trios and smaller pieces remain, as well as the Creation and The Seasons.

Haydn's orchestra consisted of strings, two flutes, two obi, two fagotti, two horns, two trumpets, and tympani. This still remains the foundation of our modern orchestra. He said good-bye to the "band" oboes and bassoons of Handel's day.

Mozart

Wolfgang Amadens Mozart, 1756-1791, was certainly the greatest child prodigy genius ever known. The son of a good musician, he had many compositions to his credit at six years of age, as well as a tour of principal European cities. A tour of Italy in 1769 developed his wonderful gift of melody, and his numerous works for all sorts of instruments won admiration. Going into the service of the new Archbishop of Salzberg in 1772, this prince was to be the bane of Mozart's life with his extreme conservatism, and opposition to all reform in musical composition.

"Idomenev," his first "reform" opera. was produced in 1781. Though in advance of Gluck, it was a long way behind what he himself wrote later. But it incurred the Archbishop's extreme hostility, and Mozart was literally kicked out of the service. Thereafter his life was one long struggle against poverty which was increased by his marriage to a charming woman who, however, was a very bad manager.

"Marriage of Figaro"

The great "Marriage of Figaro" appeared in '86, Don Giovanni in '87, after which the Emperor gave him a small salary to prevent him going to England. In '88 he wrote his three greatest symphonies within the space of six weeks. In '90 came "Cossi fan Tutte," "La Clemenza di Tito" in '91, and the greatest of all, "The Magic Flute" in '92. Beethoven considered this the greatest of all operas, because it contained every known species of music from the lied to the chorale and fugue. Also the artistic and dramatic flow of the action.

The Requiem

Mozart was commissioned to write the Requiem a few weeks before his death. It was left unfinished. In addition to these masterpieces he wrote hundreds of the most beautiful works—concertos for piano and violin; sonatas, trios, quartets, etc. To the everlasting disgrace of Vienna he was buried in a pauper's grave when he died at the tragically early age of 35.

There is little doubt that Mozart, had he been granted a normal span of life, would have been by far the greatest of all musicians, presuming that what he did actually accomplish was a specimen of what he would have done. Even as it is, his greatest works have never been surpassed, and "music's miracle man" might be a fitting title for this truly great genius.

For the Beginner

Voltage Measurements

An Explanation Regarding the Choice of a Voltmeter for Eliminator Output Measurements

IT has been stated many times in these pages that it is essential to use the right type of meter when measuring such points as detector anode voltage, S.G. voltage, or the output of a mains unit or eliminator. It still appears, however, that the reason why a special type of meter must be used is not clear, and that to many beginners the difference between a low-resistance voltmeter and one of high resistance is a point of little consequence.

It should be clearly understood that a voltmeter is a milliammeter having a resistance in series with one of its leads, this resistance being usually enclosed in the meter casing. The function of the resistance is to cut down the current to the value permissible through the ammeter. When a voltage is applied across the output terminals of the ammeter-resistance combination (i.e. the voltmeter terminals), a current will flow through the meter, causing a deflection of the needle. To avoid loss of time in calculation, the ammeter scale is marked in volts, so that while the current is still the actuating force in the meter, the deflection is now registered in volts.

The value of the series resistance is governed by the current range of the meter, and the maximum voltage it is desired to measure. For reasons that will be explained later, this resistance must have a high value if accurate voltage measurements are to be obtained.

A milliammeter having a full-scale deflection of 2 mA. or less, may be converted into a reliable voltmeter; or in other words, a voltmeter having a resistance of 500 ohms per volt, or more, will give sufficiently accurate voltage measurements for all ordinary wireless purposes.

Reason for Inaccuracy

A low-resistance meter is unsuitable for measuring eliminator voltages, because eliminators have a high internal resistance, due to the incorporation of smoothing chokes and dropping resistances. A low-resistance meter will naturally drain more current than a high-resistance instrument—Ohm's Law states that current is equal to voltage divided by resistance. This high current drain reacts on the source of voltage to be measured, thus causing an inaccurate indication on the meter.

Effect on D.C. Mains Unit

Let us take, for example, a simple 250 volts D.C. mains unit as shown in Fig. 1, having an output of 125 volts at 25 mA., or, in other words, having a voltage of 125 across points A and B when the current registered on milliammeter C is 25 mA.

As will be seen from the sketch, the total internal resistance of the eliminator is 5,000 ohms (500 ohms choke, plus 4,500 ohms dropping resistance). In order to obtain the specified output of 125 volts, the current consumption must be 1/40 amp. (25 mA.), and therefore the total circuit resistance must be 250 volts divided by 1/40 amp., which amounts to 10,000 ohms. We already have 5,000 ohms in the eliminator, therefore the external load (receiver to which eliminator is connected) must be 5,000 ohms. If a voltmeter having a resistance of 5,000 ohms is now connected across A and B, with the receiver switched on, the total load will be reduced to 2,500 ohms, because the meter resistance of 5,000 ohms will be in parallel with receiver resistance of 5,000 ohms. Therefore, the total resistance across the 250-volt mains will be 4,500 ohms (dropping resistance) plus 500 ohms (choke), plus 2,500 ohms (meter and receiver). This amounts to 7,500 ohms, and consequently the total current consumption will be increased to 1/30 amp. (250 volts divided by 7,500 ohms). The voltage drop inside the eliminator will then be its internal resistance of 5,000 ohms multiplied by 1/30 amp., which amounts to $166\frac{2}{3}$ volts. Therefore, when the meter is connected across A and B, the actual voltage across these points will only be $83\frac{1}{3}$ volts (250 minus $166\frac{2}{3}$), but as soon as the meter is removed, the voltage will rise to 125 volts.

If, however, the meter resistance were 100,000 ohms instead of 5,000 ohms, it will be evident from the above calculation that its effect on the voltage output would be negligible, and, therefore, the reading obtained would be sufficiently accurate.

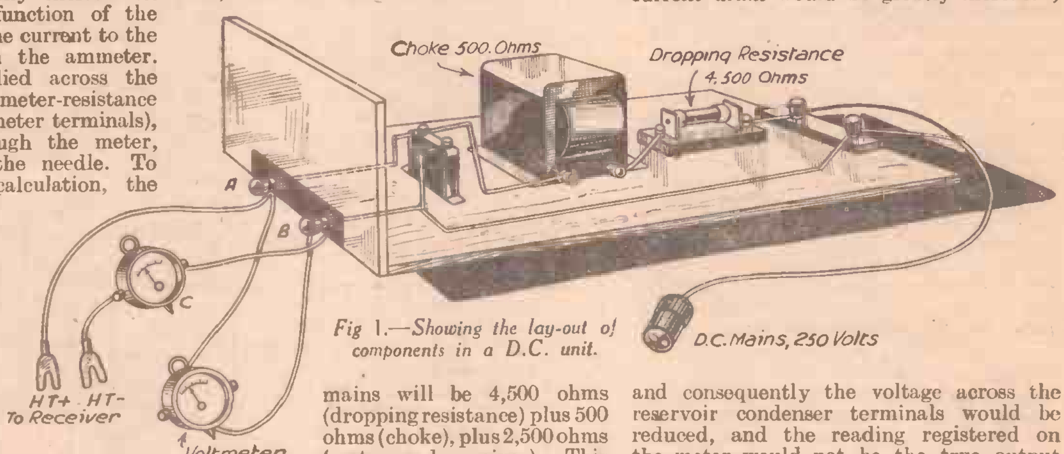


Fig 1.—Showing the lay-out of components in a D.C. unit.

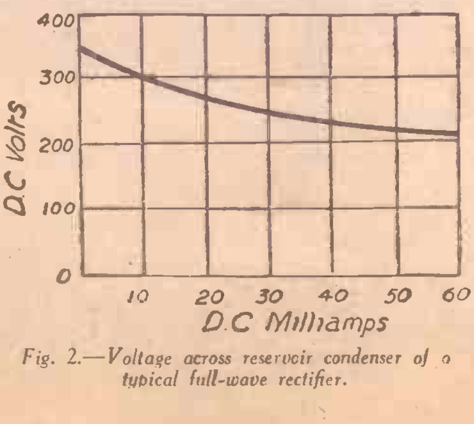


Fig. 2.—Voltage across reservoir condenser of a typical full-wave rectifier.

Effect on A.C. Mains Unit

The foregoing limitation applies when dealing with A.C. units also, but we have a further limiting factor to contend with—namely, the effect of the reservoir condenser. This condenser is connected across the rectifier output circuit, and the voltage across its terminals varies with the output-circuit current drain. Fig. 2 shows the drop in D.C. voltage across the reservoir condenser as the current drain imposed by the receiver is increased. It is, therefore, obvious that if a low-resistance meter were connected across the output terminals, the current drain would be greatly increased, and consequently the voltage across the reservoir condenser terminals would be reduced, and the reading registered on the meter would not be the true output voltage.

The foregoing calculations should also make it quite clear that the specified output voltages of an eliminator are only obtained when the eliminator is on load—that is, when the receiver is switched on.

Battery Receivers

In the case of the battery-operated receiver, a low-resistance meter will give sufficiently accurate measurement of the voltage of the H.T., L.T., and G.B. batteries, because the internal resistance of these is very low. If, however, it is desired to measure the H.T. voltage applied to the plate of a valve having a resistance in its anode circuit, for example, a detector valve preceding a parallel-fed transformer or R.C.C. unit, the low-resistance instrument again becomes unsuitable for the same reason as that given above in the case of the D.C. mains unit.

An Optical Tuning Indicator

A Description of a Phase Resonance System, Incorporating a Cathode Ray Tube

THE arrangement to be described in the following notes operates as a "phase" resonance indicator, and has the advantage over the "amplitude" resonance indicator that whereas the amplitude curve exhibits only a flat maximum at resonance point, the phase curve shows strong variation in this region.

Consider a receiving circuit including a two-circuit band filter: at exact resonance, there is a phase difference of 90 degrees between the voltages across these two circuits, so that if these voltages are respectively fed to the two mutually perpendicular pairs of plates of a cathode-ray tube we shall obtain on the luminescent screen a diagram in the form of a circle, where the two voltages are equal in magnitude, or a right ellipse, where these voltages are unequal. If now detuning occurs, the figure on the screen will take the form of a more or less inclined ellipse, and the direction of its inclination will indicate the direction of the detuning. It will, however, be appreciated that the size of such figures on the screen depends on the high-frequency amplitude of the received signal, and for a very strongly received signal the figures might be so large that a luminescent screen of a size large enough to accommodate them would be too unwieldy for incorporation in a standard type of broadcast receiver. Moreover, when such signals are modulated, the outlines fluctuate in conformity with the envelope of the transmitted amplitude, giving rise to a trace on the screen which is broad, indistinct, very badly illuminated, and generally incapable of permitting an exact reading.

This difficulty can, however, be overcome if an arrangement is found whereby the velocity of the electron ray is caused to vary in automatic dependence on the high-frequency amplitude in such a manner that the magnitude of the ray deflection, and hence the size of the figures on the screen is approximately independent of the high-frequency amplitude. One possibility would be to use the D.C. voltage generated by detecting and filtering out the superimposed modulation low frequency for accelerating the ray; this gives a fairly good degree of independence of the incoming high-frequency field strength, the size of the screen figures being the same for strong and weak stations, the former, however, giving a brighter image.

Application to Straight Three

A better arrangement is that shown in the accompanying diagram, applied to a straight three-circuit receiver with triode detector and single stage of low-frequency amplification.

Between the high-frequency amplifier valve H and the triode U is a two-circuit tunable band-filter K_1K_2. The high frequency voltages appearing across the two circuits are fed via block condensers C1 and C_2 to the mutually perpendicular deflecting plates P_1 and P_2 of the cathode-ray tube E, which are not earthed as regards high frequency. The corresponding partner plates P_1' and P_2' are in direct conductive connection with the perforated anode A and connected to a suitably chosen tapping on the anode load resistance R of the triode, as is also the (conductive) luminescent screen L.

Since the high frequency is previously filtered out through the filter chain F, the voltage on the electrodes A, P_1', P_2' and L with respect to the earthed cathode K fluctuates according to the amplitude of the incoming high frequency: and in fact the voltage is the more positive the greater the received amplitude. The plates P_1 and P_2 are connected to the same potential via decoupling resistances R_1R_2, so that deflection is effected only through the high-frequency voltages across the two circuits.

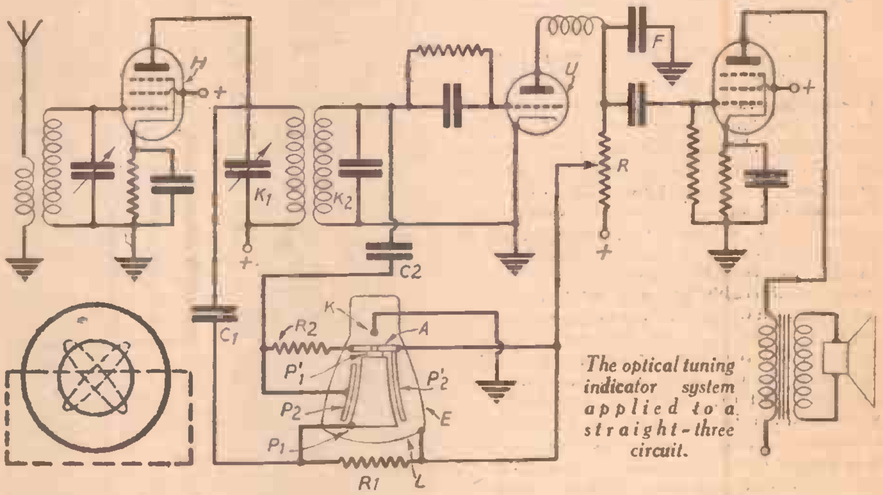
Indicating Screen Figures

At exact resonance a circle appears on the luminescent screen L (if the voltages in the two circuits are approximately equal in magnitude); on detuning there appears a more or less inclined elongated ellipse, the inclination being to left or right, depending on the sense of the detuning. The upper or lower half of the image, or even a greater fraction, may, if desired, be covered over as indicated in broken line (or may be prevented from being effective), so that it is possible to determine directly the sense of the detuning from the lateral shift of the visible parts of the ellipse.

In order to increase the deflection sensitivity, the anode A may in some circumstances be given a lower, possibly fixed potential, while the luminescent screen may receive a potential having a higher mean value and fluctuating with the envelope of the high-frequency oscillation. Further, the accelerating voltage may be taken from the sliding screen-grid voltage of a regulated high-frequency amplifier valve (or I.F. amplifier valve), in which case a suitable fraction of the low-frequency oscillation from the low-frequency amplifier must be added, of such phase that the influence of the high-frequency deflection voltage, which varies with the modulation, is compensated.

Amplitude Differences

If the receiver has no, or only weak, A.V.C., it may, of course, happen that the amplitude differences between the various station signals are still so great as to make complete compensation of the amplitude difference by corresponding variation of electron-ray velocity impossible over the whole range. In that case, on passing from one station to another station which produces a very different signal field strength, the size of the figures will change. Since for the indication of the phase difference (and thus the accuracy of tuning) the outer parts, not the central parts, of the figures are operative, the deflection device may be so designed that with an arrangement generally as illustrated, the upper parts of the circles and ellipses on the luminescent screen remain in the same horizontal line, while the centre of the circle or ellipse shifts up or down slightly according to the signal amplitude. This can be achieved by applying between the one pair of deflecting plates—say between P_1 and P_1'—not only the high-frequency voltage, but in addition the D.C. voltage arising from detected high frequency and pulsating with the low frequency, so that the total deflecting voltage always oscillates



The optical tuning indicator system applied to a straight-three circuit.

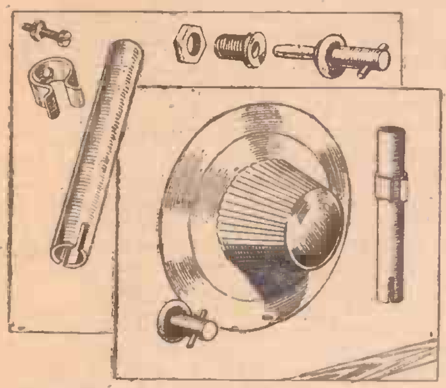
between zero and a fluctuating maximum value in the high-frequency rhythm. The deflection then occurs in the vertical co-ordinate, only upwards or downwards. This may very conveniently be done, e.g., by connecting the plate P_1 through the resistance R_1 to a fixed positive potential as regards D.C. The corresponding effect may be achieved if, e.g., P_2' is connected to a fixed potential as regards D.C. In this case P_2 may also be directly connected to the grid of the triode U. The right-hand ends of the figures on the luminescent screen L will then always lie on one and the same vertical line. It is, of course, desirable in that case to twist the indicator tube through 90° in space, so as to obtain a horizontal indication.

On the other hand, in those cases where the automatic volume control of the receiver is so good that the high-frequency amplitudes across the band filter circuits K_1K_2 are of equal magnitude for all stations, and only fluctuate with modulation, it is sufficient to modulate the accelerating voltage for the electron-ray only by the low-frequency received oscillation so as to maintain a sharp trace on the screen.

Practical Hints

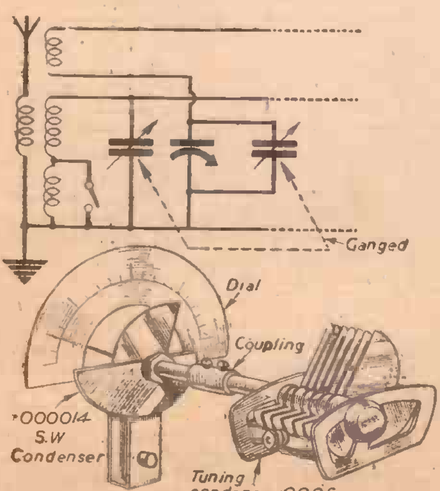
Slow-motion Remote Control Device

IN short-wave receivers particularly, a good slow-motion control, with anti-hand-capacity control, is essential. The arrangements illustrated may be made up to operate on the standard 3in. ebonite dials.



Details of a novel slow-motion control device.

A large socket, such as the Clix No. 14, is mounted on the panel close against one part of the dial. A plug to fit the socket is then provided with a rubber ring such as may be obtained for one penny for umbrellas. Through the upper part of the plug a piece of stiff wire is passed, projecting about ¼in. on either side. A piece of ebonite tubing having an internal diameter to form a fairly comfortable fit over the plug end is next obtained, and a saw-cut made for a depth of about ⅜in. at one end to accommodate the cross wire. A small spring tool-clip from the popular stores is next screwed on the panel or inside the cabinet lid to accommodate the ebonite handle when not required. In use, the handle is removed and placed over the cross wire and rotated, during which it is pressed slightly so that the rubber ring presses on the edge of the dial. —D. LANIE (Hendon).



Circuit diagram and pictorial view of a simple unit for preventing oscillation.

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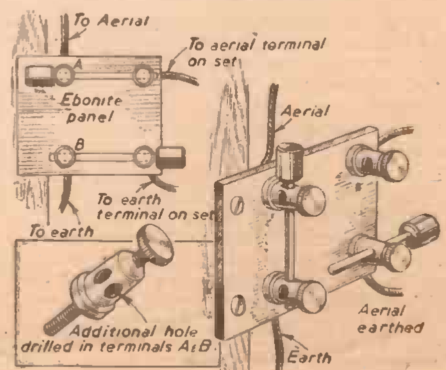
Preventing Oscillation

WHILE searching for stations on a set it is often found that, as the capacity of the tuning condenser is increased, the set tends to oscillate. The reaction condenser (kept at nearly oscillation point for volume) has thus to be continually adjusted.

To obviate this trouble, I devised the following scheme. A small condenser (.000014 S.W.) is ganged to the tuning condenser in the manner shown, so that as the capacity of the tuning condenser is increased, that of the small condenser is decreased. The small condenser is connected in parallel with the normal reaction condenser, and saves adjusting the reaction while exploring to prevent oscillation.—B. W. COOPER (Wellingboro').

A Simple Aerial-earthing Switch

HERE is a simple but effective aerial-earthing device which entirely isolates the receiver when placed in the "earth" position. A piece of 3/16in. ebonite about 3in. by 2½in. is drilled to take four large telephone type terminals, which are arranged as shown in Fig. 1. In each of the left-hand pair of terminals an additional hole is drilled at right angles to the existing one, as indicated in Fig. 2. Two pieces of ⅛in. brass rod, 2½in. long, are fitted with a small ebonite knob on the end of each. Two holes are drilled near one edge of the ebonite for taking screws for fixing the switch to the edge of the window frame. The leads from the aerial, earth, and receiver can be clamped under the back nuts of their respective terminals. When the receiver is to be used, the brass switch rods are both pushed horizontally through the terminals as in Fig. 1, and the terminal screws tightened up. For earthing the aerial, the bottom switch rod is simply pulled out to the right, clear of the left-hand terminal, and the top rod withdrawn, and passed vertically through both left-hand terminals, as in Fig. 3, thus completely isolating the receiver. — W. DAVEY (Wembley).



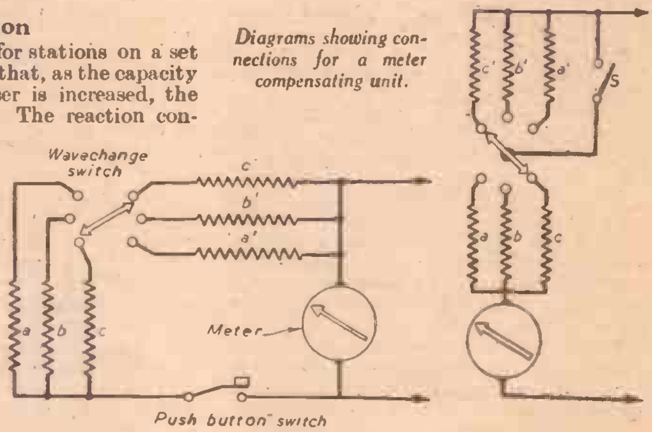
Details of a simple aerial and earth switching arrangement.

A Meter Compensating Unit

I WAS recently testing the voltage across the screen of a valve when I noticed a considerable diversity in the readings obtained on different scales. I sought for a mathematical connection between the true voltage and the readings taken, and from the formula I obtained I devised the following unit which I added to the meter proper.

The resistances a, b, c are respectively equal to the resistances a^1, b^1, c^1, the range-charging resistances, together with the resistance of the meter. If the voltage given by the meter (e_1) with S open, is the true voltage, the depression of S will make no difference to the needle position.

Diagrams showing connections for a meter compensating unit.



But if a new voltage (e_2) is obtained, the true voltage (e) is given by the equation

$$e = \frac{e_1 \, e_2}{2e_2 - e_1}$$

Alternatively, the resistances a, etc., can be arranged in parallel with S, and in series with the meter, whereupon

$$\text{True voltage} = \frac{\text{Product of Readings}}{\text{Difference of Readings}}$$

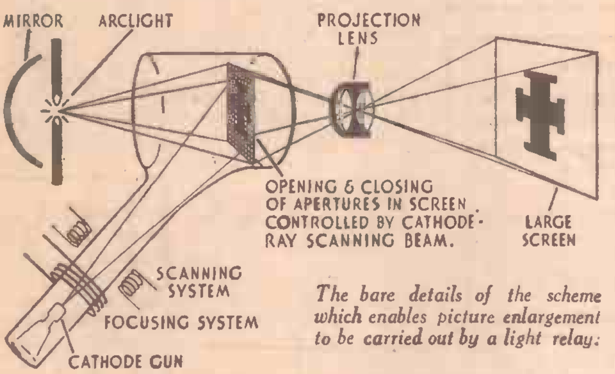
—P. A. STURROCK (Grays, Essex).

ELECTRONIC BREVITIES

Notes on Cathode-ray Tube Developments, and Photo-electric Cells

Removing a Danger

CATHODE-RAY tubes for certain purposes have to be operated at extremely high voltages, a figure of 50,000 volts for the final anode not being uncommon. If by accident a short-circuit should occur in the main E.H.T. supply, or should there be a flash-over, then the capacity which exists between the electron beam, and deflecting coils and the anode, is capable of causing the coils to assume for a short period of time a potential of 50,000 volts which is negative to earth. This is, therefore, a source of danger to any engineers who may be working with the tube, and in addition, damage may be caused to equipment or components associated with this part of the apparatus. Various schemes have been devised to overcome or reduce this risk, and in one of the most up-to-date, inductive windings are connected in series between the main H.T. terminals, and those sections of the equipment associated with it. A flash-over or short-circuit will then be instrumental in producing a very large voltage drop across these windings, and this will have the effect of reducing very materially the momentary potential which is assumed by the deflecting equipment.



The bare details of the scheme which enables picture enlargement to be carried out by a light relay.

A Triple Use

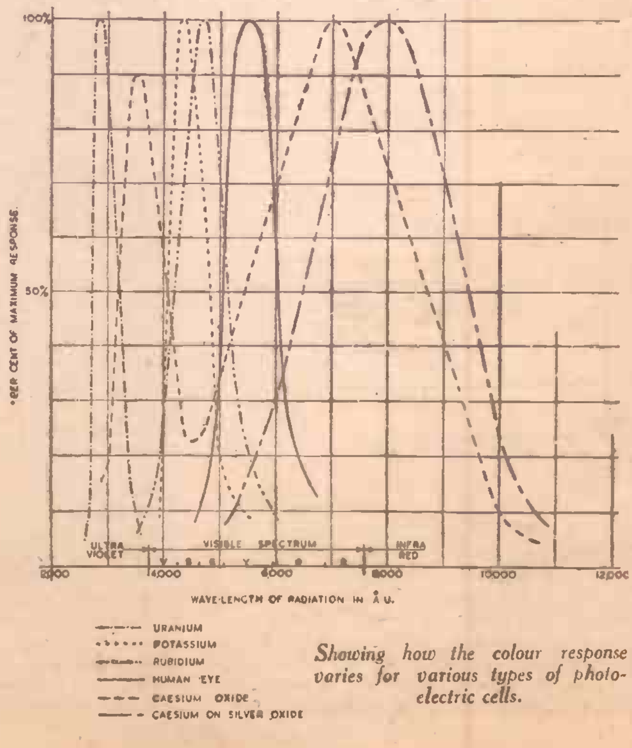
THE electronic multiplier continues to be developed for a variety of specific purposes, but in America details have been made available of this device which in the form proposed is said to be generally suitable as a generator of oscillations, amplifier, or detector. The most important feature seems to be dependent upon the shaping and disposition of the secondary emitting electrodes, and for this multiplier they are constructed in the form of two or more conical rings. The walls of these rings are made to diverge in the direction of the final collecting electrode which is generally the high-potentialled anode, and to converge towards the cathode with which is associated a grid, also conical shaped. This grid has an open mesh, and is raised to a high positive potential with reference to the cathode. When the operating potentials have been applied and regulated to their correct values, the primary electrons released from the cathode surface are drawn outwards in a radial direction, and so strike against the inner wall of the initial conical ring secondary-emitting electrode. The primary electrons with the secondaries released by the impact are now attracted by the high voltage of the open mesh grid, and pass through the interstices at great speed to impact on the opposite inner wall of the second ring electrode. A further electron multiplication takes place, and this process continues until finally the amplified electron stream is drawn through an aperture at the top of the conical assembly to be collected by the final anode. Although the process of working is described, no details appear to be available to show exactly how the device can function in any one of the three purposes mentioned at the beginning of the paragraph.

Enlarging by Projection

A CONCENTRATED effort seems to be taking place abroad in order to perfect schemes, which can be regarded as quite satisfactory, for enlarging television pictures to a size comparable with that normally seen in an average up-to-date cinema. There is little doubt that this work will have many repercussions on any subsequent developments which take place in this country in the eagerly awaited post-war period. A large percentage of the present schemes incline towards the principle of replacing the fluorescent screen of the cathode-ray tube with a special form of surface which reacts to the modulated electron beam in such a way that each elemental area changes its degree of transparency or opacity in direct proportionality. The idea will be made clear by a reference to the accompanying simple diagram where the light from an arc lamp is concentrated by means of a back reflector on to this special surface, while a projection lens directs the emerging beam towards a remote screen so that the final picture is enlarged by many diameters. In one of the most up-to-date of these methods the surface which acts as a light controlled relay—shown in the diagram for simplicity as a series of apertures to correspond to the elemental areas—is built up by depositing a very large number of tiny light particles over a rippled sheet of glass. This sheet is positioned close to the screen of the electronic relay so that as a direct result of the electrostatic of the electron beam impact the tiny particles orientate edgewise to the arc lamp beam instead of remaining broadside. The actual degree of rotation will depend on the strength of the electrostatic influence which in turn has a direct relationship to the television picture modulation. Another advantage of this relay scheme is that there is a storage effect, for each element of picture remains bright or dark as the case may be for the whole period of a picture scan, and in consequence the overall brightness of the final enlarged picture is much greater than one where at any one instant only a single elemental area is operative.

Colour Response

ALTHOUGH photo-electric cells for different purposes have found their way into every form of modern industry, there is one particular feature that still needs careful observation, namely, the colour response. The perfect photo-electric cell for general purposes would be one which had a colour response exactly simulating the human eye, but so far the efforts of the inventors have failed to produce a cathode material which falls within this category. Some cells are colour sensitive at the red and infra-red end of the spectrum, while others work best in ultra-violet light. As an indication of the extent of these variations reference can be made to the accompanying graphs where the percentage of maximum response of one or two representative photo-electric materials used for cells has been plotted against the wavelength of radiation in Angström units (A.U.). At 50 per cent. it will be seen that the eye covers the approximate range of 5,000 to 6,000. The same diagram shows how cæsium oxide and cæsium on silver oxide have really good sensitivity outside the visible spectrum at the infra-red end, while potassium has its best performance in the ultra-violet region.



Showing how the colour response varies for various types of photo-electric cells.

CHOOSING A CHOKE—2

In This Article L.F. Chokes are Dealt With

THERE are at least five uses to which low-frequency chokes may be put in radio receiving apparatus. The most familiar, and that for which there is no substitute whatsoever, is in the smoothing circuit of a high-tension supply unit—" battery eliminator " or " power pack," as it is variously termed. In a power unit operating on alternating current mains, the rectifier, whether of the valve or metal type, gives an output which is certainly a direct current, so far as being uni-directional is concerned, but which is, in its present form, totally unfit for use as the high-tension supply because it is fluctuating in value, carrying a ripple corresponding to twice the frequency of the A.C. supply, and also ripples of higher frequency.

Similarly, a supply drawn from direct current mains is far from steady as regards voltage, for it suffers from ripple also, and in many districts where direct-current mains are available, it is more difficult to eliminate the ripple than to smooth the output of the average A.C. rectifier.

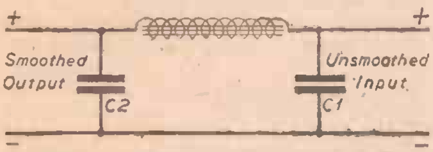


Fig. 1.—Smoothing circuit as used in mains units and receivers.

Smoothing Circuits

The method of removing ripple is the same in either case—the use of a smoothing circuit as indicated in Fig. 1. Here the two terminals marked " input " are those connected either to the output of the rectifier, or the direct current mains (when the condenser C1 is really unnecessary), so that a " ripply " voltage exists across these two points, and any current flowing in a circuit attached thereto will be subject to similar fluctuations. But a low-frequency choke is connected in series with the circuit, and by virtue of the impedance it offers to current fluctuations shunts a very large proportion of the ripple current into the alternative path provided by the large capacity condenser C_1. A further condenser C_2 is also shunted across the supply at the other end of the choke and has the effect of still further smoothing.

A single smoothing choke of suitable design, with two reservoir condensers—usually of 4 mfd. capacity—is in most cases sufficient for smoothing the output from a full-wave rectifier valve operated on normal commercial A.C. systems, and also for smoothing a supply taken from some D.C. mains. In many instances, however, it is found necessary to add another choke and condenser to obtain satisfactory smoothing on D.C. mains.

The Output Stage

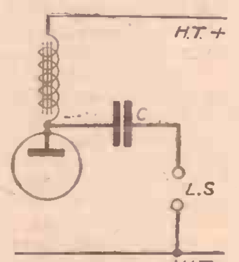
The next application of low-frequency chokes is in the output stage of a receiver. The anode current of the output valve consists of a steady direct-current component and also an alternating current component corresponding to the audio-frequency power which will ultimately operate the loudspeaker. It is, of course, possible to pass the whole anode current through the speaker winding, and in many cases the loudspeaker will operate quite satisfactorily, provided its impedance is correctly matched to that of the output valve. But then the direct current portion of the anode current will pass through the winding as well as the alternating current component, and will have the effect of heating it up. This may not be of importance in the case of a small output valve, but the mean anode current of many large output valves is fairly heavy—a matter of 30 milliamperes or more, and may be greater than the speech coil can carry continuously without overheating or even the risk of burning out.

One way of avoiding this is to employ a choke-capacity output filter, as shown in Fig. 2. A choke having a suitable inductance value is inserted in the anode circuit of the output valve between the anode and H.T. positive terminal. The choke has a comparatively low resistance to the direct current portion of the anode current, but the audio frequency portion is choked back and takes the easier path through the condenser C to the loudspeaker, and thence to the H.T. – terminal. An additional advantage of this system is that, as the speaker winding is entirely isolated by the condenser C from the high-tension voltage, there is no risk of shock or disastrous shorts if the loudspeaker or extension leads are accidentally earthed.

Choke-capacity L.F. Coupling

A similar application for a low-frequency choke is as a coupling between two audio-frequency valves. The connections are shown in Fig. 3, and are identical with the somewhat better known resistance-capacity coupling. It has an advantage over R.C.C., however, in that as the choke is of comparatively low resistance, the drop in anode voltage in the coupling device is comparatively small.

Fig. 2.—Smoothing or L.F. choke in an output filter circuit.



It is, perhaps, not so well known as it should be that a low-frequency choke can be employed in place of a decoupling resistance in situations where it is desired to keep the voltage drop in the decoupling arrangements as low as possible. The action of a decoupling choke is exactly the same as that of the smoothing choke in a high-tension supply unit and it can, in effect, be considered as an extension of the smoothing system. Another use for a choke is in place of a grid-leak in resistance capacity couplings where, for any reason, it is desired to keep the resistance of the grid circuit low.

H.L. and L.F. Choke Differences

The design of low-frequency chokes differs from that of radio-frequency chokes in several particulars. In the first place, in order to achieve the necessary high impedance at the comparatively low (audio) frequencies, a much higher inductance is necessary. Inductances of 15 to 30 henries are usually specified for output chokes, and somewhat larger values, up to 50 henries, for smoothing. In order to achieve the necessary high inductance, low-frequency chokes are wound on iron cores built up from a number of laminated sheets, similar to those forming the cores of low-frequency transformers.

Such a construction is not applicable to high-frequency chokes because at the enormous radio frequencies the loss due to eddy currents induced in iron cores and other magnetic losses would be very serious.

Another point of difference is that low-frequency chokes usually have to carry much heavier currents than radio-frequency chokes, and are therefore wound with wire of much heavier gauge. To help readers, practical values are reproduced on page 300.

Selection

We must now consider what points affect the selection of a low-frequency choke. Obviously, the first consideration must be to see that the choke has the correct inductance—the figure specified by the designer of the set. Next, it is important to ascertain that the rated inductance is obtained when the choke is carrying the full load current of the circuit. This is, of course, a matter of design. The inductance of the choke depends upon the number of turns, the size of the coil, the size of the core, and the current carried. If the core is not of sufficient section, the iron may become magnetically saturated at, or even before, full load. If the steady, direct current component is sufficient to saturate the core, the alternating current component will not be able to produce the alterations in magnetic strength required, and the effective inductance will drop. The correct specification for a low-frequency choke, therefore, is that it shall be of a given inductance at a given current. All good makes of choke are rated in this way by the manufacturers.

The resistance of the choke is the next point to receive attention, especially in the case of smoothing chokes. If such a choke has a somewhat high resistance, a fairly big voltage drop will develop across it, and

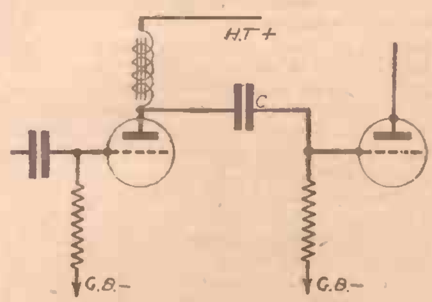


Fig. 3.—L.F. choke used for L.F. coupling purposes.

this voltage drop will be high when the current passing is high, and less when the current passing is reduced.

(Continued on next page).

CHOOSING A CHOKE

(Continued from previous page)

Three effects will follow: first, the drop in voltage due to the choke's resistance will reduce the anode voltage available for the various valves; second, the voltage regulation of the supply unit will be poor; and third, the receiver will be more prone to low-frequency oscillation, hum, and motor-boating because the resistance of the smoothing choke will be common to the anode circuits of all the valves.

Matching

If the choke is intended for use in a choke-capacity output filter, it may be necessary to obtain a tapped choke for impedance matching. Every listener knows that the impedance of the load in the anode circuit of an output valve must bear a certain relation to the valve impedance, and the best value of load impedance is usually quoted by valve manufacturers for each type of output valve. If the impedance of your loudspeaker is not the correct value to form the optimum load for your output valve, you must adjust matters by employing either an output transformer of appropriate ratio, or a tapped choke. A tapped choke may be considered as a kind of transformer (auto-transformer is the technical name), in which the whole or a part of the choke winding acts as the transformer primary, while a part of the whole of the winding functions as the secondary. Tapped chokes giving a variety of different ratios can be obtained, as well as centre-tapped chokes for push-pull, quiescent push-pull, and "Class B" circuits.

Concerning the mechanical design of low-frequency chokes there is really not much to be said. The purchaser will naturally see that the general finish is good, and will attend to such matters as convenient and accessible fixing lugs or feet, and solid terminals or soldering tags. Insulation is an important matter, particularly in smoothing and output chokes, and must be designed to withstand the full voltage to which the component is likely to be subjected.

It is sometimes necessary, especially in the case of chokes which are to be incorporated in the receiver proper, to shield the component magnetically, in order to prevent stray magnetic fields from the choke inducing hum in other parts of the circuit. Shrouded chokes are encased in a metal case, and this case should be connected to earth by the terminal provided. Shrouding is not so important in smoothing chokes embodied in supply units installed some little distance from the receiver proper.

Purpose	*Inductances*	*D.C. Res.*	*Current*
L.F. Coupling ..	15/20 henries	500/800	15/30 mA.
Power-grid Coupling ..	100/300 ,,	1,000/2,000	5/10 mA.
General Purpose ..	20/30 ,,	300/500	30/60 mA.
Output Filter ..	20/60 ,,	200/500	20/60 mA.
Pentode Output ..	30/60 ,,	500/1,000	20/60 mA.
Mains Smoothing ..	30/60 ,,	200/500	20/80 mA.

Loose laminations often produce a very annoying form of hum—or even buzzing—due to magnetic stresses, and we have known cases when this hum was so bad as to be audible as a most unpleasant background to even fairly big volume production, and was often mistaken for actual circuit hum.

B.L.D.L.C. The British Long-Distance Listeners' Club

THE weather conditions recently have apparently increased the interest in long-distance reception, and we have received some very comprehensive logs from various parts of the country. It is interesting to note the variations in signal strength, and countries received in different parts of the country when similar types of apparatus are used, and when several reports are received from one locality: there is also a very good opportunity of seeing the difference in receiver efficiency. For instance, it has been found that in one locality three listeners may receive a certain American station during a certain period at R9, whereas one listener in the same locality will only get the station at R3, and yet with a similar type of receiver. From this it is fairly obvious to assume that this single listener is either using a very inefficient circuit, or that his aerial is not well arranged. Obviously, however, there is also the risk that his results may be due to peculiar local conditions, and from the remainder of his log it is possible to see whether or not this is so. It is often not worth while publishing logs because of the risk of misleading listeners in other parts of the country who may consider that conditions are suitable for the reception of certain countries, simply because those places are being well received in another part of the country.

However, for those who require some guide we would mention that Member 6364 has written us again stating that he has had to move from his normal residence, and is now in Buckinghamshire. He was able to take his 0-v-2 with him, and from May 1st to the 26th his log includes the following:

Fone: K4ESE, K6QHU, KA1BH, PY2AV, W1(8), W2(11), W3(8), W4(3), W5EUL, W6WD, W8XCB, W9KQG.

CW.: CE3AJ, CE6AF, CX1LG, HH1KC, HJ1K, J2CZ, K4FCV, K6KQG, PAH, KQB, KA1(7), LU6DJK, OQ5(4), PK1PM, PY1(4), PY2(3), PY4(2), PY4BX, PY6AC, PY7(2), PY8AN, TA1AA, U9MI, VQ2AM, W1(56), W2(28), W3(14), W4(5), W5GRU, W6(7), W7(2), W8(23), W9(15), XE3AG, XU5WT, XU8MY.

Spring Cleaning

WE recently published an article on overhauling a receiver, and it may have appeared to some members that such an overhaul was not needed in radio apparatus. Some idea that this impression is erroneous may be gained from the fact that one member wrote and said that he had cleaned up his receiver on the lines given, and that the better results obtained were well worth the extra trouble. Incidentally, we recently heard of a case where a reader had used petrol for cleaning certain parts, knowing that petrol was a dirt solvent, but unfortunately he had not allowed sufficient time to elapse for the petrol fumes to evaporate, and he switched on with disastrous results, due to a faulty on-off switch. This arced, and the resultant slight explosion and fire, although very localised, and quite small, damaged several components, and led to unnecessary expense for replacements. There are, of course, specially-prepared chemical cleaners for switches, etc., and these should be used if the parts are sufficiently dirty to warrant their use. Normally, of course, an ordinary rag and a little elbow grease should be sufficient.

Contacts Wanted

PLYMOUTH: Member 5897, 90, Albert Road, Devonport.

Newcastle-on-Tyne: Member 6609, 43, Hyde Terrace, Gosforth, Newcastle-on-Tyne 3, Northumberland. (Incidentally, we recommend our "Wireless Transmission for Amateurs" for the purpose mentioned by you.)

Wakefield: Member 6573, 131, Manygates Larne, Sandal, Wakefield. This member is anxious to contact anybody who listens to 10-metre "hams," and also anybody who has heard OK3ZN on 20 metres, during April.

Harrow Weald: Member 6295, "Leswyn," 643, Kenton Lane, Harrow Weald, Middlesex.

Dunfermline: Member 6583, 12, Park Place, Dunfermline.

Walthamstow: Member 6736, 15, Borwick Avenue, Walthamstow, E.17.

Change of Wavelength

MEMBERS who are interested in American reception should note that WPIT, Pittsburgh, Pennsylvania, has changed the wavelength on which it carries the English Hours, from 19.72 metres (15,210 kc/s) to 25.27 metres (11,870 kc/s). We are indebted to Member 6402 for this information.

NEW RECORDS

AN interesting album issued by Brunswick this month contains a set of records for tap dancers. These new accompaniment records—the music is in the Russ Morgan manner—have been made so that they can be used for every possible tap routine—*Brunswick* 02914/7. Russ Morgan and his Orchestra play two hits of the moment on *Brunswick* 02959—" Woodpecker " and " In an Old Dutch Garden," whilst Ella Fitzgerald and her Orchestra have made " Baby, What else can I do " and " Lindy Hopper's Delight " on *Brunswick* 02951.

Tunes from his latest film " The Road to Singapore " figure prominently in Bing Crosby's latest recordings. On *Brunswick* 02973 he sings " I'm too Romantic " and " The Moon and the Willow " and on *Brunswick* 02974 " Sweet Potato Piper," all of which are from the film. The last tune is coupled with " Between 18th and 19th on Chestnut Street," which he sings with Connie Boswell.

A "Switch-in" H.F. Unit

Details of a Simple Fixed-tuned H.F. Amplifier which can be Brought Into Action Quickly when Required.

By FRANK PRESTON

NOW that the majority of listeners use only the B.B.C. "Home" or "Forces" programme, the simplest type of receiver is generally sufficient to provide good reception. A receiver of the 0-v-2 type, for example, will give very satisfactory results in most parts of the country. This is a particularly important point when a battery set is in use, for battery current can be saved.

As everyone has found out, however, there are times when reception suddenly falls off, the programme becoming very weak or even inaudible until the volume control is turned up. And when that is done background noises are sometimes troublesome or reproduction is too weak for comfortable listening. A high-frequency amplifier provides the best and simplest means of overcoming this difficulty, but since the amplifier is required only on certain occasions—and then it is usually for only a very short time—it is an advantage to be able to switch it out of circuit.

It would be possible to obviate this disadvantage by including another switch in the anode circuit, or by employing a two-point on-off switch, of which one pair of contacts was in the L.T. and the other in the H.T. circuit. But that may not be convenient, and the capacity between the two circuits would not be desirable. It should be pointed out that, in practice, the disadvantage of having the two circuits virtually in parallel is often unimportant. The idea can, therefore, be tried and then employed if found satisfactory. Instead of moving the aerial lead, a change-over switch can be fitted, joining the centre contact to the aerial lead (or to a fixed condenser in series with it), and then taking leads from the two other terminals to the aerial terminal on the set and to the anode terminal of the valve respectively. Care should be taken to avoid possible short-circuits, and the switch should be placed fairly near to both the aerial terminal and the valve-anode terminal.

the receiver is used almost exclusively for the reception of the two B.B.C. programmes it is possible to use a fixed-tuned amplifier, in which the tuning circuit consists only of a medium-wave coil and a preset condenser.

Fig. 1 shows the type of circuit which may be used conveniently. As may be seen, there is a coil with a preset condenser in parallel, and this is connected in the grid circuit of an H.F. pentode. A change-over switch is fitted, by means of which the aerial lead may be connected either to the top end of the pre-tuned circuit or to the aerial terminal of the Det.-L.F. set In addition to this there is a two-pole on-off switch; this is used to break the filament circuit of the H.F. pen. and also to disconnect the anode coupling condenser from the aerial terminal of the receiver when the unit is not required. To bring the unit into action it is necessary to operate the aerial switch so that the aerial is connected to the top of the pre-tuned circuit and also to close the two-pole switch. This completes the filament circuit and also connects the anode circuit to the input tuning circuit of the Det.-L.F. receiver.

By following this arrangement it will be

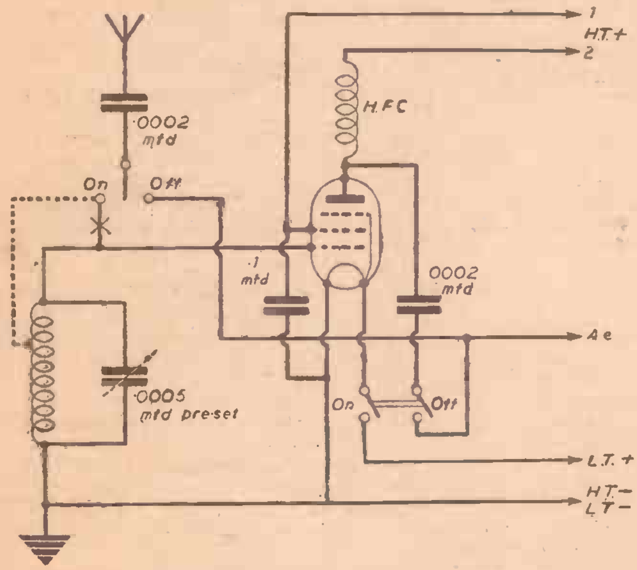


Fig. 1. (Left)—Circuit of a simple pre-tuned H.F. amplifier for use with a Det.-L.F. type of receiver.

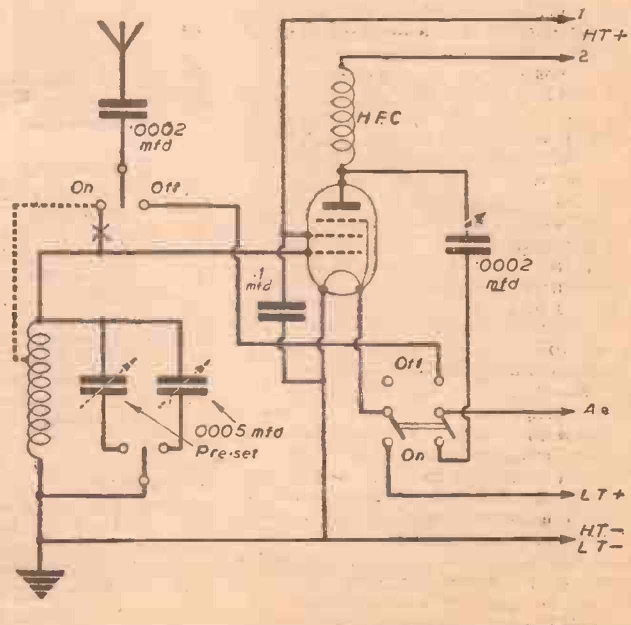


Fig. 2. (Right).—A modified circuit similar in essential principles to that shown in Fig. 1.

Alternative System

There are various methods of arranging the switching in an H.F. receiver, but some of them are not conducive to efficiency. In fact, it is an axiom that switches should be avoided wherever possible in H.F. circuits. One method is to transfer the aerial lead-in from its usual terminal to the anode terminal of the H.F. valve; if battery current is to be saved, however, it is also necessary to break the filament circuit of the H.F. valve. This can be done most easily by fitting a separate on-off switch in one of the filament leads.

This method of cutting out the first valve is not always ideal, for the simple reason that the H.F. choke in the anode circuit of the H.F. valve (in the case of the most widely used tuned-grid circuit) is virtually in parallel with the tuning circuit for the grid of the detector valve. This is because the choke is connected between the anode and the H.T. battery, which is at earth potential in the H.F. sense.

The above remarks apply particularly to a "straight" set already having an H.F. stage. When a detector-L.F. type of receiver is used it will probably be considered worth while to add an H.F. amplifier which can easily be switched into circuit when signal strength is temporarily reduced—this is done by the B.B.C. in the interests of national security, as has been announced on various occasions.

Simple H.F.-Amplifier Unit

Details have often been given in these pages of H.F. amplifier units, but for the purpose under consideration a simpler form of unit is often to be preferred. As

seen that the H.F. choke is isolated from the detector tuning circuit when the amplifier is not in use. Although two separate switches are shown it would be a simple matter to gang them or to use a three-pole change-over switch. This should, for preference, be of the anti-capacity type, since some Q.M.B. switches are not altogether satisfactory for use in tuning and H.F. circuits.

Both Programmes

Only a single preset condenser is shown in Fig. 1, and this would be adjusted to bring the circuit into tune for either of the two B.B.C. transmissions—probably the

"Home" service. An alternative switching system is shown in Fig. 2, and here again two separate switches or a three-point change-over switch could be used for bringing the amplifier into use. In addition there is a single-pole change-over switch to bring either of two preset condensers into circuit. These can be adjusted for the two alternative programmes, but the switch must, of course, be separate from the three-pole unit.

The principle of the main switching does not differ from that shown in Fig. 1, but is to be preferred when a fairly long lead must be used between the aerial lead and a two-pole switch; it may also be found better to screen the aerial lead running between two separate switches.

Practical Details

No matter which of the switching methods is adopted, the H.F. unit can be made in very simple form, using a small baseboard to carry the valveholder, coil and H.F. choke, and a small panel to carry the switches and, if desired, the preset condensers. The whole could well be fitted into a compact box to stand alongside the receiver. Terminals, on a terminal mount, should be used for the aerial and earth leads, but all other connections may conveniently be made with direct flexible leads running to the H.T. battery and the set.

The aerial and earth leads could be transferred from the receiver to the amplifier unit, and the Ae lead would be connected to the aerial terminal on the set. H.T.+1 and 2 should be fitted with wander plugs and connected to 72 and 120-volt points on the H.T. battery, or to other sockets which provide the most suitable voltages. It is most convenient to connect the combined H.T.−L.T. −lead and the L.T.+ lead to the corresponding points on a valveholder in the receiver, but they may be taken directly to the batteries if the amplifier is switched off each time the receiver switch is turned to the off position.

The Coil

No mention has yet been made of the coil, but it may be of any standard type. If, however, a dual-range coil is used, see that the wavechange switch connections are short-circuited. A suitable coil can be made quite conveniently by winding 55 turns of about 26-gauge enamelled wire on a 2½in. diameter former. If a tapping is taken after the 20th turn so much the better, for then the aerial connection may be as shown by broken lines in Figs. 1 and 2; these will replace the leads marked by crosses. The use of a tapping will increase selectivity, although very sharp tuning is not always needed for what is virtually local-station reception. If a ready-made coil is used which has a tapping or a separate aerial winding, this may be used in the same way.

REGENERATION IN TUNED CIRCUITS

A Novel Reaction Scheme for Plug-in or Other Replacement Coils

It is sometimes desirable to sharpen the tuning of an oscillatory circuit, one end of which is earthed, without in any way altering the connections of this circuit or making any extra points of connection to its inductance. There are a number of known ways for doing this, but most of them involve a drawback of one sort or another. For example, an extra coil having a few turns may be wound in coupling relation to the coil of the oscillatory circuit, and utilised as a feed-back coil in different ways. Where it is desired to use plug-in coils, however, there may not be any extra pins provided on the coil support for connection to this extra coil. Also, this extra coil should not have a fixed value, because a fixed coil is not suitable as a feed-back coil for a wide variety of different plug-in coils which may be plugged into the oscillatory circuit. Similarly, a variable inductance in the plate circuit of a valve is known to produce regeneration in a tuned circuit connected between its grid and cathode. However, for each different plug-in coil, it would be necessary to provide a different value of variable inductance to obtain the desired amount of regeneration.

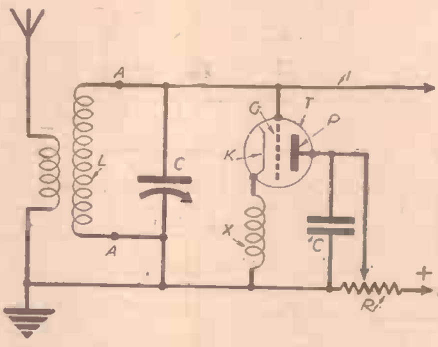
The object of the arrangement about to be described is to provide a simple means for producing regeneration in a resonant circuit, and especially to provide a means which functions satisfactorily without alteration for a wide variety of different coils that may be plugged into the resonant circuit.

Referring to the accompanying diagram, a parallel tuned circuit composed of a plug-in coil L and condenser C is connected at one end by a lead 1 to the grid of a frequency-changer valve (not shown), and the other end is earthed. The reference-letters AA designate the terminals of the plug-in coil holder.

An extra valve T arranged to operate as an amplifier is provided, and its grid G is connected to the earthed end of the resonant circuit LC, while its cathode K is connected to earth through a choke coil X whose impedance at the operating frequency is capacitive. The plate P of the valve is earthed for radio-frequency variations through a sufficiently large condenser C, while its direct current potential is adjustable by means of potentiometer R connected between earth and a point of positive potential.

Operation

The operation of the arrangement depends upon the existence of inherent capacity between grid G and cathode. K of valve T which, together with the effective capacity of choke X, forms a capacity potentiometer across the tuned circuit so



Circuit-diagram of a parallel tuned circuit as described in the text.

that the grid and plate of the valve T are connected to the ends AA of the tuned circuit, while the potential of the cathode is intermediate the potential of these two ends. The valve T is thus connected to the resonant circuit in the same way as it would be connected in the case of a Colpitts three-point oscillator circuit, except that one terminal of the resonant circuit is earthed, instead of the cathode being earthed as in the Colpitts circuit. By sliding the connection of potentiometer R from earth toward the positive potential end, the transconductance of the valve T is varied, and the effect of the valve is first to regenerate the circuit LC, and ultimately to produce oscillations. This arrangement has been found in practice to produce readily controllable regeneration over a wide range of frequencies. It is, of course, possible to supplement the grid-cathode capacity of the valve T or the distributed capacity of the choke X, or both, by auxiliary condensers, but this has not been found necessary in practice, and it is preferable not to increase the total capacity shunted across the variable condenser C any more than necessary, since this alters the tuning range of the variable condenser.

Although the circuit diagram shows the grid G of valve T connected to the upper end, or unearthed side, of the resonant circuit LC, while the plate P is connected for radio-frequency energy to the lower, or earthed, end of the resonant circuit, if desired, the grid and plate electrodes may be reversed in position.

While the proposal has been described with reference to the first tuned circuit in a wireless receiver, it will be understood that it may be applied to any tuned circuit whether it be used in a receiver or in a transmitter in connection with an amplifier, frequency changer or detector, or merely as a wave-meter. The arrangement described has been developed by the laboratories of the Radio Corporation of America.

Automatic Reduction of Static Interference

A Brief Description of a New Use for "Westectors"

By W. A. FLINT

MOST readers will be familiar with the use of "Westectors" for detection, A.V.C. and battery economy, but they may not know that they may be used as automatic "silencers" in communication receivers and the like, where static and automobile interference must be reduced to a minimum.

If such rectifiers are worked below the bottom bend of their characteristic curves (see Fig. 1) by keeping the normal audio voltage impressed on the rectifiers low enough to prevent the operating point of the rectifiers rising up the curve to the straight portion, and are connected back to back to give a non-linear characteristic in both directions, all audio voltages above this level will move the operating point up the characteristic curve to the straight portion, and the rectifier will short circuit the output for the duration of the noise peak.

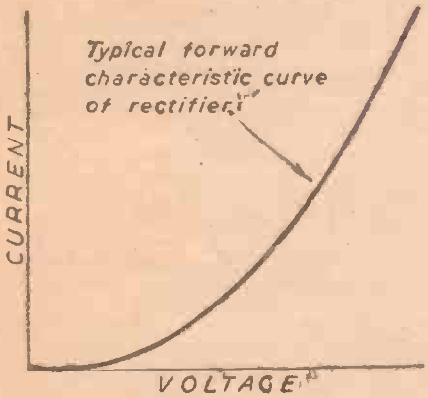


Fig. 1.—Curve of a normal Westector.

Such a circuit will considerably reduce the level of the noise peak and bring it to the level of the normal signal, even though the peak may be many times stronger than the normal signal.

Where the normal audio frequency is of the order of 1.5 volts, such as in an early low frequency stage of a receiver, two W.X.6 Westectors may be connected across the grid leak as shown in Fig. 2, and peaks caused by static will be limited to this voltage.

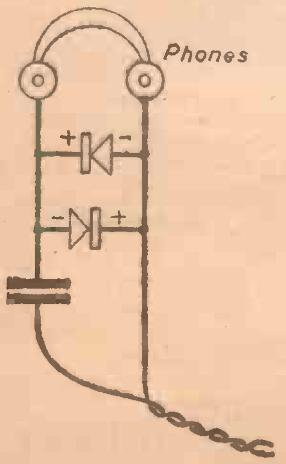


Fig. 4.—A noise silencer for the output stage.

In Early Stages of Receiver

Another arrangement for use in the early stages of the receiver is shown in Fig. 3, where two W.6 Westectors are used, connected back to back across the secondary of a transformer. The primary winding of the transformer is connected between the grid of the L.F. valve and the earth line in a combined resistance and choke capacity coupling circuit, and the rectifiers are biased so that voltages above a value determined by the bias voltage are short circuited. The bias may be obtained from a grid bias battery and control obtained by using the various taps in the battery, or, in the case of a mains receiver, may be obtained from the bottom end of a screen voltage potentiometer and adjusted by means of a variable potentiometer connected at the bottom of the original potentiometer.

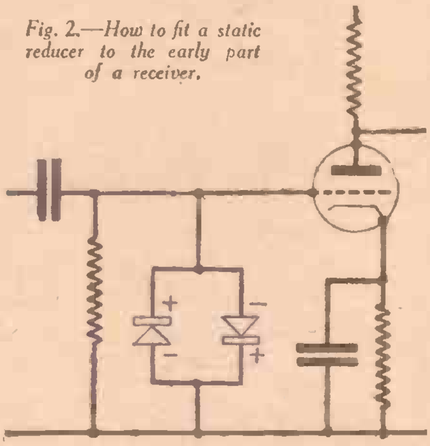


Fig. 2.—How to fit a static reducer to the early part of a receiver.

By adjusting the potentiometer or grid bias battery, the operation of the circuit may be controlled to suit the prevailing reception conditions so that all sounds above a certain amplitude, which is controllable, are cut off.

In the latter stages of the receiver, where the audio voltage is normally greater than 1.5 volts, it is necessary to use the "H" type of metal rectifier.

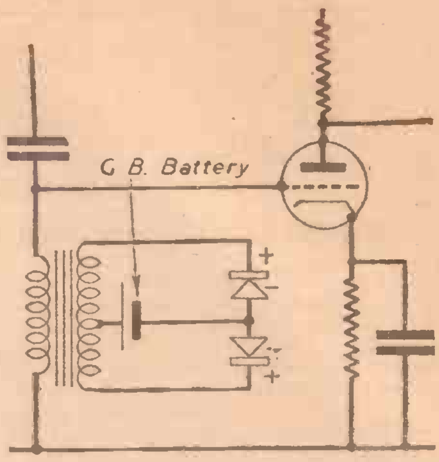


Fig. 3.—An alternative to the Fig. 2 arrangement.

With Headphones

When headphones are to be used, two styles H.6 rectifiers may be employed, connected across the headphones, as shown in Fig. 4, to limit the signal output to a maximum of about 15 milliwatts, which corresponds to comfortable headphone strength. These rectifiers will absorb any excess voltage such as that caused by static, which might otherwise cause loud "clicks" in the 'phones. When using this circuit, however, it is essential to isolate the 'phones from the H.T. supply by transformer or choke-capacity coupling. Otherwise, there will be a voltage drop across the headphone coils, which will serve to bias the rectifiers, and cause them to operate on the wrong part of their characteristic curve.

Another simple noise silencer circuit is shown in Fig. 5, where two "H" type rectifiers are connected across the centre-tap of a choke and the "earth" line of the receiver. The choke is connected in the normal combined resistance and choke capacity coupling circuit, and the size of the "H" type rectifiers used depends upon the maximum audio-frequency signal voltage which is developed across the centre tap of the choke, and the "earth" line. For a maximum audio voltage of 2, type H.10 rectifiers should be used, for 4 volts the H.20, 6 volts the H.30, 8 volts the H.40, and 10 volts the H.50.

Such circuits as those outlined above may require minor adjustment to suit prevailing local conditions, but where static interference is experienced, their use will definitely prove of benefit in reducing such interference to a minimum.

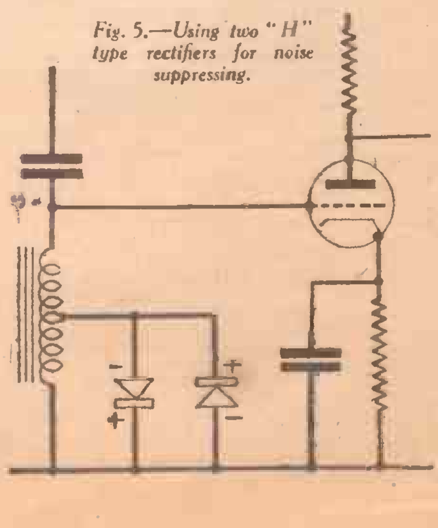


Fig. 5.—Using two "H" type rectifiers for noise suppressing.

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).

Peculiar Fault

SIR,—I wonder if you or any of your readers could explain a fault which I recently experienced, but which cured itself and left me completely in the dark regarding the cause. The receiver was a commercial 7-valve superhet, with magic-eye tuning. I was listening to a local programme, when suddenly there was severe distortion, and I noted that the eye had closed considerably. Just as I was going to see if a tuning re-adjustment was required the eye opened, but another station came in, quite clearly and with no trace whatever of the original local. The signal was constant (due to A.V.C.) but the eye varied slightly just as with a normal fading signal. I stood for a moment wondering what had happened, when the procedure repeated itself and the original station came back. The same thing has not happened since, and I understand that no one near me was listening to the second station I heard, so that it was not due to re-radiation. The makers of the set have not had any similar complaint and cannot explain the phenomenon.—J. DARBY (S.E.17).

Anti-fading

SIR,—I was interested in the Diversity method of reception which you recently dealt with, and would like to inform other readers that the idea is well worth trying out, especially in districts where fading is experienced more or less severely. I have travelled about a great deal and have noted that in some districts fading is very pornounced and some such steps are essential in order to prevent uncomfortable listening. I tried a scheme once where I used two separate aerials, pointing in different directions and found that this also gave some freedom from fading, but introduced a difficulty due to an unbalancing of the input with the result that an effect very similar to fading was actually introduced. This was proved by using another set at the same time and whereas this gave fading at times, which was counteracted on the other set with the two aerials, there were times when a constant signal was received on the "comparator" receiver, but the signal from the two aerials actually faded. I should like to hear of the results experienced by other experimenters who have experimented with anti-fading devices.—G. TRIMBLE (Winchester).

Push-pull *versus* R.C.C.

SIR,—I have been a regular reader of PRACTICAL WIRELESS for about two years now, and feel that I must let you know how much I enjoy reading it. I started in radio about five years ago, when I built my first crystal set. At present I am busy building a set of S.W. coils, which I am going to use in a short-wave-3 circuit, and I hope to let you know the results. And now, may I make a suggestion? From time to time you have described receivers with a push-pull output stage, but all these seem to employ push-pull transformers; but I seem to have read in your paper that R.C.C. is best for quality, and is also much cheaper. Could you possibly publish an article on this subject? The very best of luck to PRACTICAL WIRELESS which, in my opinion, is doing a national service.—P. W. BARNETT (St. Albans).

A 5-valve S.W. Set!

SIR,—With reference to Mr. A. G. Martin's letter in your issue of the 23rd of March last, I suggest a three v. set, i.e., a S.G. valve untuned, triode det. and a tetrode output (e.g., a Cossor 420T.), the set to employ 6-pin coils, and some kind of power unit with a valve or metal rectifier. I should make the parts as optional as possible; for instance, I have a mains unit which supplies approx. 250 v. at 80 mA, and 4 v. at 4 amps. which I should use. I think parallel trans. coupled for the L.F. stage should be employed.—R. GUILLAUME (Weybridge).

Correspondent Wanted

A. H. JOHNSON, 28 Windsor Road, Willesden Green, London, N.W.2, is desirous of getting in touch with an amateur in his locality who is interested in general radio, and who would be willing to co-operate.

Prize Problems

PROBLEM No. 405

ABBOTT had an A.C. mains receiver which had worked well for some time, but suddenly developed a fault of the following nature: When adjusted for normal volume the results were almost as good as when the set was first installed, but as soon as the volume was reduced bad distortion occurred. What was the cause of the trouble? Three books will be awarded for the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 405 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, June 24th, 1940.

Solution to Problem No. 404

When Kent introduced his output circuit coupling he overlooked the fact that the L.F. choke would have a much lower resistance than 50,000 ohms, and, accordingly, the use of the latter component, in view of the high anode current of an output valve, resulted in the loss of substantial H.T. voltage and the valve accordingly failed to deliver the original output.

The following three readers successfully solved Problem No. 403, and books have accordingly been forwarded to them:

D. Hay, Argyle House, 12, Elgin Avenue, W.9.
C. V. Davies, Isle of Whithorn, Scotland.
D. Abelson, G. Ward, County San., Harefield, Middx.

HUM REDUCTION

MAINS hum in the output of a wireless receiver or low frequency amplifier is usually attributed to imperfect smoothing of the rectified alternating current supply, but it may be present if alternating current is applied directly to the cathode heaters of indirectly-heated valves. The hum currents in such a case may be due to the capacity between the lead-in conductors of the control-grid and heater. Again, the heater itself may act as a grid to vary the current flowing from the anode to the cathode and thus produce hum.

The alternative expedients about to be described have been found effective in reducing hum produced by the causes mentioned.

Referring to Fig. 1, an octal valve base is shown, and the electrodes to which the pins are connected are indicated. The shell or metal envelope of the discharge device, which is connected to the terminal 4, is commonly connected through external connections to the heater terminal 3, and to earth because of the greater convenience of wiring adjacent terminals together. The opposite heater terminal 7, it will be observed, is adjacent to the control grid terminal 6. The capacity between these two terminals, or more particularly between the lead-in conductors extending from these terminals up through the glass seal, which capacity is indicated by dotted lines 9 in the figure, is sufficient to induce into the grid circuit of the discharge device an objectionable amount of voltage from the heater circuit. In fact, this voltage after amplification in two or three amplification stages may amount to as much as 10 volts, and is thus decidedly objectionable. This voltage may be very substantially reduced by earthing the heater terminal 7 through the external connections, this terminal being the one nearer to the control grid. The metallising terminal 4 is then connected to the terminal 7, and terminal 3 is, of course, not earthed. This change in circuit connection has been found to reduce the hum voltage produced by the capacity 9 to as low as one quarter of its initial value.

Fig. 2 shows a valve circuit in more complete detail. The valve 10 has a cathode which is connected through bias resistor 11 to earth and to the terminal 7 of the heater. The cathode is also connected through terminal 4 to the envelope of the electron discharge device. The source of heating current which is represented by the cathode transformer 12 is connected directly across the heater, i.e., between terminals 3 and 7.

The input circuit of the valve comprises an input coupling condenser 13 and a resistance 14 connected between the control

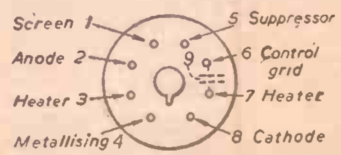


Fig. 1.—Octal valve base showing electrode connections.

grid and cathode of the valve through the bias resistor 11. The output circuit comprises the coupling condenser 15, anode coupling resistor 16, and source of anode potential 17. Screen-grid potential is supplied by the source 18. The sources 17, 18, and similarly the cathode bias resistor 11, are by-passed for currents to be amplified, by condensers 19, 20 and 21 respectively.

(*Continued on facing page.*)

With the connections shown it will be observed that due to the cathode heating current supplied by transformer 12, the

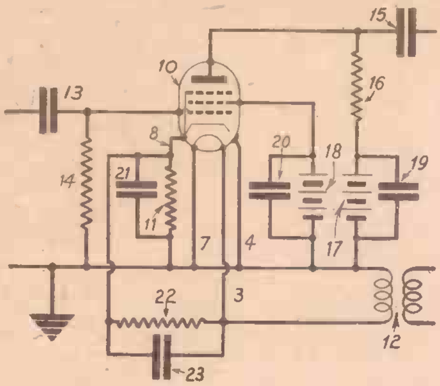


Fig. 2.—Detailed valve circuit for explanatory purposes.

potential of the heater varies cyclically with respect to the potential of the cathode. This heater has the effect of a grid within the discharge device in that when its potential varies in the positive direction, the current in the anode circuit increases, and when it varies in the negative direction, the anode current decreases.

In order to eliminate the hum resulting from these effects a voltage is supplied between the control grid and the cathode, which tends to oppose these variations in anode current. It has been found convenient to supply this voltage across the cathode bias resistor 11, and this is effected by the shunt combination of resistance 22 and condenser 23, the latter being connected between the cathode of the discharge device and the terminal 3 of the heater. It has been found that by properly proportioning this resistance and condenser relative to the resistance 11 and condenser 21, a voltage may be produced across resistance 11 tending to make the grid sufficiently negative with respect to the cathode during the half cycles of the heating current, when the anode current tends to increase just to overcome these variations. To effect this, it is merely necessary that the voltage supplied to the cathode through resistance 22 be in phase with the voltage supplied to the heater, and it may easily be shown that this condition obtains when the time constant of resistance 22 and condenser 23 is equal to the time constant of resistor 11 and condenser 21. By the use of this connection, including resistance 22 and condenser 23, the hum voltage may be reduced to substantially less than half that which is produced when these elements are omitted from the circuit.

Of course, the tendency of the anode current to increase, due to variation in the heating current, is opposed to a slight extent by the potential produced on resistance 11 by the passage of this anode current. That is, an increase in anode current produces a larger potential on resistance 11 which, in turn, drives the grid more negative and tends to maintain the anode current constant. This effect, however, is far too small to be of importance in the elimination of hum, and for effective elimination of hum it is necessary to supply a greater voltage across resistance 11 as is done by resistance 22 and condenser 23.

Fig. 3 shows a modification of the arrangement in which the heating current is supplied from a transformer 12 as in Fig. 2. The secondary winding of this transformer, however, has an intermediate point which is connected to the terminal 7 of the heater, the terminal at one end of the secondary winding being connected to the opposite terminal 3 of the heater, and the other terminal of the secondary winding being connected through grid coupling resistor 14 to the control grid of the discharge device. In this way it will be seen that when the heater is driven positive with respect to ground, thereby tending to cause the anode current to increase, the grid is simultaneously driven negative with respect to the cathode, thereby tending to oppose the increase in anode current, and thus prevent the production

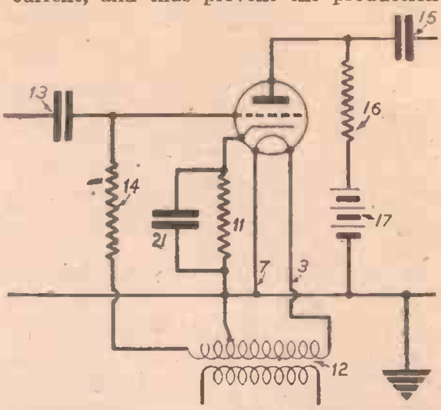


Fig. 3.—Modified circuit showing how hum may be prevented by the special heater and cathode arrangement.

of hum. This system was developed in the Laboratories of the G.E. Company of America.

In reply to your letter

Mains Components

"I have been given an indirectly-heated A.C./H.L. valve and as I have not had one of these before I am a bit puzzled about the centre and fifth pin. Could you tell me what are the connections to it, please? Another problem is, if an H.T. battery is used for H.T. and a mains transformer for L.T., is the negative end of the H.T. only connected to earth?"—L. N. H. (Feltham).

THE centre pin on an indirectly-heated A.C. valve is the cathode connection. The heater (or filament) is only a means of heating the cathode in order to obtain the emission and thus the main point of connection is the cathode. It may be regarded as the essential filament pin in an ordinary battery valve. Therefore, in a simple detector stage the cathode would be joined direct to the earth line and the grid leak would be joined direct to the cathode. In an L.F. stage the bias required is obtained automatically by inserting a resistance between cathode and earth, the value being chosen according to the normal anode current and the voltage required. A by-pass condenser is shunted across the resistance. When using the two sources of supply mentioned in your second query, the centre tap of the heater winding for L.T. must be joined direct to earth. If there is no centre tap you must connect a low resistance across the winding, and earth the centre tap of that. Special small adjustable components are available for this purpose and are known as "hum-dingers." The resistance is generally between 20 and 50 ohms.

Faulty Components

"I have built two or three sets recently and they have all failed to work properly. I attach a list of the parts I used and should be glad if you would send me a blueprint to enable me to build a good set with these parts, as I do not want to go on trying out any more."—J. L. (Hove).

WE assume that you have built circuits of standard design and have not tried to make up your own arrangement. As most circuits to-day have been standardised it is not worth while our recommending another circuit as it would be most likely that one or more of your parts is faulty, or you have not appreciated some fundamental point in construction and thus would be likely to adopt the same scheme in a new receiver. It is therefore recommended in this case that you either have all your present parts properly tested or alternatively purchase a blueprint of one of our receivers and then obtain new parts for its construction. Incidentally, we would remind you that we only guarantee our receivers when built from parts which we specify.

New Design for Chassis

"I have been experimenting for some time and have hit on a scheme which I think is novel and offers some advantages. Instead of adopting the usual chassis form of construction I have tried the chassis inverted. That is to say, the condenser and valves only are on top and everything else is inside the chassis. A 'lid' is then put on the bottom of the chassis, and the result is a perfectly stable arrangement which seems to give more gain than when the orthodox arrangement is used."—D. C. R. (Lambeg).

THERE is nothing novel in your idea and you could probably obtain the same results with a standard scheme properly carried out. Firstly, the valves and condenser are always on top of the chassis and therefore the only parts you have transferred are the coils and majority of the wiring. If you look back through many of our past issues you will see that we have often put the coils underneath (for instance, in the "Ideal" radiogram) and this is quite a normal procedure.

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters.

We regret that we cannot, for obvious reasons—

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

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

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

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

Wiring, if properly carried out may be run on top of the chassis, and the coils may also be there, if properly screened. The only point about your idea which is not often used, but one which has been mentioned before in these pages, is the closing of the bottom of the chassis. This prevents direct signal pick-up on the inter-circuit wiring and is often worth while where selectivity problems are experienced due to the close proximity of a powerful station.

Special Tuner

"I have a well-known make of P.A. amplifier delivering 10 watts. This has been used for some time for dance work but there is not much doing now and I should like to use the amplifier for radio work. I believe it is possible to add a form of tuner to this and should like details as to the best way of doing this. Have you any designs you could offer?"—P. E. (Keighley).

YOU could build either a simple H.F.-detector unit for local-station reception, or a powerful superhet unit for general work. In any case you would have to include a detector stage and this would provide the output for feeding your amplifier in the same way as a microphone or pick-up. We have described one or two H.F. units in the past, and for general work we would recommend a superhet unit consisting of frequency changer, I.F. and 2nd detector, with A.V.C.

Pilot Lamps

"I am constructing a receiver from a 'commercial' diagram and there is one little point I should like clarified. You will note from the extract I send that there are four small circles marked 'pilots.' These, I assume, are dial lights, but I do not wish to use four and wonder if there would be any readjustment to the circuit needed as the lamps seem connected in a special way."—T. N. (Winchester).

THE dial lights, or pilot lamps, are obviously intended for a multi-waveband dial, each being switched for the waveband in use. There is thus only one lamp in circuit at a time and in the circuit in question an ordinary 6-volt bulb may be used. The lamp is joined in parallel with any of the single valveholders, and the only thing to do in the circuit in question is to ignore all the switch wiring to the lamps. Do not use a 4-volt filament as the supply is 4 volts A.C. and a 6-volt filament will therefore be more suitable and give longer life.

Low-loss Insulation

"I have noted that some modern parts are mounted on what looks like glass and I have been told that this gives higher efficiency. I have an old broken fire-proof glass dish on hand and wonder if I could cut this up and use it for insulation purposes? Would it be suitable, and if so, what is the best method of drilling?"—G. A. C. (Oswestry).

THE material in question is only needed on ultra-short-wave apparatus, the improvement from its use on broadcast bands being offset by losses in other parts of the circuit. For 5 metres and below the material offers undoubted advantages, but you would no doubt find that the material you have would be difficult to work and, furthermore, insufficient; flat sections would be difficult to get out. Good quality paxolin or the special ceramic insulation would be almost as good, unless you were anxious to make a really highly efficient set and then special precautions would have to be taken with all other parts of the set.

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.

M. J. H. B. (Shaftesbury). Write to the Columbia Company and to F. L. Masters, Forest Way, Pound Hill, Crawley, Sussex.

M. F. (Southwark). Get into touch with the makers. There may be a faulty component, probably a short-circuited or partially short-circuited H.T. condenser.

W. F. (Blackburn). The critical component is the anode choke, and it is this which should match the valve.

L. T. R. (Oswestry). The original component is not now on the market, but it may be substituted by the Bulgin component, type L.F.10.

M. C. N. (Seaview). We are looking into the matter, and will publish details as soon as they have been received.

G. H. M. (Standtow, Belfast). You must use a driver stage in the circuit in question. Do not try to feed from the detector stage.

J. L. L. (S.E.11). We have no details of the set in question, but we think it would be inadvisable to try to modify it on the lines you suggest.

R. A. J. (Caernarvon). The details have now been reprinted, and appeared in last week's issue.

J. A. (Fishponds, Bristol). We do not know of any coils similar to those mentioned.

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

LATEST PATENT NEWS

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

NEW PATENTS

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Latest Patent Applications.

9289.—Cossor, Ltd., A. C., Stevens, W. H., and Bedford, L. H.—Thermionic Valve Circuits. May 27th.

9426, 9427, 9428.—Fox, P. X.—Coil-winding machines. May 29th.

9256.—Keyser, N.—Clock-on wireless set. May 27th.

9364.—Marconi's Wireless Telegraph Co., Ltd., Beanland, C.P., and Cockerell, C. S.—Inductance and capacity trimmer unit. May 28th.

9214.—Page, H.—Wireless aerial systems. May 25th.

9244.—Page, H.—Wireless antenna systems. May 25th.

9128.—Philco Radio and Television Corporation.—Loop antenna circuits. May 23rd.

9280.—Scophony, Ltd., and Dodington, S. H. M.—Supersonic wave apparatus. May 27th.

9160.—Slater, G.—Automatic gramophones. May 24th.

Specifications Published.

521439.—Kolster-Brandes, Ltd., and Smyth, C. N.—Focusing magnets for cathode-ray tubes.

521490.—Thornton, A. A. (Philco Radio and Television Corporation).—Noise-limiting circuits for carrier-wave communication systems.

521589.—Thornton, A. A. (Philco Radio and Television Corporation).—Noise-limiting devices for use in electric transmission systems.

521408.—Standard Telephones and Cables, Ltd., and Currey, J. C.—Public address horn-type loud-speakers.

521409.—Kolster-Brandes, Ltd., and Tedham, W. F.—Time-base circuits.

521522.—Kolster-Brandes, Ltd., and Smyth, C. N.—Television systems. (Addition to 520235).

Printed copies of the full Published Specifications only, may be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

Notes from the Test Bench

Magic-eye Tuner

WE have heard recently one or two cases where listeners have broken a valve or the connections to it. In each case the valve in question was the magic-eye tuner fitted to some commercial receivers by means of a horizontal fitting which leaves the end of the valve projecting slightly through a round escutcheon on the panel. Normally this should be quite satisfactory, but apparently over-zealous cleaning has been responsible for pushing the valve in or something has fallen against the front of the set and the valve has received a severe blow. This type of trouble may be overcome in a simple manner, and in fact the following idea is also applicable to home-made receivers where this type of indicator is required. The valve is mounted in the ordinary way on the chassis, preferably towards the front. A small mirror is then mounted at an angle of 45 deg. above the valve and a hole is cut in the panel and provided with a slightly projecting screen so that the reflection of the valve to pin the mirror may easily be seen. An additional refinement is to mount a small magnifying lens between the valve and mirror so that a larger image may be obtained.

Marking Valveholders

AT one time it was customary for some set makers to label the valveholders on the receiver with the type of valve to be used. This is a good idea for the home constructor also, as it is possible with modern valves to insert a valve in a socket and the disposition of the pins may be such that a valve will be damaged although not receiving excessive L.T. supply. The marking should preferably be made by means of small paper labels attached to the chassis or by means of adhesive tape of the surgical type, marked with ordinary linen marking ink.

Phase Splitter

MANY listeners are using a push-pull output stage with R.C. coupling and for the input valve utilise a single indirectly-heated triode, taking the output from cathode and anode. Whilst this works very well, it will be found that an improvement in quality and very often in gain and stability may be obtained by using one of the double-triodes, either with a single cathode or double cathode. In either case the bias resistance may be of the single type included in the cathode lead, the two cathodes being linked in the double type of valve and earthed through the single bias circuit.

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COMPLETE Specified S.T. 900. Kit A. With B.T.H. Phones, (only 3 months used). Value 75/-, accept 47/6. Post paid. Genuine bargain.—Barrett, Front Street, Cookfield, Durham.

CONSTRUCTOR'S surplus. Coil units, I.F. Transformers, Gang Condensers, Dual Range Short-Wave Coil, Tapped Pentode, Smoothing, H.F. and L.F. Chokes, Class B, Driver, L.F. Transformers, 2-volt Valves, D.C. Avominor. Sell cheap. Write: Crolla, 23, Forbes Street, Aberdeen.

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"**H.A.C.**" one-valve Short-wave Receiver, famous for over 5 years, now available in kit form; complete kit of precision components, accessories, full instructions, 12/6, post 6d., no soldering necessary; descriptive folder free on request.—A. L. Bacchus, 109, Hartington Road, S.W.8.

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COUPON
This coupon is available until June 29th, 1940, and must accompany all Queries and Hints.
PRACTICAL WIRELESS, 22/6/1940.

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PREMIER SHORT-WAVE BATTERY-OPERATED KITS for OVERSEAS NEWS
Incorporating the Premier 3-Band S.W. Coil. 11-86 Metres without coil changing. Each Kit is complete with all components, diagrams, and 2-volt valves. 3-Band S.W. 1-Valve Kit, 14/9. 3-Band S.W. 2-Valve Kit, 22/6.

DE LUXE S.W. KITS
Complete to the last detail, including all Valves and coils, wiring diagrams and lucid instructions for building and working. Each Kit is supplied with a steel Chassis and Panel and uses plug-in Coils to tune from 13 to 170 metres.

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CONTROL OF SELECTIVITY—See page 315

A NEWNES PUBLICATION

Edited by F. J. CAMM

Vol. 16. No. 406.

Practical Wireless and PRACTICAL TELEVISION

4D. EVERY WEDNESDAY June 29th, 1940.

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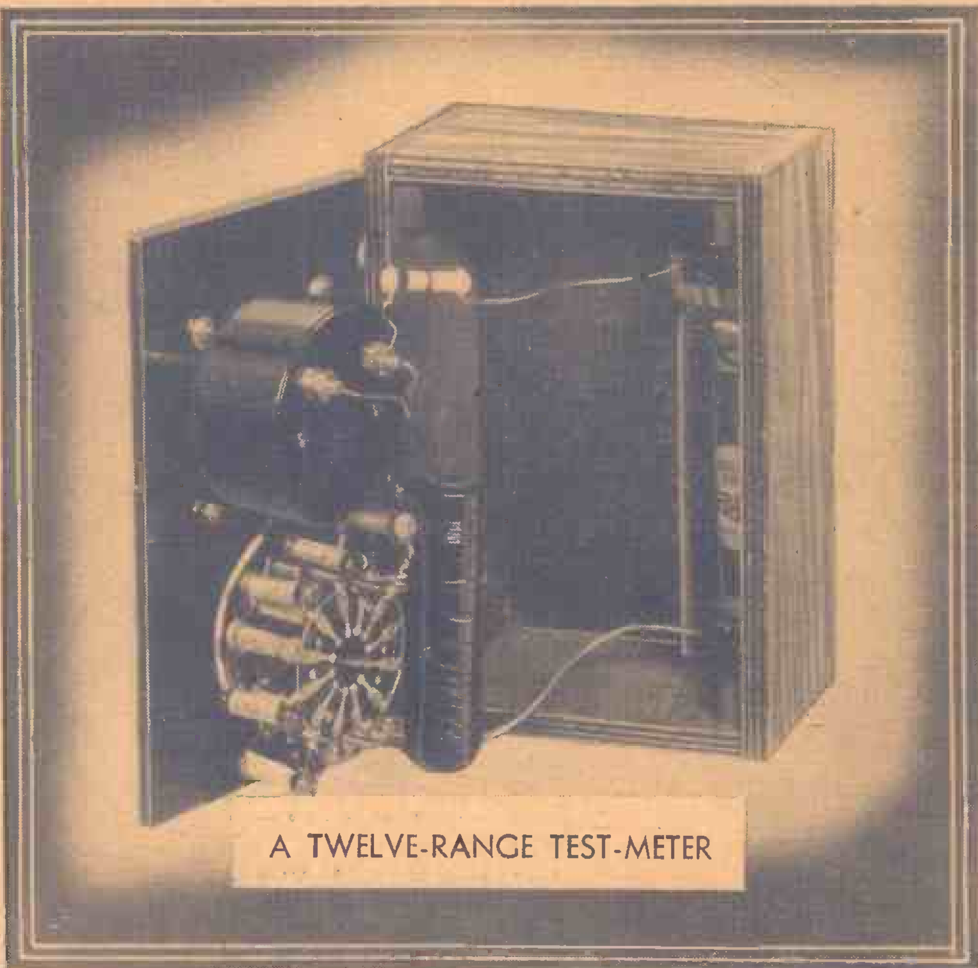

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Practical Wireless

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PRACTICAL WIRELESS

CRYSTAL SETS

	Date of Issue	*No. of Blueprint*
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set ..	27.8.38	PW94

STRAIGHT SETS. Battery Operated.

One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode) ..	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF) ..	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow) ..	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow) ..	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	PW49
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen) ..	—	PW61
The Tutor Three (HF Pen, D, Pen)	21.3.36	PW62
The Centaur Three (SG, D, P) ..	14.8.37	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen) ..	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans)	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve : Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P) ..	1.5.37	PW4
Fury Four (2 SG, D, Pen) ..	8.5.37	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P) ..	26.9.36	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	PW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90

Mains Operated

Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen) ..	—	PW18
A.C.-D.C. Two (SG, Pow) ..	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW23
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow) ..	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen) ..	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS.

Battery Sets : Blueprints, 1s. each.		
£5 Superhet (Three-valve) ..	5.6.37	PW40
F. J. Camm's 2-valve Superhet ..	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve) ..	—	PW43
D.C. £5 Superhet (Three-valve) ..	—	PW42
Universal £5 Superhet (Three-valve)	—	PW44
F. J. Camm's A.C. Superhet 4 ..	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four ..	16.1.37	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model .. / Push Button 4, A.C. Mains Model ..	22.10.38	PW95

SHORT-WAVE SETS. Battery Operated.

One-valve : Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen) ..	1.10.38	PW68

PORTABLES.

Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen) ..	—	PW65
Parvo Flyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86

MISCELLANEOUS

Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A

AMATEUR WIRELESS AND WIRELESS MAGAZINE

CRYSTAL SETS.

Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450

STRAIGHT SETS. Battery Operated.

One-valve : Blueprint, 1s.		
B.B.C. Special One-valver ..	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans.) ..	—	AW388
Full-volume Two (SG det, Pen) ..	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G.3 (SG, D, Trans) ..	—	AW412
Lucerne Ranger (SG, D, Trans) ..	—	AW422
£5 5s. Three: De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen) ..	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans) ..	*Mar.* '34	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen) ..	—	WM389
Certainty Three (SG, D, Pen) ..	—	WM393
Minitube Three (SG, D, Trans) ..	*Oct.* '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
65s. Four (SG, D, RC, Trans) ..	—	AW370
2HF Four (2 SG, D, Pen) ..	—	AW421
Self-contained Four (SG, D, LF, Class B)	*Aug.* '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	*Feb.* '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	*Apr.* '36	WM404
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

Mains Operated.

Two-valve : Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C. ..	—	AW383
Mantovani A.C. Three (HF, Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	*Jan.* '36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen) ..	*July* '33	WM329
Harris' Jubilee Radiogram (HF Pen, D, LF, P)	*May* '35	WM386

SUPERHETS.

Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
'Varsity Four	*Oct.* '35	WM395
The Request All-Waver	*June* '36	WM407
1935 Super-Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. 6d. each.		
Heptode Super Three A.C. ..	*May* '34	WM359
"W.M." Radiogram Super A.C.	—	WM366

PORTABLES.

Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two HF Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans)	—	WM367

SHORT-WAVE SETS. Battery Operated.

One-valve : Blueprints, 1s. each.		
S.W. One-valver for America ..	15.10.38	AW429
Rome Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-Short Battery Two (SG, det, Pen)	*Feb.* '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve : Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	*July* '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF Pen, D, RC, Trans) ..	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valve Short-waver (SG, D, LF, P)	22.7.39	WM383
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super ..	*Nov.* '35	WM397

Mains Operated.

Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	13.1.40	AW453
"W.M." Long-wave Converter ..	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C. ..	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) ..	—	WM391

MISCELLANEOUS.

S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM392 (1/-)	*Nov.* '35	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	*Mar.* '36	WM403
New style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-) ..	—	AW456
Superhet Converter (1/-) ..	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	*May* '36	WM405
Wilson Tone Master (1/-) ..	*June* '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM408

Practical Wireless and PRACTICAL TELEVISION

EVERY WEDNESDAY
Vol. XVI. No. 406. June 29th, 1940.

EDITED BY F. J. CAMM

Staff: W. J. DELANEY, FRANK PRESTON, H. J. BARTON CHAPPLE, B.Sc.

ROUND THE WORLD OF WIRELESS

Simplified Valves

THE beginner may justly be excused some doubts concerning the wisdom of manufacturers supplying such a wide range of valves. In the early days there were only a few types, and they were easily distinguished by references to indicate their main application. With improvements in circuit design various novel types of valve were introduced, many of which have ceased to exist, but a number are still in existence. To add to the confusion the various makers use different references so that it is not a simple matter to decide a given alternative. In America this has been overcome by using a common reference for all types, irrespective of the maker. Thus there is an R.C.A. 45, or a Raytheon 45 or a Sylvania 45, and it is only necessary in a specification to quote a type 45 and the constructor can use any make he desires with the knowledge that it will have the correct specification. Readers will remember recently an attempt to simplify matters in this country by the introduction of a special valve to suit any stage in a receiver, but it is obvious that there is a growing need for a simplification in the valve classification, either by a limitation in types or a standardisation in reference numbers. In this issue we give details of a proposal which has been made by the British Institution of Radio Engineers on the subject.

Literary Productions

THE B.B.C. announces that on July 8th the first instalment of a serial version of "Rupert of Hentzau" will be broadcast in the Home Service. It has been adapted from Anthony Hope's book by Hugh Stewart. Charles Mason will play Rupert; Edana Romney Princess Flavia; Sebastian Shaw doubles the King and Rudolph Rassendyll, Frederick Lloyd is Colonel Sapt and Ronald Simpson Fritz von Tarlenheim. On July 11th, in the Children's Hour, "The Prisoner of Zenda" in a new adaptation by Barbara Sligh will have the first of a series of weekly episodes.

College Rhythm

THE Three College Boys, who are students at a Glasgow Medical School and who, instead of working, sing their way through college, will take part in a short variety programme on June 28th, with Harry Carmichael and Dave Goldberg (guitar). While on holiday in France, they gave a guest concert with the Quintette of the Hot Club of France, and their performance earned congratulations and a magnum of champagne from two celebrities present, Adèle Astaire and Cole Porter.

Au Drapeau

A REVIVAL of the programme called "Au Drapeau," which was broadcast at the end of April, will be produced by Denis Johnston on June 29th. It consists of a "review" of the French Army and listeners will hear a portrayal of something of the spirit and tradition behind the army and how it is run and maintained both in peace and war.

Gloria Brent, the attractive singer who is often heard on the air with various famous bands.

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

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

Old Favourite, New Name

GIVEN the title "Nippit Fit and Clippit Fit," few people would say they had even heard of the story. Yet it is really one of the most famous tales in the world, for this is the Scottish version of Cinderella, which has been retold by March Syke and will be read by Christine at the beginning of the Children's Hour on June 27th. For Sassenachs "Nippit Fit and Clippit Fit" may be literally translated as "Nipped Foot and Clipped Foot," which explains the whole story. In the same programme, another of Helen Drever's "Songs of the Clans" will be heard. This time she is dealing with Clan Scott, another of those which do not belong purely to the Highlands of Scotland. It includes some of the best songs and stories of the Scottish Border country, including "Blue Bonnets over the Border" and the story of "Muckle Mou'ed Meg."

Oscar Rabin and His Romany Dance Band

OSCAR RABIN and his Romany Dance Band will be the "Band of the Week" beginning June 30th, and it is hoped that all the regular solo vocalists will be heard, including Harry Davies, Beryl Davies, Diane, and Garry Gowan; and that Eddie Palmer will play the novachord.

"Three in a Bar"

A MYSTERY play entitled "Three in a Bar," to be broadcast on June 27th, has for its setting an old-fashioned public-house bar parlour. A mock trial, arranged by three customers in the parlour, leads to the apprehension of a murderer, who is "caught out," by the clever cross-questioning of a police inspector and a police sergeant in disguise. The play is written by Peter Franklin and will be produced by Peter Creswell.

Return of "Crime Magazine"

AFTER more than a month in which to take stock, "Crime Magazine" will return to the Home Service and Forces programmes on July 2nd, but at a slightly later hour in the evening. It is expected that practically all the features which were included at the end of the first series will be retained. Ex-Detective Inspector Jack Henry, late of New Scotland Yard, will again be heard in a further series of adventures based on incidents of real life; Billy Milton will appear in "Meet the Arrow," a series of detective occasions written by Ernest Dudley; and Bill Maclurg will again be in charge of the feature.

Suggested Valve Standardisation

Some Interesting Proposals which Have Been Put Forward by the British Institution of Radio Engineers

THERE have been many suggestions in the past for a standardisation and limitation in the number of valve types. Many interesting schemes have been formulated, and the standardisation committee of the British Institution of Radio Engineers have recently published a report which has been submitted to the Ministry of Supply, Ministry of Labour and the Service departments regarding a scheme proposed by Mr. J. A. Sargrove. It is claimed by the B.I.R.E. that adoption of the proposals set out would enable the Radio Industry to:

1. **Satisfy home demand but**
2. **Increase export trade.**
3. **Make available for other important industries many highly-skilled technicians such as tool makers and jig and tool designers.**
4. **Save a considerable amount of raw material which is now absorbed unnecessarily.**
5. **Make good some of the loss of essential import material.**
6. **Alleviate difficulty in Radio Servicing.**

It should be noted that the first step towards achieving the ideal is the immediate all-round adoption of the existing range of 6.3 volt 0.3 amp. valves. This range, including its higher voltage companion types, consists of a mere twenty types as against the formidable list of types at present available, which approaches 1,000 different types.

The scheme in its final form is essentially based around five specific types of valves, as follows:

Type "A"

This is a screened triode-hexode of the type in which the first grid of the hexode is common with the triode-grid, having an indirectly-heated cathode and a 6.3 volt 0.3 amp. heater.

In addition to its customary use as a frequency changer, such a valve can also be used as an R.F. variable-mu amplifier; a variable-mu I.F. amplifier and diode for A.V.C.; as a demodulator diode and as a controlled variable-mu A.F. amplifier, tetrode or triode; as a two-input circuit mixer and, of course, also as any constituent part of the above combinations.

Type "B"

A universal output tetrode valve of the type capable of working at 100 screen voltage having an indirectly-heated cathode with a 25-volt 0.3 amp. heater.

Type "C"

A two-system rectifier of the type in which all electrodes are brought out separately, having indirectly-heated cathodes with a 25-volt 0.3 amp. heater.

Receivers designed on the use of these three types could equal any receiver at present available. In fact, a set incorporating Types "A," "B" and "C" would result in a greater all-round advantage—at a lower cost to the manufacturer and consumer.

Such features as automatic inter-station noise suppression, automatic volume control, post demodulator, automatic volume level maintainer, would, with the incorporation of these three types, be included without difficulty, thereby proving of sales advantage in the home and export field.

The scheme envisages all receivers as A.C./D.C. supply types, thus entirely eliminating the need for mains transformers and, in the case of the smaller sets, also eliminating the smoothing choke, thereby saving a considerable amount of high-quality transformer (or Swedish) iron and copper (former important source—Belgium).

Adoption of these three types would, it is estimated, solve 70 to 80 per cent. of the market requirements for radio receivers.

Type "D"

A battery valve type, analogous to Type "A," having 1.5 volt 0.05 amp. filament. Its functions are identical to Type "A."

Type "E"

Analogous to Type "B," but having a centre-tapped 2.8 volt 0.05 amp. filament.

Types "D" and "E" can be used to fulfil the majority of requirements outside the field of utility of Types "A," "B" and "C," but two or three of the additional existing 1.5 valves would also be required in the initial stages of the scheme.

The ultimate national production of the proposed five types of valves would actually aid the valve manufacturing industry by ultimately eliminating "frozen" stocks of diverse types while similarly aiding production on the restricted amount of material now available, for home and particularly export trade.

This is important in view of the following essential imports:

Pure nickel: Scandinavia and U.S.A.
Pure molybdenum: main sources U.S.A.

Eliminating two hundred odd types of glass bulb shapes which, owing to cut-off supplies from Belgium and Czechoslovakia, are at present being manufactured in this country, to the detriment of other glassware export.

A Summary of Discussion of the Objections to Mr. J. A. Sargrove's Proposals

1. The standardised component parts suggested do not affect the ultimate performance of receivers or impose limits on the design of specialised receivers; the resultant performance of the suggested design can be confirmed by *independent* and qualified Radio Engineers.

2. The scheme will provide the Radio Manufacturer and Designer with an adequate but limited number of components.

3. The technical objection that certain specialised apparatus will still require specialised types of valves is undeniable, but does not materially affect the scheme, since of the ten to twelve million radio receiver valves absorbed by the Radio Receiver Industry, well over 80 per cent. are used in sets in which the five specified types of valves could be satisfactorily used. The other 20 per cent. is made up of Replacement Valve business which, if the above proposed scheme is put into effect, could be easily satisfied for the next eighteen months to two years from the *existing* available stocks of diverse types.

4. The specialised types of valves manufactured have always been less than 10 per cent. of the normal Receiver Valve business, and the adoption of the scheme put forward will undoubtedly expedite production of the specialised types which may still be required for the Defence Departments, the B.B.C. and the G.P.O.

Summary

Consideration and development of these proposals by a technical committee representing the industry will undoubtedly contribute to our occupying a more influential position in the world market both now and after the war.

For The Beginner

The Differential Condenser

A Description of This Special Type of Variable Condenser and Its Various Circuit Applications

It is sometimes noted that a specification includes a "differential" condenser—generally for reaction purposes. In view of the rather infrequent use of this type of component certain amateurs are not quite clear as to its special design and application, although the fact that it has three sets of plates in comparison with the usual two sets of moving and fixed vanes, may be known. Fig. 1 shows the theoretical symbol and the general form of construction of the differential condenser and it will be seen that, from the theoretical point of view, it is really two condensers in series. There are two sets of fixed vanes mounted exactly opposite each other, and the spindle carries a set of moving vanes of standard shape and arranged in the same manner as on a normal variable condenser. The moving vanes are semi-circular in shape, so that when the spindle is half-way through its total arc of rotation each set of fixed vanes has an equal section of the moving vanes intermeshed with it. Thus each separate condenser (considering them as two in series) will be of equal value which at the mid point will be half the maximum value. This position is indicated in Fig. 2. It will be obvious from this that as the capacity of one condenser is increased that of the other is decreased, the balance between the two sections being maintained.

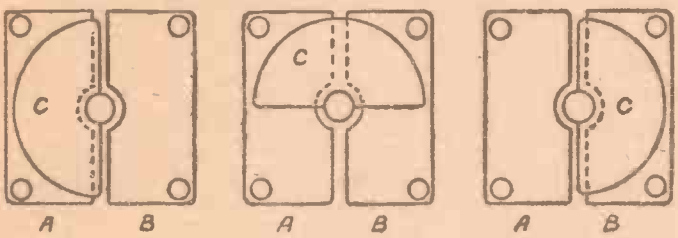

Fig. 2.—Plan of the vanes of a differential condenser, showing three different settings of the condenser.

Now there are several uses to which a differential condenser may be put, but we will deal first with its most common application, namely, its use as a reaction control.

By-passing the H.F. Currents

For many years now the standard method of controlling reaction has been by using a reaction coil with a fixed number of turns of wire and fixed coupling, and to vary the current through this by connecting it in series with a variable condenser. This method is illustrated in Fig. 3. However, as shown here, it has certain drawbacks. The most obvious is that when the reaction condenser is set at a minimum there is no easy path for the H.F. component of the anode current of the detector valve.

The anode current of the detector valve may be considered as consisting of three separate parts. There is the steady direct current from the high-tension supply, the rectifier speech current, and the amplified H.F. impulses. It is the last-named which are used for reaction purposes. They are fed back by means of the reaction coil, and superimposed on the input current. Now, apart from its use for reaction purposes, this H.F. part of the anode current is not really wanted. If it finds its way to the grid of the next valve it will cause distortion and possibly actual howling. Again, if it is allowed to pass on round the anode circuit when an H.F. stage is used before the detector, then it is possible for it to cause undesirable back coupling through the medium of the common impedance of the H.T. source.

The usual thing to do with this unwanted current is to impede its progress by including an H.F. choke in the anode circuit of the detector immediately following the anode itself, as shown in Fig. 3. This choke acts as a barrier, and prevents its travelling farther than the anode of the valve. However, the choke is not in itself sufficient, and the "unwanted current" may be strong enough to force through this barrier unless some alternative path is provided. In Fig. 3 this alternative path is through the reaction coil and reaction condenser to the filament. It is indicated by the arrows. Now when the reaction control is "turned on fully," that is, when the reaction condenser is set somewhere near its maximum capacity, this path offers a very easy exit, but when the reaction condenser is set to its minimum position it presents a very high impedance, and the "unwanted current" has no escape.

This is where the differential condenser comes in. It is connected as in Fig. 4. Now a moment's consideration shows us that whatever the setting of this condenser the by-pass effect is always constant. When the condenser is in the "full-on" position then the H.F. currents travel from the anode via the reaction coil, the fixed vanes A, and the moving vanes C, to the filament, as shown by the arrows in the left-hand diagram in Fig. 4. When the reaction is "turned-off" then the path of the H.F. impulses is from the anode to the fixed vanes B, thence via C, to the filament. In any intermediate position the currents follow a divided path—partly through the reaction coil and A C, and partly through the path B C.

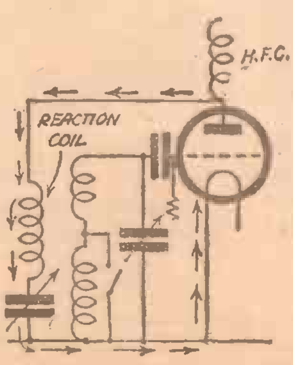

Fig. 3.—The orthodox method of controlling reaction, using an ordinary variable condenser.

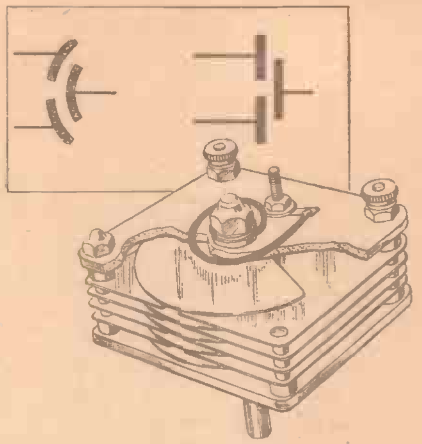

Fig. 1.—The elements of a differential condenser. Above, two ways of representing a differential condenser diagrammatically.

High Note Cut Off

It may be argued that if the only drawback to the ordinary reaction condenser is that it does not provide an alternative path for the H.F. component when it is set at zero, then a fixed condenser between anode and filament, as in Fig. 5, is all that is needed. Admittedly, this often provides a solution of the problem if the value of the fixed condenser is carefully chosen, but even so it has not quite the same advantages as the differential method. For one thing, the value of the fixed condenser must be sufficiently large to by-pass the H.F. current when the reaction condenser is at zero. However, this value may be *too* large when a reaction condenser is all in, for the total value of the by-pass condenser and the reaction condenser may be such as to by-pass some of the higher audio-frequencies and thus mar reproduction by loss of the higher notes. It is also found in practice that the use of the differential condenser provides a smoother control of reaction. It certainly provides a greater *range* of control than an ordinary condenser of equivalent value used in conjunction with a by-pass condenser, for when the differential is in the "full-on" position, nearly 100 per cent. of the current passes through the reaction coil, while when it is in the "off" position practically all of the current passes direct to the

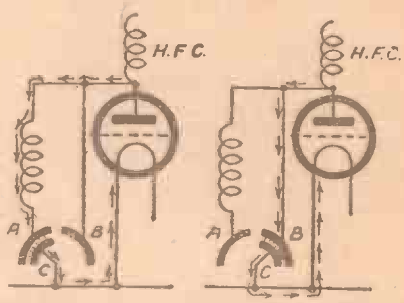

Fig. 4.—Showing the connection and the working of a differential reaction condenser.

(Continued on next page).

THE DIFFERENTIAL CONDENSER

(Continued from previous page).

filament via B C (see Fig. 4), and only the smallest fraction (due to the minimum capacity between A and C) passes through the reaction coil. This is an advantage with some circuits. For instance, with some multi-range coils there is considerable difference necessary in the setting of the reaction condenser on one wave-band compared with another.

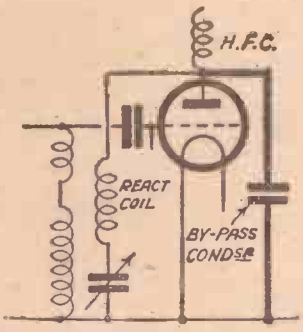

Fig. 5.—The use of a by-pass condenser. See text.

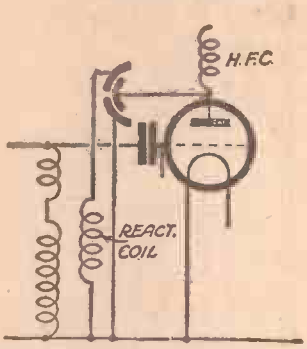

Fig. 6.—Alternative connections for a differential reaction condenser.

The "Differential" as a Volume Control

The connection for a differential reaction condenser, shown in Fig. 4, is not the only possible arrangement. Another version is shown in Fig. 6. Differential condensers are also used for a variety of other purposes besides reaction control. One of the best known is as a volume control which works by varying the aerial input. The circuit is shown in Fig. 7. When the moving vanes of the condenser are completely interleaved with the fixed vanes marked A, then the input to the tuning coil is at a maximum and loudest signals result. As the moving vanes are rotated towards the other set of fixed vanes, so the input via C A is reduced and at the same time the aerial currents find an alternative path direct to earth via C – B.

This type of volume control has the advantage that it is very simple, noiseless in operation, and covers a large range, it being possible to cut down the most powerful stations to a whisper. Its disadvantages are, firstly, that even at the full volume setting there is some slight reduction of input owing to the fact that there is still a small minimum capacity existing between C and B. Secondly, that variation of the control means slight variation in the wavelength of the aerial circuit, so that when the volume control is operated it may be necessary to readjust the aerial tuning condenser. If this latter is ganged this will naturally be impossible. Incidentally, with this form of volume control the selectivity will be increased as the volume is reduced.

A similar use for a differential condenser is as a variable coupling between the H.F. valve and the following grid coil in a tuned-grid circuit. This is also shown in Fig. 7. The condenser used as a variable coupler is represented at D E F. Here the action is precisely similar to that of the differential condenser A B C. In the same way that A B C controls the input to the first valve, so D E F controls that to the next valve (in this case the detector). In practice it is hardly necessary to include both devices in the one circuit, as in Fig. 7, as more than sufficient control can usually be obtained with either one or the other. The variable coupler, however, is sometimes used, in conjunction with an ordinary pre-set or variable condenser, in series with the aerial as an additional selectivity control.

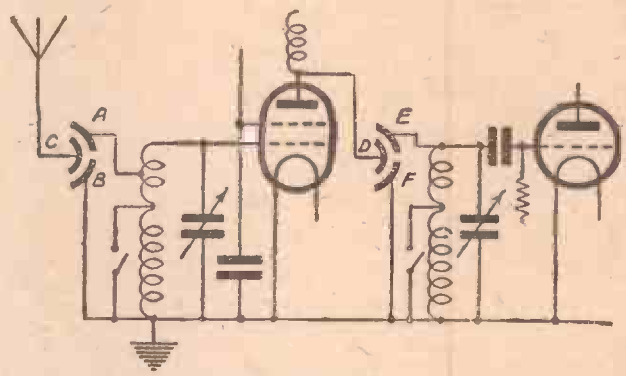

Fig. 7.—Differential condensers used as volume and selectivity controls.

LATEST PATENT NEWS

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

NEW PATENTS

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

Latest Patent Applications.

9819.—Cole, Ltd., E. K., and Kennedy, F. W. O.—Tuning mechanism for radio-receivers. June 5th.

9841.—Hazeltine Corporation.—Television systems. June 5th.

9703.—Philips Lamps, Ltd. — Wireless receiving-sets. June 3rd.

9471.—Standard Telephones and Cables, Ltd.—Generation and transmission of radio waves. (Cognate with 9470.) May 30th.

9470.—Standard Telephones and Cables, Ltd.—Generation and transmission of radio waves. May 30th.

9472.—Standard Telephones and Cables, Ltd.—Generation and transmission of radio waves. (Cognate with 9470.) May 30th.

Specifications Published.

521637.—Radioakt.-Ges. D. S. Loewe. —Deflection of cathode-ray beams.

521710.—Kolster-Brandes, Ltd., and Arnold, J.—Remote-control systems, particularly for radio-receivers.

521711.—Kolster-Brandes, Ltd., and Beatty, W. A.—Antenna systems and supporting structures.

521714.—Standard Telephones and Cables, Ltd., Terry, R. St. G., and Beard, J. R.—Electromagnetic relay switching devices, particularly for radio equipments.

521809.—Philco Radio and Television Corporation.—Method of assembling and welding loud-speaker parts.

521808.—Philco Radio and Television Corporation.—Loudspeakers of the electrodynamic type, and methods of assembly thereof.

521810.—Philco Radio and Television Corporation. — Sound - reproducing devices.

521811.—Philco Radio and Television Corporation.—Loudspeakers.

521872.—Kolster-Brandes, Ltd., and Brigham, C. E.—Thermionic valve circuits.

521873.—Television and picture-transmission systems.

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

PROGRAMME NOTES

"Up The Poll!"

ALLAN MACKINNON and Jack House, pioneers in writing for radio in Scotland, have resumed partnership and collaborated in what they have described as a "Mass Observation Musical Comedy," to be broadcast on June 27th. It is called "Up the Poll," and deals with events in a country whose happy people astonish the world. Nothing ever goes wrong in Morania, where the Government, having studied public opinion surveys and American magazines, employs a firm of professional public pulse-holders to find out what the country wants. Thus the king is able to make perfect laws, because of the so-called infallibility of the percentage polls. But, as the listener will find out, everything in the garden is not quite as lovely as that. Allan MacKinnon is well known in the film world, having been jointly responsible with another Scot, Roger MacDougall, for the scripts of "This Man is News" and "This Man in Paris."

Denmark

A FEATURE telling listeners in this country of the peaceful life which was led by the people of Denmark right up to the eve of the German invasion on April 8th, 1940, will be broadcast on June 27th. The programme will consist of four scenes and will be performed by members of the B.B.C. Repertory Company. The story has been written by Marianne Helweg and her father, J. H. Helweg, and will be produced by Laurence Gilliam.

ON YOUR WAVELENGTH

By Thermion

Aliens and Radio

A GOOD deal of publicity has been given to the official announcement that some hundreds of aliens were engaged by the B.B.C. A considerable amount of resentment has also been aroused at this revelation, and also parliamentary criticism has been raised against the employment by the B.B.C. of aliens. Naturally, I have received a very large post on this problem, and the questions which readers ask I am unable to answer. For example, one reader wants to know why foreigners are employed in the *British* Broadcasting Corporation; they want to know whether these foreigners are of such calibre that there is no Englishman of equal ability. Is is necessary to have a foreign-sounding name before the B.B.C. will employ you? Why are not all foreigners turfed out of the B.B.C. now that we are at war? Especially, why are not all Germans and Italians turfed out and interned? And so on and so on! As I have said, I cannot answer these questions. There are many Germans employed in England, and some of them have been in this country for many years. We may assume that they are friendly, but I wonder what would happen in the unlikely event of the Germans arriving here? We cannot afford to take the slightest risk. A German cannot change his nationality any more than the leopard can change its spots. I wonder whether there are any Englishmen employed in the German Broadcasting Stations? I wonder, indeed, whether any foreigners short of Haw-Haw, and Lady Hee-Hee, are employed there? I will wager not.

One would imagine that this is a most elementary matter concerning which we should not take the slightest risk. I hope that by the time you read these words something drastic will have been done.

A.R.P. Receivers

ALTHOUGH appeals have been made for radio apparatus for the use of A.R.P. staffs, etc., dealers can also help in this connection. A trade paper recently quoted a case where the members of a post had overcome the difficulty of obtaining a receiver. The members, especially of the A.F.S., work in many cases in shifts of 12 hours, and some form of radio is essential not only to pass away the time but also for the reception of news. The article goes on to say:

"Who provided the radio?" I asked the leading fireman at the sector to which I am attached.

"We did," he replied. "As it took the authorities a long time to realise we must have something to make waiting tolerable, we clubbed up, 2d. per man per week, to raise the money for the set you are now listening to. One of us signed a document and agreed to collect the coppers and pay the dealer.

"Then the full-time crews were assisted by part-time men, and they got the benefit of our set. We put it to the A.F.S. officers that they should provide the radio. They agreed, took over our agreement and are now making the payments.

"There is now no need for crews to buy their own radio sets for the sectors. Arrangements for the installation of radio are made by the authorities."

Observe how the initiative came from the lower ranks. What can be done in one place, a big city with hundreds of sector posts, can be done in other places.

Limitation of Supplies

UNDER the Limitation of Supplies (Miscellaneous), Order, 1940, many articles are restricted as to supply for the home market. These restrictions apply to a miscellany, such as candelabra, pendants, lanterns, bowls and reflectors, musical instruments, such as gramophones, radio gramophones, pianolas, and accessories for such instruments, excluding wireless receiving sets, sound amplification wireless apparatus, music strings (!) and loudspeakers. It also includes gramophone records, and the idea is, I suppose, to conserve supplies of material for war, and for export purposes.

Our Roll of Merit

Our Readers on Active Service—Second List.
Home addresses only are given.

W. L. Bicknell
(Searchlight Detachment),
38, Albion Road, Westcliff-on-Sea, Essex.

C. J. Robinson
(Private, Infantry),
Bury St. Edmunds, Suffolk.

A. Johnstone
(L/Cpl., Searchlight Unit),
nr. Boston, Lincs.

E. Cusack
(R.N.),
Portsmouth.

E. Howgate
(Sapper, R.E.),
Walsingham.

J. M. Whendon
(Lieut., R.N.),
Gosport, Hants.

W. G. Webb
(Sapper, R.E.),
Hornsey, N.8.

D. Coney
(A.C., R.A.F.),
5, Spa Street, Lincoln.

The New Station

SO at long last a Midland town is to have its own transmitting station, which will include fixed and mobile transmitters. It is not stated as to when the construction will begin, but the Home Office urges an early installation, so that it can be used in connection with the capture of criminals, as well as for the dissemination of war news. It is said that the equipment will cost £2,500.

Our Roll of Merit

A FURTHER list of names is published this week. I want to make this list as complete as possible, so if you are serving the country in any way I hope you will write to me letting me know your name, home address, military number, and unit, adding a few words as to how you are faring. It is only right that this journal should set on record the names of its readers who are serving the country.

Those readers who have already written to me from France and other countries state that in spite of the bitter struggle in which they are engaged, they are having this journal sent to them each week, and it provides them with a pleasant relaxation from fighting.

No Sooner Said . . .

A FORMATION of six Fighter Command Hurricanes was on patrol recently over the sea off the south coast of England. Suddenly the leader spotted a German Henschel aircraft 2,000 to 3,000 feet below. He spoke into his radio-telephone, addressing one of his accompanying pilots.

"Hello. There is a Hun below you. Go and deal with it."

The Hurricane pilot to whom the radio message was given left the formation and dived down without a word. He went straight at the Nazi aircraft below, pressed his gun button to send a few hundred rounds of ammunition into it, and saw it go down in flames to the sea.

He then climbed back to rejoin his flight.

Again the Squadron Leader's radio-telephone spoke.

"Hello. Hello. Did you get my message? Repeat, did you get my message? Over to you."

Back came the laconic reply from the successful pilot: "Your message received. Your message received . . . and understood. Over to you."

"The Radio Training Manual"

ALL readers who have reserved copies of the "Radio Training Manual" should apply for their copies according to the instructions immediately. In these days of paper shortage it may not be found possible to reprint it. This book has already played an important part in the war effort in helping to train radio operators, so claim your copies before it is too late.

Comment, Chat and Criticism

Outline of Musical History–6

A Brief Sketch of the Life and Works of Beethoven, by Our Music Critic, MAURICE REEVE

WE have now arrived at the greatest name in all musical history.

Ludwig van Beethoven, who was born in 1770, and died in 1827.

As with Shakespeare, Leonardo da Vinci, Dickens, or any other supreme genius, we do not say that any one of them is the greatest master of his craft merely because we prefer his work to that of his fellow craftsmen. Nor do we award him the crown of supremacy because a majority prefers it to any other master's. No, it is far from being a matter of personal taste or prejudice. But rather do we award it for what he did for his art than for any collection of works he may have given it. And of Beethoven it can truly be said that he contributed more ideas to music and laid down more laws for musicians to obey than any other composer. Like Napoleon, whom he admired so much for a time, he was a legislator and statesman, philosopher and pedagogue; as well as the fashioner of wonderful compositions.

Many others have written wonderful works, but they have not exerted influence on others' thought to anything like the same extent.

He made instrumental music supreme and proved that it could work miracles without the extraneous aids of words, acting or scenery. He is the supreme classicist, and completed the work of Haydn and Mozart, to whom his debts should not be overlooked.

Symphony and Sonata

He took the symphony of his two great predecessors on to the heights where it still remains. He perfected the sonata. But whereas he was succeeded by at least one great symphonist, no one has as yet approached him in his supremacy in the latter genre. In writing sonatas his methods were entirely different from those of anyone else, and in his own greatest examples he makes use of every phase of musical self-expression. Whole movements are written, for example, in variation or fugal form. Marvellous tonal contrasts and modulations are to be heard throughout the collection, more particularly in his choice of keys for the second subject.

But it was in his revolutionary uses of rhythm that Beethoven showed the most astounding originality, and in which he most widely opened the path for his successors. In such examples as the D Minor and F Minor sonatas, and the Seventh Symphony, his handling of it marked the commencement of a new era.

He also developed the minuet and trio into the monumental scherzo, and, here again, his own creations have never been rivalled. He removed all the "padding" from a symphonic work, which even the greatest examples of Haydn and Mozart suffered from to some extent. And he finally removed the rough edges from the form. He also invented the coda.

Three Periods

Beethoven's music is easily divisible into three marked periods. He was always striving and seeking after something new: something he felt the form he was working in needed for its completion and consummation. The last of his scherzos, from the Ninth Symphony, and the last of the piano sonatas are clear cases.

The three periods of his creative genius might not inappropriately be termed the "student," the "master," and the "visionary." The first ends with the Second Symphony, and includes the first twenty sonatas, the six quartets Op. 18, the C Minor piano and violin sonata, and the first two piano concertos, etc. All these works clearly foreshadowed the mighty masterpieces that were to come, and established their author as the most original composer of the day. At the same time they prove his acknowledgements to his masters and predecessors; the influence of Haydn in particular is very evident. Side by side with daring innovations and a constant spirit of empiricism is a most catholic regard for his antecedents.

The second is truly a cataclysm of stupendous works. Never were prophecies more fully borne out. Symphonies 3 to 8, the Archduke Trio, Fidelio, the Waldstein, Appassionata and Kreutzer sonatas, the forth and fifth piano concertos, and the one for violin, the Rassoumowsky quartets, the Leonora overtures, and scores of other works. An unrivalled output—the period covers about twelve years—which embraces a range of thought and a universality of musical expression that no other master can rival.

The third period clearly shows the master with his thoughts stretching out into the future and into another life. Struck with deafness and racked with pain and disillusionment, his mind is seeking the peace and tranquillity that this world so signally failed to give him, whilst his message is being conveyed to generations yet unborn, but far more likely to heed the prophet and seer than the living teacher.

Closing Years

The works of the closing years of his life take on a diffuseness and speculative character, and are an ethereal and visionary quality. If they can be charged with being less incisive and terse than their immediate forerunners, and to be too abstract and disquisitious, they are among the most sublime and imaginative works in all music, and over a hundred years acquaintance with them have not been sufficient to plumb their profound depths and extract their wealth.

The Ninth Symphony, the Missa Solemnis, the last five piano sonatas, the last six quartets, the Diabelli Variations, etc., are among the masterpieces of this last period.

The briefest sketch of Beethoven's life can serve as a conclusion to this article. He was the son of the third generation of a musical family that had settled in Bonn. His father and grandfather were both dissolute drunkards, though good musicians, especially the latter, who was employed at the Electoral Court. Young Ludwig was cruelly overworked at his musical studies, and on his father's death found himself responsible for his mother and a numerous family.

He was a wonderful improviser, and on his first visit to Vienna in 1787 Mozart, greatest of all musical phenomena, was amazed at his inventiveness and brilliance. This hard and bitter childhood and youth brought him up against life's realities very early, and this fact unquestionably did more than anything else to impart that ruthless and uncompromising character that is the feature of all his work.

Haydn, then the doyen of musicians, also thought very highly of him. Consequently the Elector sent him to Vienna to study with the composer of "The Creation." But they did not get on very well together: young Beethoven's empirical and ardent nature frequently coming into contact with the older man's resting on his laurels, and more contented philosophy. As an example may be cited the incident when Beethoven dedicated the three sonatas, Op. 2, to his master. When it was suggested that the dedication should be made to read "to my master Joseph Haydn," the reply was terse and to the point. "Why, Haydn didn't teach me anything!"

As a Pianist

He then studied with Albretsburger, and proved himself a brilliant pianist in many concerts. He had the good fortune to meet most of the leading figures of the aristocracy, and men like the Archduke Rudolph, Prince Lobkowitz, Count Waldstein, and Prince Rassoumowsky, were faithful patrons.

But the shadow of his future deafness now appeared and warned him of what fate was holding in store. Because of it he had to abandon his pianistic activities. It is doubtful whether, even at this early period, he could hear much of what was played. But, during most of his third period it has been established that he couldn't hear anything, and the authentic story of his conducting his Seventh Symphony at a benefit concert and having to be turned round to face the audience as he couldn't hear their tumultuous applause is typical of the state he was in.

A worthless brother, apparently typical of the strain, died and left a boy for whom Ludwig developed the most extraordinary fondness. He took sole charge of him, and the story, far too long to be told here, is one of the most tragic pages in the master's life.

It must be admitted that he showed an inherited liking for intoxicants, but the wonderful nobility and fortitude of his character, coupled with his slavish devotion to his art, generally kept it well in check.

His death reads like a page from Greek tragedy. Blind at the last as well as stone deaf, racked with pain and in the direst poverty, he was buried during a snowstorm amidst every sign of public grief and homage. Among the pall bearers—all notable musicians—was Schubert. On the way home they stopped for some refreshment, and Schubert—then 29—raised his glass "to the next one of us to go." He it turned out to be—two years later!

Control of Selectivity and Quality

Some Simple Methods of Obtaining Better Reception of the Two B.B.C. Programmes, by Eliminating the Need for Very Sharp Tuning

by The Experimenters

SINCE reception is now largely confined to the two B.B.C. programmes, put out by what are virtually "local" stations, it is often possible to improve the quality of reproduction without any sacrifice in other directions. When a receiver is used for bringing in a large number of programmes the question of selectivity is very important. And as most readers are aware, selectivity and quality seldom go well together. This is because, if tuning is sharpened, there is bound to be a certain amount of cutting of the higher audio frequencies.

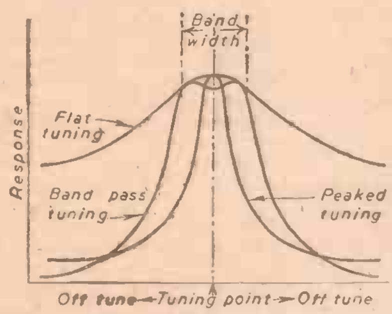

Fig. 1.—These familiar curves show the effect of using different tuning systems. When tuning is flat a wide audio-frequency range is covered, but interference is probable; with peaked tuning the reverse is the case; band-pass allows quality to be combined with selectivity.

Broader Tuning

To improve the response to these higher frequencies it is necessary to broaden the tuning by one of many methods. One of the simplest is by connecting the aerial directly to the top of the first tuning coil; another is by making the coupling between the aerial and grid windings (when there is a separate aerial winding) closer. These methods, and others which are similar in effect, are seldom desirable, since they merely make the set respond to a wider range of frequencies, the response gradually diminishing from the resonance point. Band-pass tuning provides a far more effective and efficient means of extending the response, since with it the response is practically uniform over a range of, say, 12 kc/s, but falls rapidly beyond this. The point is shown by the two familiar diagrams in Fig. 1.

Increasing Band Width

Although band-pass tuning was very popular a few years ago, it is not used very extensively to-day. When it is, the frequency band covered is generally restricted to 9 kc/s or less. In present conditions it is often possible to cover a wider range without running the risk of interference or "side-band splash." The method of increasing the band-width depends upon the particular form of band-pass circuit employed. When "bottom-capacity" coupling is employed, as shown in Fig. 2, it is necessary only to *reduce* the capacity of the coupling condenser. Thus, if the condenser in use has a capacity of .05 mfd. it may be worth while to replace this by one of about .02 mfd.

If a few fixed condensers of between .01 and .05 mfd. are available it is worth while to try them all. When the two most suitable capacities have been found (one for selectivity and one for quality) it is a good plan to fit a single-pole change-over switch for them, as also shown in Fig. 2. Thus, one position of the switch can be described as the "selectivity" position and the other as "quality."

Other Filters

The general method described is often applicable to modified forms of band-pass filter, such as those of the "mixed" type with which both capacity and inductance coupling is used. In that case the chief difference is that the condenser has a lower capacity. It is seldom satisfactory to modify the coupling coils in circuits of this kind, unless the tuners are home-made, in which case a few experiments can easily be made.

When a single-circuit aerial tuner is employed—this is generally made to tune as sharply as possible—it is often a fairly simple matter to convert it to a band-pass arrangement by employing the circuit shown in Fig. 3. An extra coil is required, which must be exactly the same as that originally used alone, and also a small variable condenser to provide "top-capacity" coupling. The additional coil must be tuned, and this can best be arranged by replacing the single condenser by a two-gang type, or by ganging another similar condenser with it, when this is possible. With many condensers ganging cannot easily be arranged, due to the fact that the spindle does not project from the base; when it does, a coupling collar of the self-aligning type can easily be used to join two condensers together.

"Top-capacity" Coupling

It is possible to use two separate condensers, but tuning is not always easy when that is done, and if both are not set accurately quality may be impaired rather than improved. A .0001-mfd. differential

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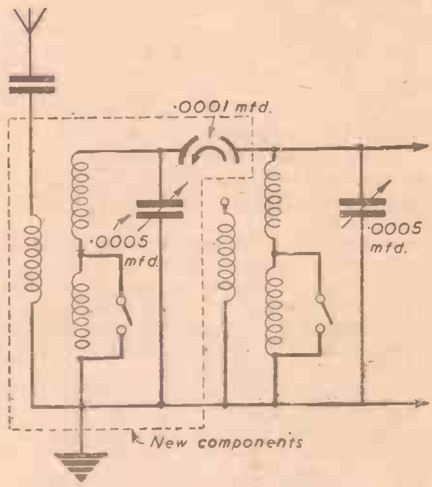


Fig. 3.—A simple form of "top capacity" band-pass coupling by adding a second tuning circuit and small coupling condenser.

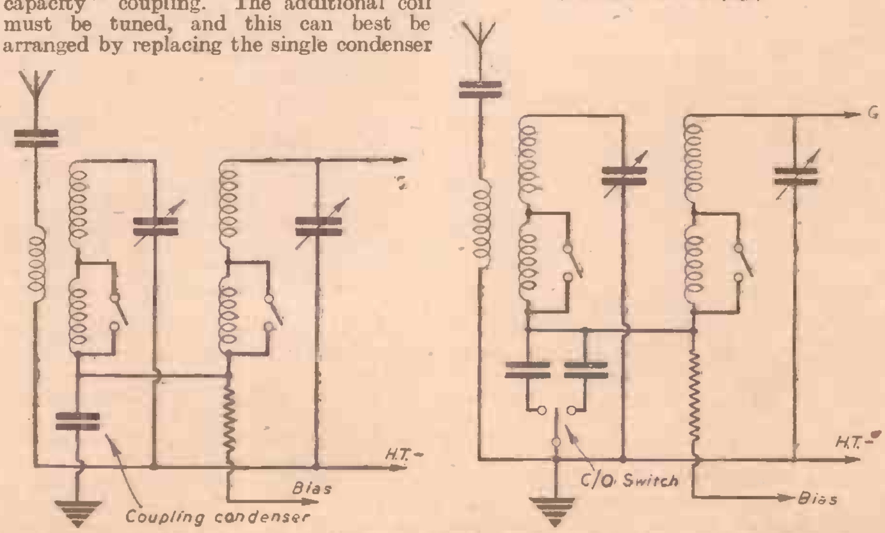


Fig. 2.—A "bottom-capacity" band-pass circuit can be modified to give two alternative band widths by fitting two condensers of different value and a change-over switch.

CONTROL OF SELECTIVITY AND QUALITY

(Continued from previous page)

condenser is shown in Fig. 3 for coupling the top ends of the two coils together. This is convenient since, by making connection to the two sets of fixed vanes only, the maximum effective capacity is reduced to .00005 mfd. and the minimum to a very low figure. As an alternative to this a neutralising condenser may be used if one of these can be found in the junk box.

In any case it is necessary to adjust the "top-capacity" condenser so that the widest possible frequency band is covered consistent with the elimination of interference. The higher the capacity the closer the coupling and the wider the band. When using a differential condenser the highest capacity is produced by setting the knob to the midway position—so that the moving vanes are half in mesh with both sets of fixed vanes. Movement of the spindle in either direction from this point reduces the coupling capacity.

Superhet Tuning

In the case of a superhet the input tuning circuit can be modified, if necessary, in one of the ways already described. But many modern superhets do not use band-pass tuning and selectivity is governed largely by the I.F. transformers. As most readers are aware, an I.F. transformer can be said to constitute a form of band-pass filter, and selectivity may be varied by altering the degree of coupling between the primary and secondary windings. Thus, if the two coils are moved closer together tuning is broadened, and *vice versa*. Sometimes it will be found convenient to move one of the windings on the central pillar; by bringing the windings closer together the response band is made wider.

When the primary and secondary coils are fixed it may be unwise to attempt any alteration of this kind, since the component may be damaged. Instead, one good plan is to connect a pre-set condenser between the anode and grid terminals as shown in Fig. 4. A condenser of .0005-mfd. maximum capacity is shown, but a .001-mfd. component is better in some cases; this depends largely upon the particular component. It might be considered better to use a fully-variable condenser of either

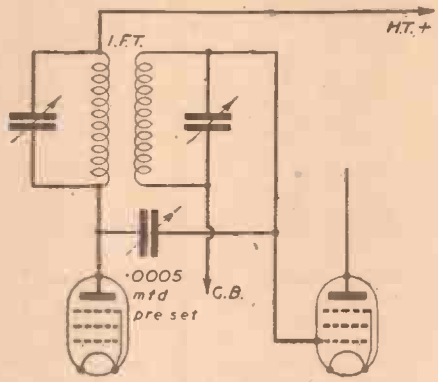


Fig. 4.—"Top-capacity" coupling applied to an I.F. transformer.

the bakelite or air-dielectric type, so that selectivity can be under full control from the panel. If this method is adopted it will be best to screen the condenser, earthing the screen. A small aluminium box can be used, taking great care that it is properly insulated from the condenser itself. It is not necessary to provide variable selectivity on more than one I.F. transformer, and opinions differ as to whether the control should be on the first or the last. We prefer to have it on the first, for then the others can be made to tune fairly broadly without running much risk of introducing interference. Those who wish to experiment can try making each transformer adjustable in turn.

Another I.F.T. Modification

Another method of making I.F. transformers to provide variable selectivity is to place a small winding between primary and secondary. This should have about 25 turns, and a 50,000-ohm variable resistor should be connected between its ends; apart from this, the winding is not electrically connected to any other component. When the resistor is set to a high value the tertiary winding, as it is called, serves as a means of coupling, but the coupling effect is reduced as it is gradually "short-circuited" by reducing the effective value of the parallel resistor. Should this method be applied to an existing transformer it will generally be found best to separate the windings slightly before adding the tertiary winding, to prevent the coupling from becoming too close. Here again there is scope for experiment.

B.L.D.L.C. The British Long-Distance Listeners' Club

THE absence of amateur transmitters from the air in many countries has made a considerable difference to the activities of members, and in many cases also has, we are afraid, led to a reduction in interest. There are, of course, still plenty of commercial stations which can be received and, although these are using very much higher power than amateurs, they do afford some fields for experiment. Amateurs are still working in U.S.A. and although certain parts of this continent are easily received, experiments in selectivity may be carried out at suitable times, with just these stations as a guide. One of the difficulties in using American amateur transmitters for test purposes is that owing to the different restrictions applying in that country and to the apparatus and money which is available to the amateurs, some elaborate aerial arrays are being used. These are of the directional type and when working European amateurs they used to beam their signal, which, of course, gives a stronger signal here, with a small output of power and if it was not possible to hear what type of aerial they were using, you might be misled into thinking your receiver was extra-efficient. However, at the present time, a very good test is to listen to these amateurs, and note when they are working other Americans in a different part of the continent and on reference to a map you will be able to see whether or not they are using a beam aerial which is non-directional to this part of the world, which would, of course, be equivalent to the use of an ordinary aerial and thus give you some guide as to reception conditions.

One Valve Sets

A MEMBER has asked us if we can recommend a one-valve set capable of "phenomenal" results. This is rather a sweeping request, and as we have pointed out in other columns of this paper from time to time, the so-called "super" and other types of receivers are generally very tricky to get going, although undoubtedly when properly working they do give results exceeding those normally expected from the number of valves in use. The modern double type of valve lends itself, however, to many circuits, and a special American-type valve was introduced some time ago to facilitate the design of such receivers. It consisted of a triode and S.G. valve in one envelope and the characteristics are such that it is possible to construct a detector L.F. receiver with the single valve. This operates with a 1.4 volt filament, and is a straightforward circuit, although a similar arrangement could also be made up round a standard Class B valve using one triode as detector and one as L.F. Reflex circuits and similar arrangements are not generally found worth while to-day, but we shall be glad to hear from any members who have experimented with this particular type of receiver with really reliable and worth-while results.

Signal Strength Measurements

A MEMBER recently constructed a communication type receiver and now raises a point concerning the use of a signal strength or "S" meter. This is quite a common fitment on many commercial communication sets and this member raises the problem as to its utility. As he points out, it is really just as arbitrary as the ordinary "R" code used by amateurs without a meter and as we pointed out some time ago in these pages, there is no standardisation at the moment of signal strengths. The "S" meter is usually merely an anode current meter and shows only the comparison between different signals and thus the user has first to decide what will be R9, and gauge the remaining values according to the scale of his meter. Even when a receiver is fitted with such a meter calibrated in R values, the readings are of little use to the transmitter whose reception you are reporting unless he knows the receiver and the type of output it gives, or is familiar with any other reports you may have made on the same receiver. The only satisfactory signal strength meter is that which measures the actual incoming H.F. or, alternatively, measures the audio output against the aerial input, and this is not such a simple problem.

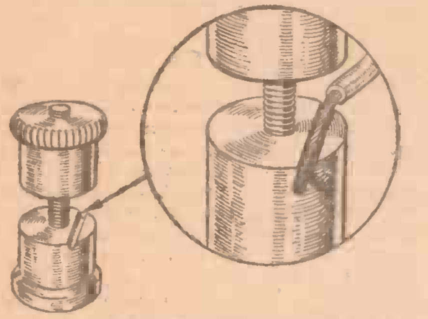
Contacts Wanted

RICKMANSWORTH—Member 6426, 39, Malvern Way, Croxley Green, Rickmansworth, Herts. (This member wishes to get in touch with a reader, about 17, interested in learning morse.)

Practical Hints

Fixing Wire Under Terminals

I USUALLY find when fixing flex wire under terminals that it is either squeezed out of the sides, or else a strand somehow



A simple dodge for clamping wire under terminals.

gets loose and jams the terminal head before it is properly screwed down. To avoid this I filed a groove in the terminal shank, as shown in the sketch, and after twisting the flex wire I placed it in the groove and screwed down the head. Instead of being pushed out, the wire is just pressed into the groove and held fast.—J. T. WHITELEY (Northampton).

Fixed Condenser Tips

WHEN it is required to ascertain the capacity of a condenser of a fairly small value, a simple method is to connect it across one of your tuning condensers and note the reduction necessary to tune-in a known station. This difference will indicate, after a little experience with this method, the capacity which the fixed condenser bears in relation to the tuning condenser in question.

When testing a disconnected mains set in which large smoothing condensers are used, it is very advisable to short-circuit such components before interfering with any of the wiring, otherwise there will be the possibility of a nasty shock being obtained by the charge held by the condenser.—E. BOLTON (Derby).

Home-recording

AFTER making several poor attempts at home-recording I have at last succeeded in making a record indistinguishable from a commercial product. I have found several essential features which I now give for the benefit of others who may have proved unsuccessful in their attempts. I scrapped a pentode output stage, as I found that one main difficulty was matching the cutting head to the output stage. A triode valve is not so critical for matching and thus simplifies this part of the circuit. Next I *had* to use a signal level or output meter. Without this all guesses were right out, but by using this and adjusting for volume as the sound came along I was able to control matters so as always to avoid overloading and also to keep up the level for good cutting. By the usual attention to L.F. circuits and components I have now got a recorder which I am proud of.—T. WARREN (Richmond).

THAT DODGE OF YOURS!

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

SPECIAL NOTICE

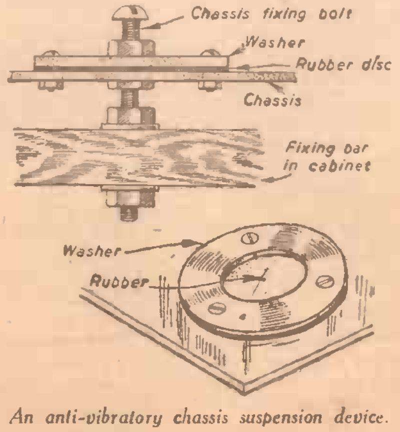
All hints must be accompanied by the coupon cut from page 328.

A Static Screen

I RECENTLY wished to fit a Faraday or static screen between an aerial and grid coil, but could not make a suitable arrangement. The following idea, however, enabled me to make a screen which really reduces static on my communications receiver, and is easy to wind. Over a solid former of a diameter suitable to fit between primary and secondary I laid a thin strip of copper foil. Across this I wound a coil of bare, thin tinned copper wire. When completed, solder was run across the turns where they crossed the coil, and then the turns were all cut through just above the foil. A slight tension on the wire before winding ensured that the turns "stayed put," and the shield was then carefully inserted between the two coils with perfect results.—P. RAKS (Gloucester).

A Chassis Suspension Device

FOR this simple anti-vibratory chassis suspension device the parts required are 12 nuts and bolts, four washers, and a piece of rubber from an old car inner tube. It will be seen from the sketch that

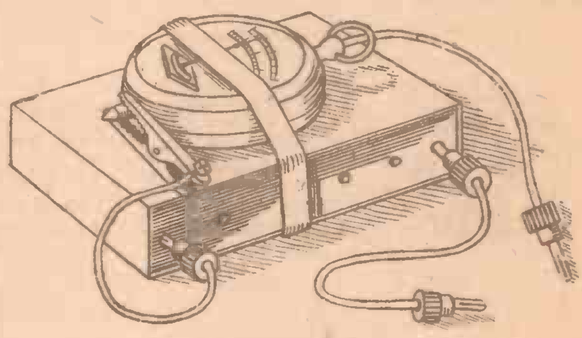


An anti-vibratory chassis suspension device.

the bolt which is fixed to the cabinet supports the chassis by contact with the rubber disc only. The chassis, therefore, is hung on the rubber discs, one in each corner of the chassis.—J. RATCLIFFE (Yatesbury).

A Simple Circuit Tester

MANY amateurs use a watch-pattern voltmeter for checking their accumulators and dry batteries, and such a meter can be made into a handy tester for tracing faults and checking over the wiring of a new set. The voltmeter is simply laid on the side of a grid-bias battery, and a stout rubber band is used to hold them together, as shown in the accompanying sketch. The positive terminal of the meter is connected by means of a crocodile clip and a piece of flex to the positive socket of the battery, and a flex lead is plugged into the other end of the battery. This simple tester comes in handy for checking a suspected short circuit in the high-tension winding. It is much better to disconnect the H.T. and test with the meter in series with the small battery than to try to locate the leakage of the H.T.



An easily contrived circuit tester.

supply by using the meter alone. Ordinary tests for continuity can be carried out with this simple combination quickly and effectively.—L. WINGROVE (Pinner).

Selective Band-pass Filter

A Description of Two Interesting Circuits

IN order to increase the adjacent channel selectivity of a band-pass filter it is known to employ low-resistance channel frequencies. Such circuits are, however, liable to prove costly in view of the high-efficiency conductances which have to be used, and consequently the possibilities of feedback to reduce the losses of less costly components are worthy of examination.

This subject has recently been under review in the R.C.A. Laboratories, and the following is an account of some of the circuits used and the results obtained.

Broadly considered, the networks of Figs. 1 and 3 include two acceptor circuits, C_1L_1 and C_4L_4, tuned to the centre of the desired frequency band, and two rejector circuits, C_2L_2 and C_3L_3 (Fig. 1), tuned respectively on the opposite sides of the pass band. As indicated by the curve of Fig. 2, this well-known circuit gives a flat top or three slight peaks with steep sides in the pass band part of the frequency-amplitude characteristic. With high-loss reactors or with a narrow pass band, the shoulders of this characteristic tend to droop. Regeneration of the rejector circuits C_2L_2 and C_3L_3 functions to maintain the desired flat pass band characteristic irrespective of the reactor losses and the pass band width.

The network of Fig. 1 includes an electron discharge amplifier 10 which is provided with input terminals 11-12 and with output terminals 13-14 coupled through reactor-capacitor units C_1L_1 and C_4L_4 to the input terminals 15-16 of an amplifier 17. A resistor R_1 of the order of 100,000 ohms may be connected in shunt to the reactor L_1 for reducing the centre peak of the curve of Fig. 2 to about the same height as the other two peaks, and a resistor R_2, which may be smaller than the resistor R_1, may be connected in shunt to the reactor L_4.

Interposed between the acceptor or coupling units C_1L_1 and C_4L_4, and connected in shunt to the main signal channel are the low-frequency filter or rejector C_2L_2 and the high-frequency filter or rejector C_3L_3. Regeneration of the low-frequency rejector C_2L_2 is effected by means including an amplifier 19 provided (1) with an input circuit including a cathode-lead resistor 20-21 and a grid-leak resistor 22 connected in shunt to the capacitor C_2 and (2) with an output circuit including the resistor 20-21, a suitable plate voltage source and a feedback coil L_5 which is inductively coupled to the reactor L_2. Regeneration of the high-frequency rejector C_3L_3 is likewise effected by means including an amplifier 23 having in its input circuit a cathode lead resistor 25-26 and a grid-leak resistor 24 which is connected in shunt to the capacitor C_3, and in its output circuit the resistor 25-26, a plate voltage source and a feedback coil L_6 inductively coupled to the reactor L_3.

Tickler Coils

It will be noted that regeneration is effected through the tickler coils L_5 and L_6, in the usual manner, except that the regenerative effect is stabilised by the cathode lead resistors 20-21 and 25-26. The lower terminals of these stabilising resistors are subjected to a negative potential such as −32 volts for neutralising the D.C. drop of the resistor and maintaining a normal voltage of about −3 volts on the feedback amplifier cathodes.

The cathode lead resistor 20-21, for example, has a stabilising influence in two ways. First, any change in the plate voltage or mutual conductance of the feedback valve results in a compensating change

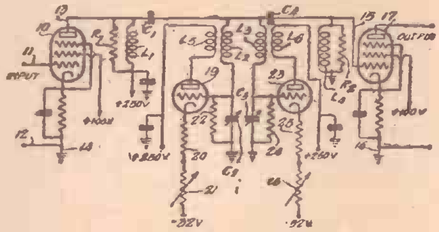


Fig. 1 (Above).—A filter stage network, incorporating shunt rejector circuits.

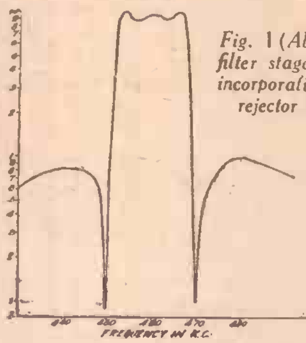


Fig. 2.—Frequency amplitude characteristic curve.

in the grid bias potential of the valve and, as a result, the valve mutual inductance varies but slightly. In addition, this small change in the effective valve characteristic is further reduced by the action of the resistor at radio frequency. When a radio-frequency voltage is applied to the grid, a voltage appears upon the cathode of the same phase, and almost equal amplitude. The true input to the valve is the difference between the grid and cathode voltages, and a radio frequency plate current flows, due to this difference voltage. This plate current is used for regeneration through the tickler L_5 or L_6.

If the mutual conductance of the valve should decrease, a smaller voltage will appear on the cathode. Hence the difference between grid and cathode voltages is greater, giving a larger input voltage to the valve. Thus it can be seen that the variation in plate current is a very much smaller percentage than the variation in valve characteristic. Thus the cathode resistor is the means of stabilising the amplification of the valve, and such amplification is then used as a means of applying regeneration to the rejector circuit. While a fixed coupling is shown between the plate and grid coils, and regeneration is adjusted to a critical value by adjusting the cathode resistor section 21 and 26, the same result could be obtained with a fixed cathode resistor and a variable tickler adjustment.

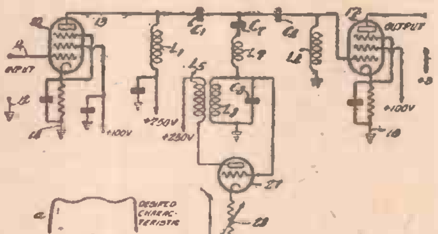


Fig. 3 (Above)—A modified network including a shunt circuit.

Modified System

The modified network of Fig. 3 differs from that of Fig. 1 in that the two shunt rejector circuits C_2L_2 and C_3L_3 are replaced by a shunt circuit which includes a capacitor C_7 and a reactor L_7 connected in series with the parallel connected capacitor C_8 and reactor L_8. In this modification, the parallel resonant circuit is regenerated through means including a single amplifier 27, a cathode lead resistor 28, and the tickler coil L_5 which is inductively coupled to the reactor L_8.

When the effective series resistance of C_8L_8 is slightly negative, the negative resistance component of this parallel resonant circuit is as indicated by the curve of Fig. 4. At the rejection frequencies, C_7L_7, C_8 and L_8 form a series resonant combination and the effective series negative resistance of C_8 L_8 should equal the resistance of C_7L_7. Oscillation does not occur because of the grid and plate coil resistances. In the pass band, the entire rejector circuit L_1-C_1-L_2-C_2 has a negative effective resistance, but suitable adjustment of the grid and plate circuit losses results in a flat pass band.

Lining up the Rejectors

In lining up a single stage filter such as that of Fig. 1, a signal generator is connected to the grid of the amplifier valve and a valve voltmeter is connected to the output of the filter. The first operation is to line up the rejectors for maximum attenuation at the rejection frequencies. This involves adjusting both tuning and regeneration for maximum attenuation. The two acceptor circuits L_1C_1 and L_2C_2 are then tuned for maximum response in the centre of the pass band. Alignment may be found easier if less than optimum damping is used for this preliminary tuning adjustment. A head and shoulders curve will then be obtained in the pass band. The steps involved in correcting this to the desired shape are indicated in Fig. 5.

In this figure, a series of curves are plotted. Each curve represents a possible shape of the pass band characteristic. (The relative height of one curve to another is of no significance here.) The top curve is assumed to be the desired one. The other curves are obtained when one or more circuit constants have inaccurate values as indicated on the figure.

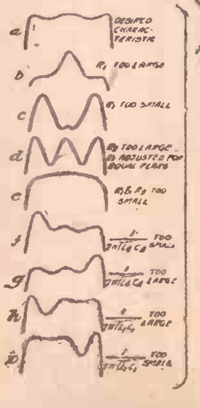


Fig. 5.—A series of curves representing the shapes of band-pass characteristics.

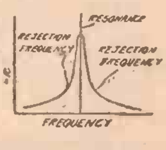


Fig. 4.—Rejection frequency curve.

QUICK-FIRE SERVICING

Practical Hints which Will Enable a Set that has Developed Valve Failures to be Rapidly Serviced

THE object of these notes is to give hints which will enable a set which has developed a "usual" type of fault, e.g., valve failure, to be serviced in as quick a time as it takes to read this article, and certainly quicker than it takes to write it.

The first thing to do when confronted with a receiver for service is to endeavour to diagnose the complaint. If the receiver is "dead" to radio signals, will the L.F. side operate from a pick-up? Is a faint hum present? Spend a few moments' thought as to the probable cause of the complaint. It will always repay you.

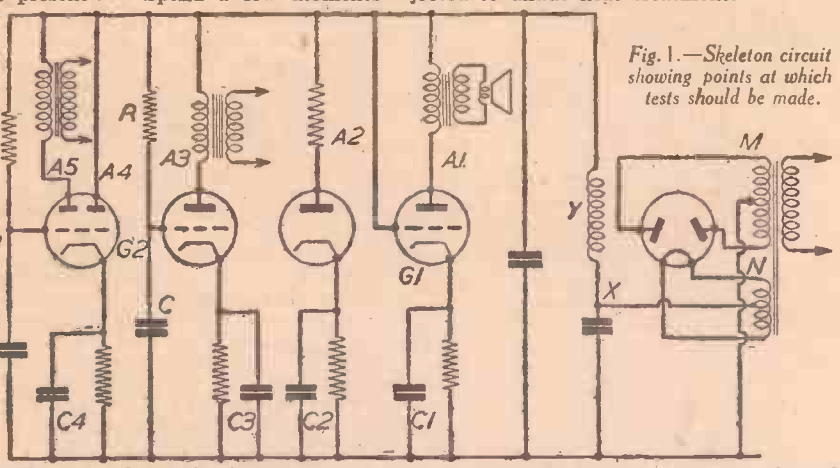


Fig. 1.—Skeleton circuit showing points at which tests should be made.

For routine testing a good A.C./D.C. test set is essential. Set about the job methodically, and measure anode and screen voltages first, commencing with the rectifier valves.

Measure the H.T. voltage at the point X (Fig. 1). Low volts will indicate: (1) a faulty rectifier; (2) a faulty mains transformer; or (3) a heavy current drain on the rectifier due to excessive leakage or breakdown of a condenser.

Measure the rectifier anode voltage (A.C.) between "M" and chassis, and "N" and chassis, if the first test has shown low volts. Disconnect the smoothing condenser at "X" and measure volts between "X" and chassis. If voltage is O.K., reconnect condenser and disconnect the other smoothing condenser at point "Y." If volts are O.K. reconnect and measure volts drop across the speaker field. Knowing the resistance of the field, the current flowing can quickly be calculated from Ohm's Law and checked against the normal current taken by the valves used in the receiver. A much higher current would most likely indicate a condenser breakdown in an earlier stage of the set.

If, as a result of disconnecting one of the smoothing condensers, the voltage becomes normal, a loud hum will become audible, and it may not even then be possible to get the receiver to work at all. In such a case, the introduction of a new smoothing condenser will remove the hum and the set will work normally.

Mains Receivers

In the case of mains receivers, it always pays to make thorough tests of the rectifier valve, and smoothing condensers, before proceeding any further. Without wishing to indicate anything detrimental against electrolytic condensers (they are really excellent when properly used), it is interesting to note that four out of the last six sets I have serviced have had smoothing condenser breakdowns. Usually it has been found that the condenser has been worked right up to its maximum voltage, and in some cases over, and has either been totally enclosed or else placed too near a valve and has, therefore, been subjected to undue heat treatment.

Now proceed to measure the anode and screen voltages at A1, A2, A3, A4, A5, G1, G2 and G3, commencing with the output valve. Also, measure the voltage drop across each decoupling resistance and, from Ohm's Law, calculate the current passed, and thence check up the anode and screen consumption of the valves against the valve manufacturers' published data and curves.

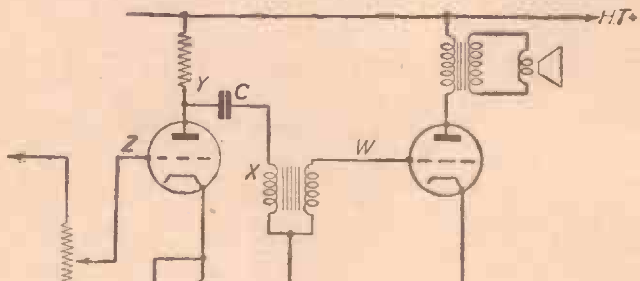


Fig. 2.—Output stages of a receiver to illustrate the use of deduction from meter tests.

For example, if the volts drop across the resistance R (10,000 ohms) is 150 volts, it is obvious that the current flowing through the resistance is 15 mA. Supposing that the normal screen current of the valve with 100 volts applied is only 6 mA, it is quite probable that the excess current is caused by a leaky decoupling condenser C, and this should be disconnected. If the current resumes normal proportions, a new condenser is the obvious cure.

The next thing is to measure the bias across the cathode resistances C1, C2, C3 and C4, and from these values can be calculated, again from Ohm's Law, the total current taken by each valve.

You should now have enough data to check the operation of all the valves in the receiver, and their associated components, and in all probability one of the tests will have cleared the fault by showing "no volts" or "heavy current." Don't expect, however, to get your readings to agree exactly with the published data on the valves being used. They should be reasonably accurate, however, say between ± 10 per cent. of normal.

"No Volts"

In the case of "no volts," the obvious thing is to work back to the main H.T. line until a voltage reading is obtained. If, for example, volts are found on one side of a resistance and not on the other, remove the resistance and test it. If the resistance appears in order or is even replaced by another and a "no volts" reading is still obtained, it is probable that the decoupling condenser is faulty and short-circuiting the H.T. supply at this point. The decoupling resistance would prevent a full short-circuit on the main H.T. supply, but it is quite probable that the resistance would become very hot.

During these voltage tests, don't jump to a hasty conclusion. If a wrong reading is obtained, consider the probable cause of the fault and proceed systematically.

An example of the use of deduction is shown in Fig. 2, which is the skeleton circuit of the L.F. portion of a commercial radiogram. The fault was distortion and low volume on both radio and gramophone, and this meant that the fault, or at least a fault, existed in the L.F. side of the receiver. Anode volts were found to be within a few per cent. of normal, and the cathode volts were then measured.

Bias for the output valve was derived from a potentiometer across the loudspeaker field winding in the H.T. negative lead, and a voltmeter between point "A," and the chassis, gave a negative reading. On connecting the meter between point "B" and chassis, i.e., on the other side of the

(Continued on next page.)

QUICK-FIRE SERVICING

(Continued from previous page)

G.B. decoupling resistance, a reading of several volts *positive* was obtained.

Consideration of the probable cause of the complaint, and an examination of the theoretical circuit, suggested that the coupling condenser C was leaky, and allowing a positive H.T voltage to appear on the grid of the output valve. The insertion of a milliammeter in the circuit in series with condenser C showed that nearly 10 mA was flowing through the condenser. On examining the condenser it was found to be an electrolytic variety, and it was learnt that this had been put in when the set was serviced on a previous occasion. Removal of the condenser and its substitution by a paper one, cured the trouble, although the positive voltage on the grid had caused the emission of the output valve to drop.

We will presume that after taking these readings, all voltages and currents have been found to be reasonably normal and that the fault cannot be located.

Interjecting Signals

The next step is to inject a modulated L.F. signal into the L.F. stages, commencing again with the output valve, and working back to the grid of the first L.F. valve. A pick-up will do for this. Provided that a condenser is fitted in series with the pick-up or oscillator leads, it is quite permissible to inject the signal into the anode as well as the grid circuits. Referring again to Fig. 2, the pick-up or oscillator should be connected to each of the points W, X, Y, Z in turn through a 1 mfd. condenser. In the case referred to above, the fault would have been immediately located at the point W, but had the primary of the transformer been connected to chassis instead of to the secondary and H.T. negative, point "W" would have been shown up O.K. and the fault not located until the pick-up was connected to the primary side of the L.F. transformer.

If the fault cannot be found in the L.F. portion of the receiver, an H.F. or I.F. signal must be injected into each H.F. or I.F. stage in turn.

When carrying out any of the above tests, remove the aerial, set the volume control to maximum, switch the receiver to long waves and rotate the tuning condenser to maximum capacity.

There are two fairly common faults which will not be located by simple voltage tests and which can be found without the use of an oscillator. One is a faulty diode or A.V.C. circuit, and the other is failure of the frequency valve to oscillate.

The simplest way to test the diode and A.V.C. circuit is to connect a milliammeter in the anode lead of one of the controlled valves (keep the meter leads a short as possible and always connect the meter between the decoupling resistance and the main H.T. supply. Never connect it between anode and the I.F. transformer.)

Keep the aerial and earth connected to the receiver and rotate the tuning condenser very slowly. As a signal is tuned in, the current should decrease if the H.F., I.F., detector and A.V.C. circuits are in order.

In a superhet receiver the oscillator section of the frequency changer is quite a frequent source of trouble. If the oscillator fails, no I.F. signal will be reproduced, but in some cases the oscillator may only fail on certain wavebands, or parts of a waveband.

The oscillator voltage should remain fairly constant over the whole of the waveband, although it may vary for different wavebands. For instance, on S.W. bands, the oscillator anode voltage is often increased. The quickest method of checking an oscillator is to insert a milliammeter in series with the oscillator anode, between the voltage dropping resistance and the main H.T. line, and note the reading. Short-circuit the oscillator tuning condenser, or connect a large fixed capacity condenser across it. A change of oscillator anode current, which may arise or fall depending on the type of oscillator in use, should occur. If no change occurs, the oscillator is not functioning.

In the case of partial failure, this will be shown up by tuning the set through the various wavebands and noting if a sudden change in current consumption occurs at any point or points, indicating that the valve is going in and out of oscillation at this point. Don't confuse this with a gradual change, for no oscillator will give a constant reading over the whole of all the wavebands.

Final Hints

Here are a few hints, which are the result of actual experience, and which may help the reader when called in to service a receiver:

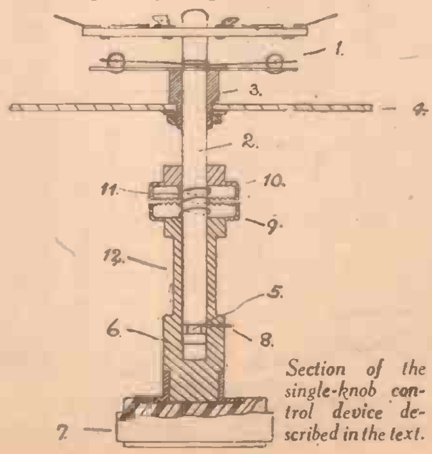
1. Always make sure that the aerial has not been inadvertently disconnected.
2. In the case of a battery receiver, make sure that none of the battery leads have been pulled out or inserted in the wrong positions.
3. The quickest way to estimate whether a valve is likely to be the cause of the trouble, especially where readings cannot be obtained without removing the set from its cabinet, is to measure the voltage drop across the speaker field. These terminals are easily accessible and the current consumption of the receiver can be quickly calculated from Ohm's Law.
4. If the H.T. supply appears to be at fault, examine the smoothing condensers first. Disconnect each one of them in turn until a voltage reading is obtained. Ignore the increased hum for the time being. It will be immediately reduced as soon as the smoothing condensers are reconnected, or new ones substituted.

Combined Tuning and Wave-change Control

A Method of Controlling Both These Operations with a Single Knob

MANY proposals have heretofore been made for improvements in the control of radio receivers. It has already been proposed, for example, to reduce the number of controls by making one control perform two or more operations, or to reduce the space occupied by arranging two or more controls concentrically.

The accompanying sketch shows a simple arrangement whereby both the tuning indicator and the wave-change switch can be actuated by means of a single control knob. The control is shown in section, and the wave-change switch 1 is provided with a spindle 2 arranged in a bearing 3 which is secured to the chassis 4. The end of the spindle 2 is provided with a circumferential groove 5 for a purpose which will be described later. A hollow control spindle 6 is rotatably mounted on the wave-change switch spindle 2, as shown, and is provided with a control knob 7. The spindle 6 is held to the shaft 2 by means of a pin 8 which projects into the groove 5, and thus allows a limited amount of axial movement between the two shafts. The end of the control spindle remote from the knob is provided with one member 9 of a clutch, and the other member 10 of the clutch is rigidly secured to the wave-change switch spindle 2. The members 9, 10 are biased apart by a spring 11. The hollow control 6 is provided with a circumferential recess 12 round which a cord from a pulley associated with the tuning condenser may be wrapped.



Section of the single-knob control device described in the text.

Operation

In operation, rotation of the control knob 7 will cause the hollow spindle 6 to rotate round the wave-change spindle 2 and operate the tuning indicator through a cord drive. When it is desired to change the wave-band the control knob 7 is displaced axially to bring the clutch members together, and then rotated so that both the wave-change switch and the tuning indicator are moved together; as soon as the correct wave-band has been found the axial pressure upon the control should be removed so that a further rotation causes only the tuning indicator to operate. It is inadvisable to secure the driving cord positively to the hollow spindle 6 so as to avoid unnecessary strain upon the cord if the control should be manipulated for changing the wave-band switch when the tuning indicator is in a limiting position.

Home-made Remote Control

A Useful Device Made from Odds and Ends

A VERY fascinating hobby is the control of various pieces of apparatus by means of distant-operated switches, and the details given in last week's issue of one reader's attempts in this direction will no doubt arouse a desire to carry out similar schemes in the homes of many experimenters. Although it is possible to purchase ready-made relays or similar devices, there is much more interest in making up your own apparatus, and the following details which were given by us some years ago are therefore reprinted for those who wish to make up a similar type of instrument. Although of very simple construction, the device is the result of considerable experiment.

A special feature is that, unlike most other controls, it consumes *no current* while the set is in use, and gives a positive on-off contact. The action is similar to a G.P.O. line relay and sounder, and complicated, unreliable clock actions, etc., are avoided. The parts required are two electric bell bobbins (complete), about 18in. of ½in. springy brass strip 1/32in. thick, two small iron or steel cycle bolts (as used for fixing mudguards), two 2BA brass bolts ⅝in. long with two nuts on each, five terminals, seven ⅜in. wood screws and a piece of wood for base 3 by 4in. by about ½in. thick. The bell bobbins are best bought if an old bell is not to hand. In the latter case two small iron or steel bolts will serve as cores.

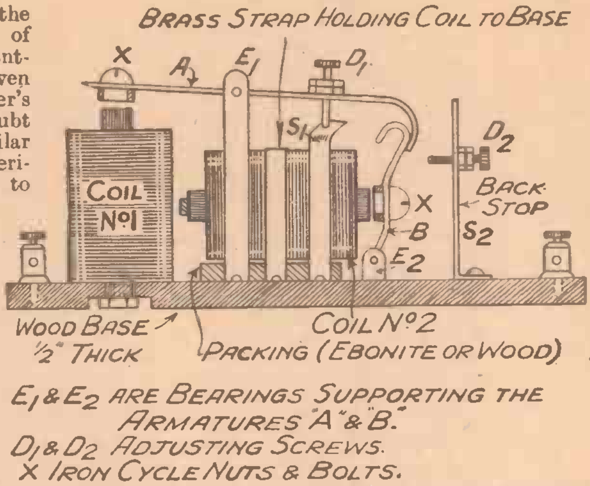


Fig. 1.—Completed relay showing armature "B" attracted, and relay in closed position after No. 2 coil has been momentarily energised. L.T. circuit is then closed and L.T. current then flows up the bottom armature to top armature through bearings to set.

Details of Construction

First drill a hole through the base as shown (Fig. 1), and mount No. 1 coil upright by means of the nut on the core end. It will be necessary to recess the bottom of base a little so that the nut will be flush. Coil No. 2 is then mounted horizontally on a small piece of 3/16in. wood or ebonite, and is secured to base by a metal strap (cut out of the brass strip), and two of the small wood screws. The armatures, bearing supports, and stops are next cut to size out of the strip and the holes drilled.

Solder the 1in. nails to the armatures, as shown in Fig. 2, and fit the iron cycle bolts. Cut the bolts off flush with face of nuts and give the nuts a thin film of solder—this secures them further and also prevents them "sticking" to the magnet cores. Fit the 2BA bolts in position and solder the *bottom* nut only on each. Bend the armatures, stops and bearings to approximately the shapes shown in Figs. 3 to 7, then assemble the top armature and bearings first. See that the iron nuts on armatures are directly opposite the magnet (coil) cores. Fix the terminals and connect up as in Fig. 8. Before testing it will be advisable to explain the action of the relay.

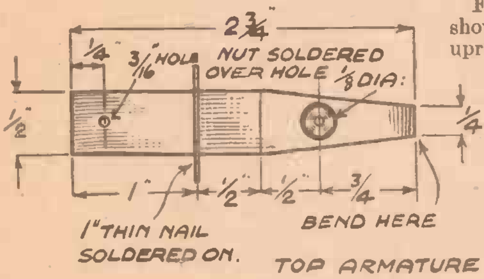


Fig. 2.—Details of top armature.

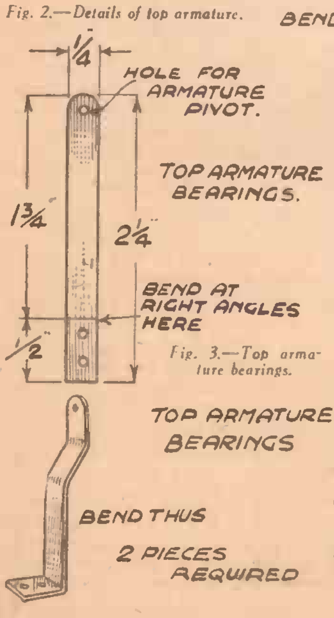


Fig. 3.—Top armature bearings.

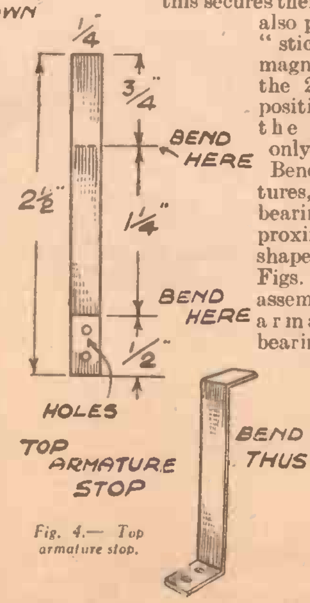


Fig. 4.— Top armature stop.

How the Relay Operates

The relay operates on each coil separately, the normal position of relay, when not in use, being shown in Fig. 10. It will be seen that both armatures are so balanced that they normally rest on the "stops." When a current is passed through coil No. 2 the bottom armature is attracted to the core, and in doing so knocks against the top armature and lifts it up. The top armature acts as a kind of latch, and *immediately* drops back over the bottom armature, and effectively locks it when properly adjusted. This action takes place instantaneously.

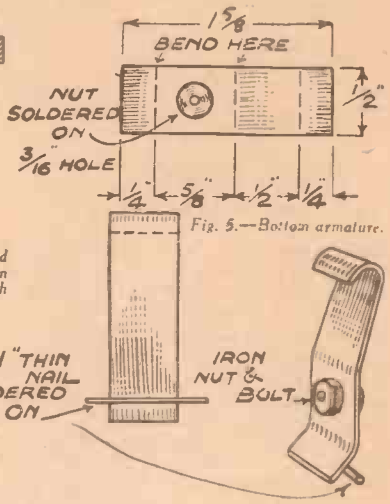


Fig. 5.—Bottom armature.

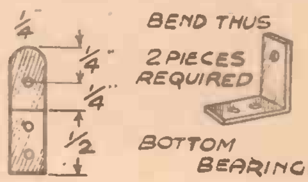


Fig. 7.—Details of bottom bearings.

On sending a current through coil No. 1, the *top* armature is attracted to core of No. 1 coil and releases the bottom armature, which falls by its own weight back to its stop.

It will be seen that only a momentary current is needed to operate the relay. The operating circuit is quite distinct and separate from the low-tension circuit of the

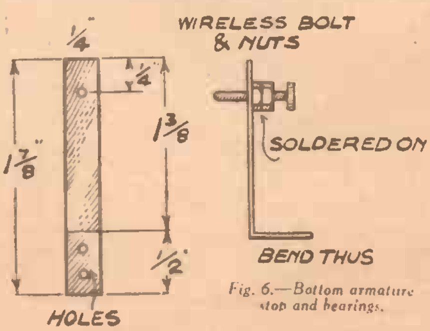
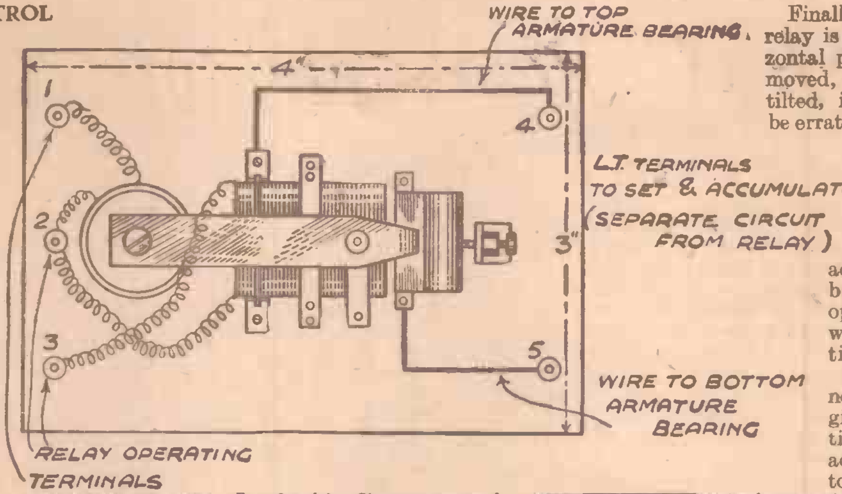


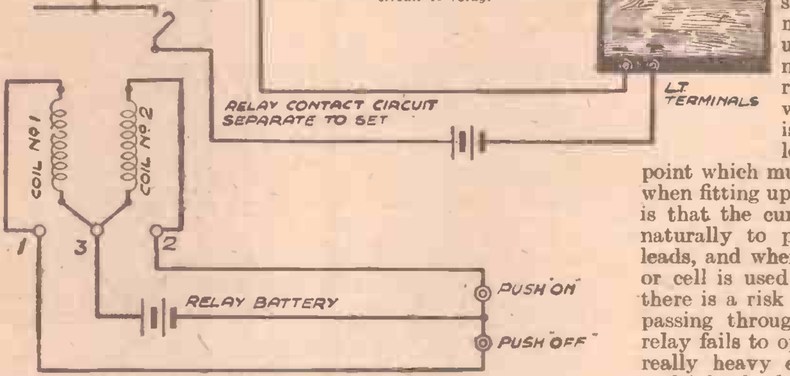
Fig. 6.—Bottom armature stop and bearings.

HOME-MADE REMOTE CONTROL

(Continued from previous page)

set which it throws on and off. The L.T. circuit is from one of the two terminals (see Fig. 8) to bottom armature, bearings, through bottom armature along top armature (wherein contact), down top armature bearings and out to other L.T. terminal on relay base. To test the relay *before* using (as is advisable), connect temporarily one end of a battery to terminal 3. Touch terminal 2 and bottom armature should be attracted as explained. On touching terminal 1 the top armature should be attracted, thereby releasing the bottom armature.





Figs. 8 and 9.—Showing wiring and circuit to relay.

Simple Adjustments

A certain amount of adjustment will be necessary on both armatures to get smooth working, but this will not be difficult as they are made of springy brass. For operating the relay 3 volts will usually suffice (or a flashlamp battery), but up to 6 volts can be used, especially if there is a long length of wire to the control pushes.

Two ordinary bell-pushes are used for operating. One push is used to switch the set off and the other to switch it on The pushes should be mounted on an oblong switch block, and may be of different colours or simply marked with panel transfers, but this is, of course, optional. Any number of control points, with two pushes at each point, may be used. Three wires are necessary to each point. Both relay and operating battery should be as near to the wireless set as is possible to keep the low-tension wiring on the set as short as possible.

Finally, see that the relay is kept in a horizontal position and not moved, otherwise, if tilted, its working will be erratic. A neat wood casing can be made to house the relay if desired. If properly adjusted it will be found to operate efficiently without attention.

Of course, it is not necessary to give any instructions as to how to adapt this control to your own particular receiver, as there are so many different arrangements which may be made up, and these depend, naturally, on the type of receiver which is in use, and what form of reproduction is used, i.e., 'phones or loudspeaker. There is one point which must always be borne in mind when fitting up this form of relay, and that is that the current which operates it has naturally to pass through the extension leads, and when only a very small battery or cell is used to operate the mechanism there is a risk of such a loss of current in passing through the long leads that the relay fails to operate. Therefore, obtain a really heavy extension lead—one of the multiple leads sold by Messrs. Bulgin especially for the purpose is admirable—and try to avoid a heavy loss through the leads by using large-capacity batteries or, alternatively, one of the smaller types of accumulator.

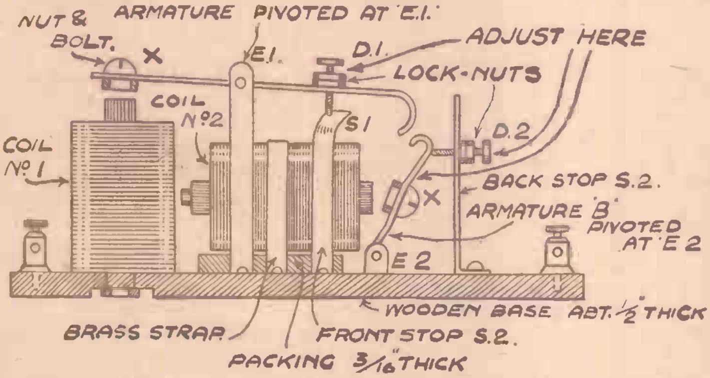


Fig. 11.—Relay in normal position—note top armature, resting on stop, as also bottom armature. No coils energised.

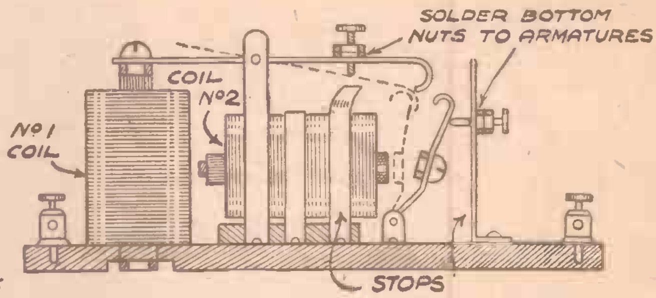


Fig. 10.—Showing top armature in action at the moment of energising No. 1 coil. The armature is clear of its stop for a moment, and this frees the bottom armature which is shown dropped clear by its own weight. The dotted lines show the previous position of the armatures. Top armature drops back on to its stop after being momentarily energised.

BROADCAST ITEMS

"The Man Who Wrote 'The Maid of the Mountains'"

MOST people are familiar with the melodies which ran through that musical-comedy success of the last war, "The Maid of the Mountains," but how many know anything about its composer, H. Fraser-Simson, who is, in fact, one of the most versatile and successful of British theatre composers? The life and work of "The Man who Wrote 'The Maid of the Mountains,'" will be the subject of a musical biography to be broadcast in the Home Service programme on June 28th. Compiled by M. Willson Disher, Gordon McConnel and Gwen Williams, this programme will give a picture of an exceedingly versatile musician who has created not only popular but musicianly scores for musical comedy, revues and ballet. Many listeners will recall Fraser-Simson's settings of the Christopher Robin verses by A. A. Milne.

The singers will include Joan Cross, Dennis Noble and Billie Baker, supported by the B.B.C. Theatre Chorus and Theatre Orchestra, conducted by Stanford Robinson.

Film Festival (4): "Babes in Arms"

THE fourth production in the Summer Film Festival will be a revival of the radio version of "Babes in Arms," which was regarded at the time as a model in intelligent compression for broadcasting purposes. It will be heard on July 1st. Of recent film music scores of this type this is surely one of the most attractive—which is hardly surprising when it is remembered that Richard Rodgers and Lorenz Hart were responsible for it. The haunting "Where or When" and the high-spirited "Good Morning" are regarded as excellent examples of the present trend in popular music, particularly the former.

Why "Y" Working?

Further Notes on Dipole Aerials, by

H. J. BARTON CHAPPLE, B.Sc.

THERE are no doubt many newcomers to radio, both in the Services and outside, who are called upon to work with dipole aerials for the first time. Furthermore, it is possible that some of the pre-war transmitting folk who used certain types of feeder and aerial systems did so without thoroughly appreciating their real significance when it came to the question of why certain steps were taken. The notes which follow have been prepared with the object of clarifying an important point in so far as it applies to a twin-wire matched impedance feeder system which has been found to be very suitable for use with push-pull transmitters, and is really a continuation of the data and description furnished in PRACTICAL WIRELESS dated June 1st, pages 239 and 240. The success of this complete aerial system may be said to depend primarily on certain physical dimensions, which must be correct for the particular operating frequency allocated for the installation. These are shown as X, Y and Z in Fig. 1, and when this has been erected correctly it is only necessary to determine the right load conditions by suitably adjusting the coil taps at the transmitter.

Proper Matching

The aerial is a dipole, erected either horizontally or vertically as required, and this is fed by a twin-wire open feeder. In the June 1st issue, referred to above, it was shown that the maximum current conditions occurred at the centre of the aerial, but feeder connection is not made directly at that point. As will be seen

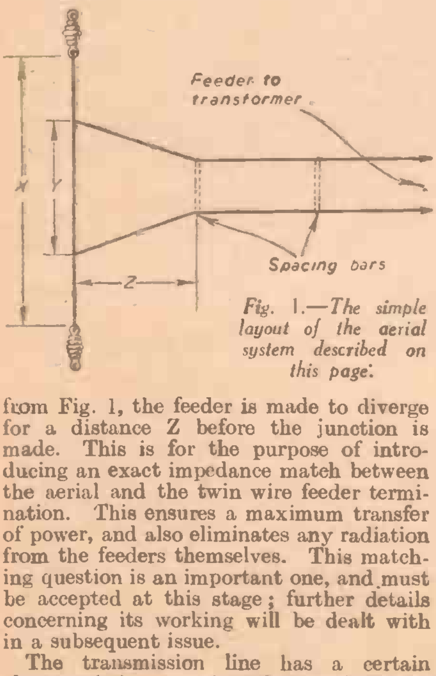


Fig. 1.—The simple layout of the aerial system described on this page.

from Fig. 1, the feeder is made to diverge for a distance Z before the junction is made. This is for the purpose of introducing an exact impedance match between the aerial and the twin wire feeder termination. This ensures a maximum transfer of power, and also eliminates any radiation from the feeders themselves. This matching question is an important one, and must be accepted at this stage; further details concerning its working will be dealt with in a subsequent issue.

The transmission line has a certain characteristic surge impedance which has been shown to depend upon the size and spacing of the conductors comprising it—see formula on page 240—and when the proper adjustment of the line is made at the radio frequency employed then it will act as a pure resistance joined across the output of the transmitter's last stage. It will be found in practice that for most commercial purposes the dimensions of the feeder line are chosen so that it provides a characteristic impedance of 600 ohms.

Surges

When the whole system is correctly balanced, each of the twin wire feeders is at an equal but opposite potential to the other, and in consequence radiation from the lines is neutralised. If this condition is not achieved, that is, if phasing and matching is not accomplished, then all the power will not be delivered to the dipole aerial for radiation into space, and the remainder will surge backward and forward along the line causing reflections, and so upsetting the efficiency of the installation. Under correct working conditions, however, the only loss should be the I^2R losses, which is quite negligible.

Fig. 2.—An actual example of an aerial and feeder installation based on the points discussed in this article.

Useful Formula

The form of connection between feeder lines and aerial shown in Fig. 1 is generally referred to as Y-matching, and if the formulæ which follow are used correctly, each installation should be capable of providing maximum radiation at the wavelength or frequency selected. The first item is naturally the length of the aerial itself, and in this case a small reducing factor k has to be introduced to allow for the fact that the aerial cannot be erected in free space. This factor will vary according to the diameter of the wire employed for the aerial, the factor becoming larger the thinner the wire. In addition, slight changes in k have to be made according to the frequency employed. For frequencies below 3,000 kilocycles, k can be taken as 0.96; between 3,000 and 28,000 as 0.95; and above 28,000 as 0.94. Reverting to Fig. 1, therefore, we have the length of the dipole X given by

$$X = \frac{150{,}000k}{f} \text{ metres}$$

where f the frequency of operation is expressed in kilocycles. That is to say, for a 2 metre system the aerial length would be 0.94 metres. If it is desired to express X in feet, then it is only necessary to introduce a simple conversion factor and we have

$$X = \frac{492{,}000k}{f} \text{ feet}$$

The next important dimension concerns the coupling between the aerial itself, and the diverging lines of the twin feeder cable, and in Fig. 1 this is shown as Y. Here, again, a reducing factor has to be introduced which changes slightly according to the frequency of operation. Calling this k_1 we have k_1 is 0.25 for frequencies below 3,000 kilocycles; 0.24 for frequencies between 3,000 and 28,000 kilocycles and 0.23 for frequencies above 28,000 kilocycles. The length Y now becomes

$$Y = \frac{150{,}000k_1}{f} \text{ metres}$$

where f is in kilocycles or

$$Y = \frac{492{,}000k_1}{f} \text{ feet}$$

The final item now refers to the length Z of the diverging section of the feeder connection and this is given by the formula:

$$Z = \frac{45{,}000}{f} \text{ metres}$$

where f is in kilocycles as before or

$$Z = \frac{147{,}600}{f} \text{ feet.}$$

These simple equations only hold good for those installations where the characteristic impedance of the twin wire feeder line is 600 ohms, but as was mentioned earlier this is the standard worked to in the majority of the Service and commercial installations. If, therefore, this figure is substituted in the formula given on page 240 (June 1st issue), it will be found that the distance between the wires of the twin feeder is nearly 200 times the radius of the wire used for the feeders. That is to say, if No. 6 gauge copper wire was used for the transmission line, then since the radius of this wire is 0.08in. the distance between the wire centres for the twin run would be approximately 16in.

An Example

As an indication to readers of an actual dipole aerial erection with a Y matched twin wire open feeder, reference can be made to Fig. 2. This shows a dipole secured by an arm at the top of a mast, which in turn is guyed to a high flat roof on the top of a building. The feeder cables are held apart by insulating distance pieces of the appropriate length, and are connected to the aerial proper at an exact distance based on calculations using the three preceding formulæ.

A Twelve-range Test-meter

A Home-made All-purpose Instrument with Single Switch Control

By W. J. DELANEY

MOST readers are now aware that an all-purpose tester may be made up round a single range milliammeter. It is usual to use a meter with a full-scale deflection of 1 mA. for this purpose, and to increase the current reading various resistances are shunted across it. To enable voltages to be read, resistances are connected in series with it, and for the reading of actual resistance values a small voltage is included in series. The basis of all these tests is that the meter passes a current up to the maximum indicated on the meter, and by including additional

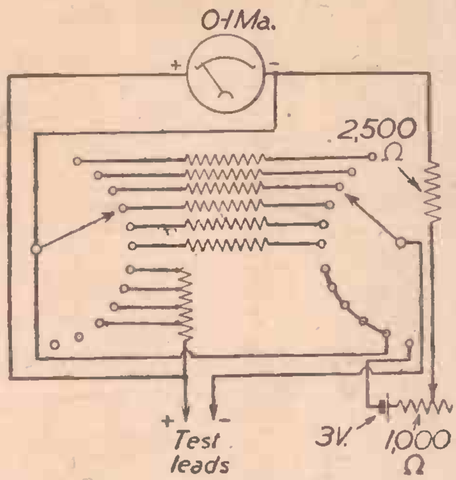


Fig. 1.—Theoretical circuit of the 12-range meter.

components inside the meter case, and choosing these properly, indications may be provided so that instead of taking the meter reading for, say, .5 mA., this may represent 50 volts. For the benefit of new readers, the idea works out as follows: The meter will have an internal value, usually of 50 or 100 ohms. Any meter may be used, but the actual current range should not be greater than 1 mA. Suppose that we use a meter with a resistance of 100 ohms, and connect across it a resistance of 100 ohms. This means that if a small voltage is applied through a circuit so that a current of 1 mA. flows, this will divide and flow equally through the meter and the extra 100 ohms resistance, and accordingly the meter needle will only rise half-way up the scale. If the scale is calibrated, this would mean that the meter would indicate .5 mA., but we suggested that the meter had been connected to a circuit through which 1mA. was flowing, and therefore, our meter indication is only half of the true current. In other words, we have multiplied the scale by 2 by shunting the meter with a resistance equivalent to the meter resistance. If we shunt the meter with a resistance of such a value that only one-tenth of the current flows through the meter and nine-tenths through the shunt resistance, the meter scale will be multiplied by 10, and so on.

Voltage Readings

The above explanation shows how the meter may be made to read various current ranges merely by switching in suitable shunt resistances. To enable a voltage reading to be obtained, for which purpose the meter has to be joined in parallel with the supply or circuit, some form of limiting resistance must be included, also in series, so that the total current flowing through the meter does not exceed 1 mA. Suppose we wish to make the needle indicate 10 volts when it points to 1 on the scale (that is, at full-scale deflection). Ohms Law gives us the rule that 1 mA. will flow through a resistance of 10,000 ohms when 10 volts are applied (current equals voltage divided by resistance). Therefore, if our meter is 100 ohms and we connect a resistance of 9,900 ohms in series and then connect the two across a 1-volt supply the needle would rise to 1 on the scale and thus we have obtained our desired range. This may be extended up to any desired voltage range, although if, for instance, we wish the meter to read 1,000 volts, we need not use a resistance of 999,900 ohms, as the percentage error would be so small that we could use a standard component of 1,000,000 ohms with little margin of error on the scale. The use of the meter for measuring resistances is carried out in a similar manner, including a small cell inside the instrument so that this is connected in series when a resistance is being measured, and calibrating our scale in resistance values in ohms, according to the current flowing. Usually, a home-made meter is arranged to cover only one range of resistance values, external batteries then being added to give multiples of the resistance range as required.

A Typical Sample

The following constructional details will give an idea of the lines to be followed in making an all-purpose meter, the main

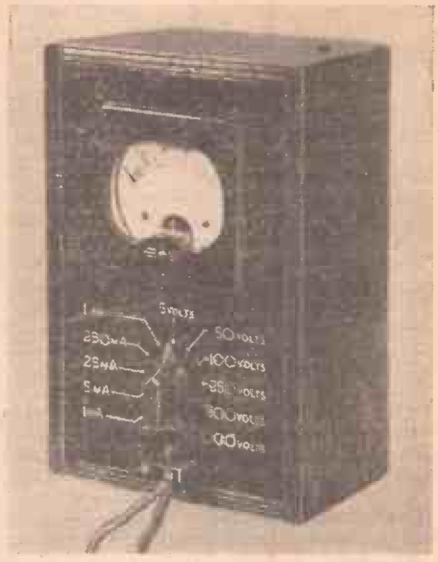
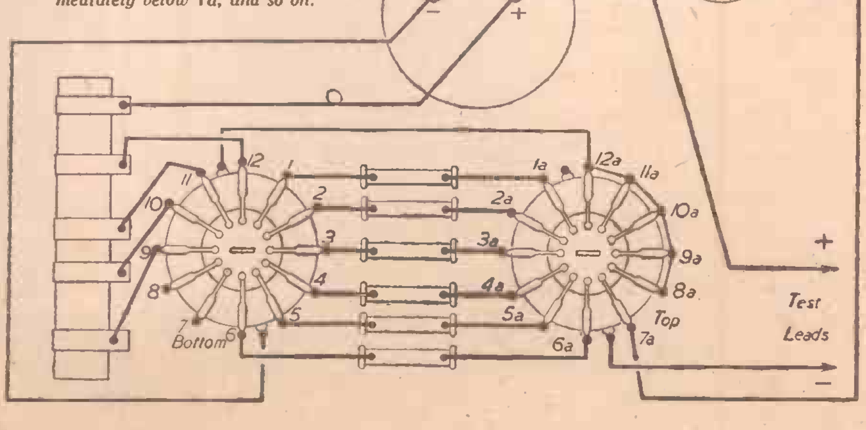


Fig. 3.—The finished instrument in its home-made case.

difference between the average home-made instrument and a commercial meter being in the selection of the appropriate ranges. Usually, the home-made instrument is provided with plugs and sockets, whereas the commercial instrument has a single control with multi-switch unit for the same purpose, and by adopting this method of construction the use of the meter is greatly simplified, and a more professional finish is obtained. In the sample illustrated, a double-band 12-contact switch was used, this being manufactured by A. B. Metal Products, Ltd., and may be obtained from B.T.S. The meter used was supplied by Premier Supply Stores and has an internal resistance of 50 ohms. We understand, however, that these are no longer available, but many readers may have one of these on hand and wish to make the instrument. On the other hand, for those who have an instrument of 100 ohms or who obtain one of that value, we give below a table of the necessary shunt and series resistances for various current and

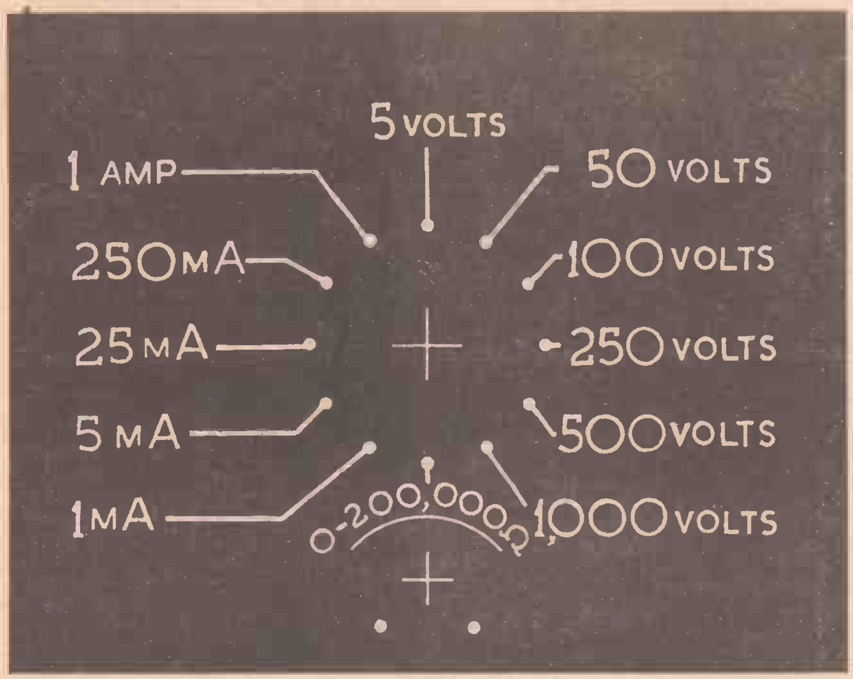
Fig. 2.—Wiring Diagram. In this diagram the "wafers" of the switch are shown as though hinged open. That is, contact 1 is actually immediately below 1a, and so on.



voltage ranges. From these the appropriate values may be chosen to give any desired range. Incidentally, Premier Radio can supply a ready-wound shunt resistance for a 50-ohm 1 mA. meter which will give readings of 5mA., 25mA., 250mA., and 1 amp. The wiring of the shunt and series resistances to the two-bank switch for the different ranges is shown in Fig. 2, and it will be seen that when set to the "Resistance" range, a battery and variable resistance is included in circuit, in addition to a fixed resistance. These are essential additions. When a small battery is included in series with the meter, a given range will be provided, but as the battery becomes discharged the reading will vary and thus a scale could not be accurately calibrated. Therefore, if a moderately low-value resistance is included in series, this may be adjusted to compensate for the varying voltage of the battery. In the original instrument this resistance has a total rating of 1,000 ohms, and it is included on a small bracket inside the box, with a hole at the top through which a small screwdriver may be inserted for a zero setting. The normal spindle is cut down to about ½in. in length and is then slotted by means of a thick-bladed hack-saw or two blades mounted side by side on a hack-saw frame. The battery used was a standard No. 8 torch cell, a small section of the bottom of the box (home-made) being cut out, and two spring contacts being made from the brass strips taken from a disused flashlamp battery. A sliding metal lid was provided with a keyhole and hinged to facilitate replacement when desired. To obtain the zero setting the two test leads are short-circuited, and the screwdriver inserted in the hole and the needle adjusted to read an exact zero. With a 50-ohm meter, a 1,000-ohm variable and a fixed value of 2,500 ohms, the meter scale will read from 0 to 200,000 ohms.

Test Prods

The test leads are ordinary red-and-black flex connected as shown to indicate correct polarity. This is most important and must be preserved to avoid damaging the meter. At the end of the leads, sockets are soldered, and these are made to take crocodile clips or other methods of obtaining contact at the points of a circuit which are to be tested. Alternatively, the Bulgin test prods may be used. As the meter in question was intended to be used for charging purposes (on the 1 amp. range), clips had to be used to maintain constant contact, but this is a point which may be left to the individual constructor. For accuracy, the series resistances should be specially selected and most manufacturers can supply these specially at a slight extra charge. These are incidentally also obtainable from Premier Radio, guaranteed 2%+.



This dial indicator may be cut out and stuck on the panel. Copies on art paper may be obtained from this office for 3d.

SHUNT RESISTANCES

Multiplying Factor	Resistance in Ohms
2	100
3	50
4	33.33
5	25
6	20
8	14.29
10	11.11
20	5.26
30	3.45
40	2.56
50	2.04
60	1.695
80	1.266
100	1.010
200	0.503
300	0.334
400	0.251
500	0.200
600	0.167
800	0.125
1,000	0.100

SERIES RESISTANCES

Voltage Range Desired	Resistance in Ohms
2 volts	1,900
3 ,,	2,900
5 ,,	4,900
10 ,,	9,900
15 ,,	15,000
20 ,,	20,000
30 ,,	30,000
50 ,,	50,000
100 ,,	100,000
150 ,,	150,000
200 ,,	200,000
300 ,,	300,000
500 ,,	500,000
1,000 ,,	1,000,000

In reply to your letter

Mains Transformer Connection

"I have removed a mains transformer from a commercial set and there is one little thing which puzzles me in its connection. There are two heater windings, one centre-tapped and one not. I know the set used 6.3 volt valves and should be glad to know how to use these two windings in the set, in the absence of the centre-tapping. The large H.T. winding is centre-tapped as usual."—M. P. (Gainsboro').

IN many commercial receivers the rectifier heater winding is not centre-tapped, the H.T. positive line being taken from one side of the filament or heater. This is apparently the case in your component, the centre-tapped low-voltage winding being intended for the valves in the receiver. This arrangement works quite satisfactorily and on many receivers there is little difference from the point of view of hum when the centre-tap is used. The main reason for dispensing with the tapping is, of course, one of economy.

Damaged Valve

"I was recently overhauling my set and in thinking the valve pins were not making good contact I tried to improve matters by opening the pins with a penknife. I am afraid that I have damaged one of the valves as the set won't work now, and in a test there is no anode current in the valve. The pins are not simple slotted ones, but bowed slightly on the sides and I had a bit of a job to get the knife blade in. Do you think I have done anything to damage the valve?"—B. T. (Blackburn, Lancs).

THERE is a possibility that you have severed the leading-out wire inside one of the pins. Absence of anode current would indicate that it is an anode or filament leg and a continuity test on the filament will enable you to ascertain which is broken. In the case of the filament leads having gone it will be necessary to replace both as it will be found that you will have to try and pull out the lead from the leg and if you attack the wrong one you are bound to break it and thus will have to do both. The slot should be opened as much as possible and the thin wire "fished for" with a crochet hook or similar implement. When located and pulled out a length of bare thin copper wire should be soldered on to the end and the solder at the base of the pin heated and shaken off to leave the hole clear. The wire will then have to be pushed through and pulled straight, when it may be soldered to the point of the pin and excess solder cleaned off. Do not try to remove the pin from the base of the valve.

Midget Receiver

"I wish to make up a very small battery midget capable of pocket use. Will two valves give me the desired result and, if so, what types would you advise, especially as I wish to keep batteries to a minimum? I should also like some recommendation as to a suitable circuit for strict portability."—G. F. (N.W.5).

WE would suggest a two-valver, which will give ample volume with a small built-in frame for headphone use at low H.T. voltage. The Hivac XD and XL valves will be found quite suitable, with transformer coupling. One of the small 45-volt H.T. batteries used for deaf-aids may be employed with a dry accumulator or dry cell. The frame could be wound in the lid of the box, assuming a box about 8in. by 5in. About 40 turns of wire would be needed for the medium-waveband, tapping this for reaction. The most suitable point for the tap would have to be found by experiment. A Bulgin midget transformer could be used for coupling, with the small tubular fixed condensers, etc., to make quite a neat set.

RULES

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

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

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

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

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

Doublet Aerial Feeds

"I am using one of the 'J' type aerials which was originally used by a well-known local transmitter. I am utilising it in conjunction with my commercial communications 8-valver and I am wondering if I can improve on the flex feeders I am now using with this type of aerial. Could you give me your recommendations as to the most effective way of coupling this to my set?"—V. G. T. (Boston).

ALTHOUGH good results are obtainable with twisted feeders used with the aerial mentioned by you, the losses are actually far higher than with any other type of transmission line. The same results apply to both transmitting and receiving aerials and we suggest that you use a properly spaced pair of feeders, coupling these to your receiver either through a small coupling coil or with a tuned matched input circuit.

L.F. Instability

"I recently assembled some parts into a straight four-valve set which, although it works well on mike and pick-up, gives a bad howl on radio. I made several modifications to the layout and screening, but I find that the output is low on the mike circuit and the howl cannot be removed. This leads me to suspect the L.F. section of the receiver and I wonder if you can suggest any likely cause of the trouble. I might mention that I have carried out all the usual tests for instability and have amply decoupled everything and seen to correct working voltages and values."—L. D. S. (Brockley).

A FORM of trouble sometimes experienced in the L.F. section of a receiver or in small P.A. apparatus is that of instability due to the L.F. volume control. This type of component is generally provided with a metal case over the element, and we have met a number of cases where the trouble can only be overcome by earthing this screening cover. Its exact cause cannot easily be discovered, but the trouble is by no means rare and our own A.R.P. equipment installed in this building had to have the control earthed in this manner in order to obtain maximum gain and complete stability. We suggest, therefore, that you try this in your case.

H.T. Battery Resistance

"I was looking through some elementary wireless articles recently and I see that decoupling has to be included in a battery set in order to avoid trouble due to a run-down H.T. battery. This seems rather incongruous to me as surely when the battery is new there is more H.T. and the trouble would thus be more intense with a new battery. Why, therefore, do you have to adopt the procedure mentioned to guard against a low-voltage battery?"—K. E. (Cambridge).

YOU have overlooked the fact that the trouble is due to the fact that without decoupling components H.F. currents will have to pass through the battery to earth. A new battery has a very low H.F. resistance and consequently offers little barrier to the H.F. which is thus effectively earthed. On the other hand as the battery becomes discharged, although the voltage is reduced the internal resistance of the battery increases and thus offers opposition to the flow of H.F. This takes the easier path to earth offered in other parts of the circuit and accordingly troubles arise. By including decoupling resistances in the anode circuits and providing a by-pass condenser to earth, the H.F. is prevented from getting to the battery and therefore, although of high resistance, it does not affect stability. Obviously, however, the reduced voltage, coupled with the fact that resistances are in the anode circuit, will result in poor reception due to lack of H.T. on the actual anode and therefore the battery should not be used when the voltage drops to a certain level—dependent upon the circuit and the characteristics of the valves in use.

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.

J. A. W. (Wolverhampton). Your sketch is quite incorrect. You have apparently applied 230 volts to the filament! The 230 volt winding must be joined to the anodes, with the centre tap to earth (H.T.—). The filament is fed from a separate low-voltage winding, and the centre tap is H.T.

G. E. (Bromwich). The valve is not suitable. You must use a Class B type driver in that circuit.

J. S. C. (Glasgow). The aerial is quite suitable, but use a pre-set or small variable condenser in series with the lead-in.

The coupon on page 328 must be attached to every query

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).

Radio Service Manual

SIR,—With reference to the "Service Manual," I once read this book through prior to purchase and found it the most intriguing and interesting publication on modern radio I've ever read, gripping one from beginning to end so much so I intend to read it through again, hence my desire for a copy. Whilst being sufficiently technical it does help one to see daylight by its very practical text and illustrations, and it is certainly a refresher for those who like myself managed to keep up with early advances in radio, but who in later years, through work and other factors, have let the study slide. As evidence of my present request for another book, I may say that it has renewed my interest in radio and the study of it.

Wishing your publications every success and many recommendations which I, personally, shall gladly add to.—J. E. EASTELLE (Dagenham).

A Satisfied Prize-winner

SIR,—I wish to thank you for the book "Sixty Tested Wireless Circuits," awarded me for solving a recent problem.

It will be very useful for quick reference, as I am constantly making up sets of one kind or another for experiment or for friends.

I have been a constant reader of PRACTICAL WIRELESS from No. 1, and have all the volumes roughly bound for reference.

I look forward to my copy each week, and thoroughly digest its contents, even the advertisements, and hope it may continue to flourish for many years to come.—D. HAY (London, W.).

Suggested Club for Huddersfield

SIR,—I have been a reader of PRACTICAL WIRELESS for the past two years, and have found it a great help on numerous occasions. The formation of a local short-wave club appeals to me, and if any readers in the district are interested I shall be glad if they will please write to me or call.

Regarding the controversy that is going on between the 0-v-1 men and those who support the more elaborate communications receivers, may I add that I listened in with an 0-v-1 and was able to receive all the stations worked by local amateurs, who all use 5-7 valve superhets.—J. HAWKINS (Huddersfield).

A DX Log from Bristol

SIR,—I enclose a short log which may interest other readers. The stations were received during the last three weeks on a simple det. and L.F. arrangement using a 60ft. vertical aerial:

WRUL, WGEA, WRUW, WCBX, WNBI, WPIT, WHAM, WFIL, W1JFG, W1ABQ, W1FH, W4CYU, W1DQ, LY1S, CR6AF, and XGOY.—H. S. THAYER (Bristol).

Prize Problems

PROBLEM No. 406

MELVYN has a two-valve set (battery operated) in which an S.G. valve was used as detector, and the tuning was effected by means of a band-pass pair of coils. He decided that the introduction of a variable-mu valve would be an improvement and accordingly obtained such a valve, fitting the standard form of volume control, namely a potentiometer across a biasing battery, with the arm of the control connected to the lower end of the grid coil with by-pass condenser to earth. He found, however, that instead of varying volume this control introduced serious distortion. Why was this? Three books will be awarded for the first three correct solutions opened. Will entrants please name their preference for a prize, selected from the list on page 310. Entries should be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 406 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, July 1st, 1940.

Solution to Problem No. 405

The trouble in Abbott's receiver was an open-circuited by-pass condenser in the cathode-circuit of the output valve. At weak or normal volumes this would have little effect, but at large volumes the effect of a bias resistor without H.F. by-pass would result in distortion and a limiting effect which would reduce volume.

The following three readers successfully solved Problem No. 404, and books have accordingly been forwarded to them:

R. C. Evans, Station House, Llangefni.
E. T. Lascelles, 3, Church Avenue, Aintree, Liverpool, 9.
K. Pitman, 31, Elmtree Road, Pitsea, Essex.

FROM THE TEST BENCH

Screwdriver Blades

MANY constructors find that screw heads become badly damaged when tightening or loosening screws or bolts, and this is invariably due to the fact that the screwdriver blade is wrongly cut. It should not, contrary to general impressions, be sharpened. If possible, the blade should be parallel-sided and the tip should be filed flat. That is, a cross section of the blade should show a rectangle. Unfortunately, this will mean that it will only fit certain slots, and this is generally overcome by making a very slight taper on the blade, but where much constructional work is undertaken it will pay to have several screwdrivers with varying thicknesses of blade, if neatness is to be preserved.

PATENTS AND TRADE MARKS

Any of our readers requiring information and advice respecting Patents, Trade Marks or Designs, should apply to Messrs. Rayner and Co., Patent Agents, of Bank Chambers, 29, Southampton Buildings, London, W.C.2, who will give free advice to readers mentioning this paper.

Get back that PUNCH in your Set! *with the D.C.*

AVOMINOR

Regd. Trade Mark

ELECTRICAL MEASURING INSTRUMENT

This precision-built moving-coil D.C. instrument, with 13 ranges covering 0-120 m/A, 0-600 volts, and 0-3 megohms, provides adequate testing facilities for checking valve performance, batteries and power units, etc. It reduces trouble-tracking to its simplest terms. In case with instruction booklet, leads, interchangeable testing prods and crocodile clips.

Voltage		Current
0- 6 v.	0-240 v.	0- 6 m/amps.
0- 12 v.	0-300 v.	0- 30 m/amps.
0-120 v.	0-600 v.	0-120 m/amps.

Resistance
0-10,000 ohms.
0-60,000 ohms.
0-1,200,000 ohms.
0-3 megohms.

Write for fully descriptive leaflet.

Sole Proprietors & Manufacturers :—
Automatic Coil Winder & Electrical Equipment Co., Ltd.,
Winder House, Douglas St., London, S.W.1. *'Phone: Victoria 3404/7*

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The man who enrolls for an I. C. S. Radio Course learns radio thoroughly, completely, practically. When he earns his diploma, he will KNOW radio. We are not content merely to teach the principles of radio, we want to show our students how to apply that training in practical, every-day, radio service work. We train them to be successful!

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Please explain fully about your Instruction in the subject marked X.

Complete Radio Engineering
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If you wish to pass a Radio examination, indicate it below.

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....

(Use penny stamp on unsealed envelope.)

Classified Advertisements

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

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

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

CABINETS

A CABINET for every radio purpose. Surplus cabinets (undrilled) from noted makers. We have hundreds in stock (no catalogues). Send measurements of chassis, etc., and say what kind of cabinet required. Stamp for reply. Inspection invited.
H. L. SMITH AND CO., LTD., 289, Edgware Road, W.2. Tel.: Pad. 5891.

LITERATURE

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

LOUDSPEAKER REPAIRS

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

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

MISCELLANEOUS

STAMPS.—50 Italy 8d.; 25 Bulgaria 8d.—Harrowven, 224, King Street, Norwich.

MORSE EQUIPMENT

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

MORSE TRAINING

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

NEW CHASSIS

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

NEW LOUDSPEAKERS

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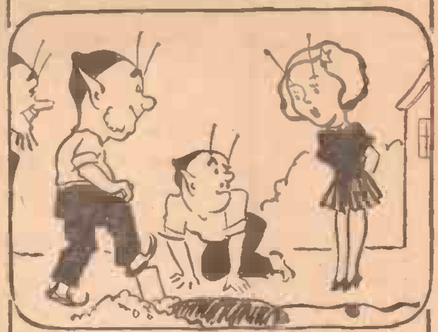

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