The Wireless Constructor

6D MONTHLY

EDITED BY
PERCY W. HARRIS. M.I.R.E.

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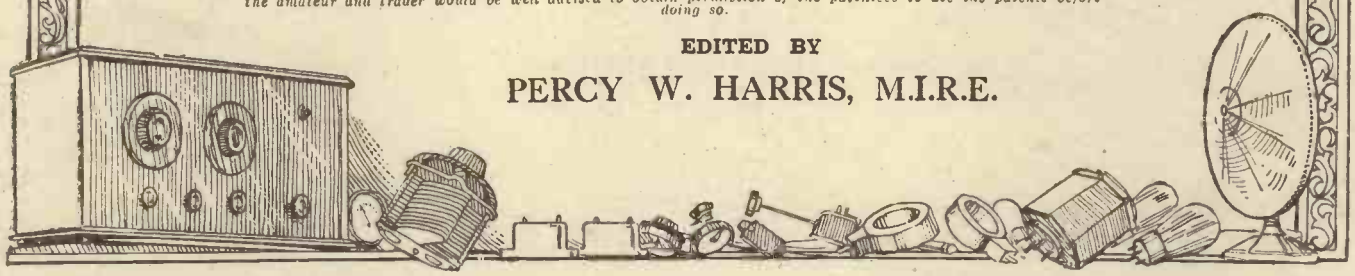
CONTENTS

As some of the arrangements and specialities described in this Journal may be the subject of Letters Patent, the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

EDITED BY

PERCY W. HARRIS, M.I.R.E.



The WIRELESS CONSTRUCTOR

Edited by
PERCY W. HARRIS,
M.I.R.E.

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THE EDITOR'S CHAT

Percy W. Harris, M.I.R.E., the Editor of the "Wireless Constructor," discusses The "Diamond" Three and other items of interest to Constructors.

ANY wireless journal which aims to provide a genuine service must publish, from time to time, not only practical designs of new circuits, so as to keep its readers abreast with modern progress, but must also keep in front of it the importance of modifications to existing designs to suit special purposes. The WIRELESS CONSTRUCTOR has published in the past a number of three-valve designs and, as our regular readers know, pioneered the now immensely popular three-valve design in which soldering is abolished.

The great popularity of three-valve sets consisting of detector with one resistance and one transformer stages of note magnification is based upon the combination of high sensitivity and excellent quality which such an arrangement gives. All the designs so far published have assumed that the user would have access to either an outdoor aerial or a good indoor aerial, and there are thousands of flat dwellers and others whose activities are confined to one or two rooms where an outdoor aerial is not available, and who, so far, have been debarred enjoying the excellent reproduction given by such a receiver.

The "Diamond" Three

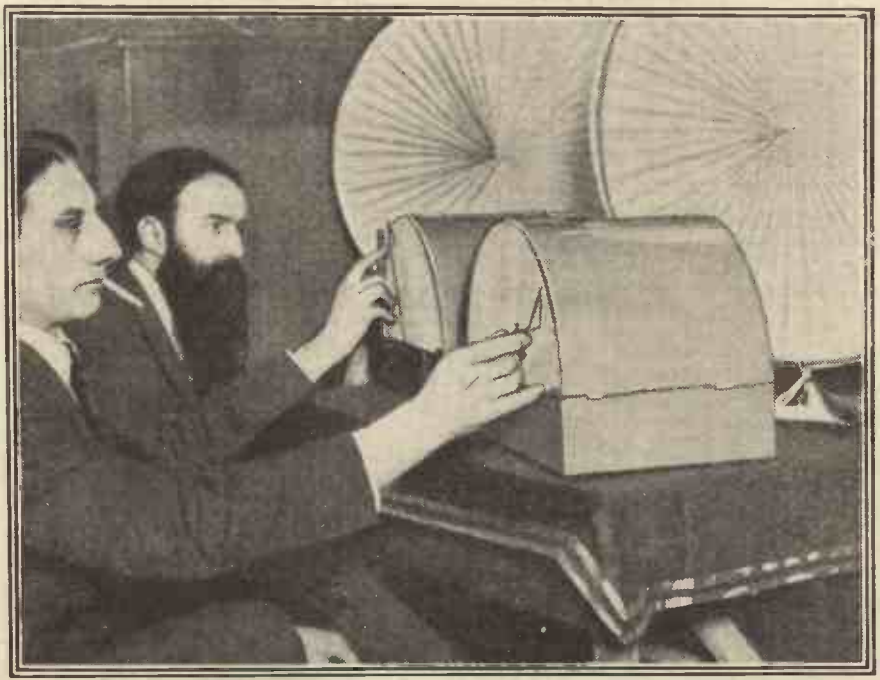
The WIRELESS CONSTRUCTOR is proud to publish the first three-valve design using a detector with one resistance- and one transformer-coupled stage specifically designed for use with a small frame aerial, thus dispensing with the inconvenience which so frequently attends the outdoor aerial and earth connections. The "Diamond" Three, fully described and illustrated in the present issue, is a compact, handsome and efficient set which should have a widespread popularity.

While not pretending to have the efficiency of a seven- or eight-valve super-heterodyne used on the same size frame, it will give first-class reproduction up to ten or fifteen miles from a main station and up to a hundred or more from 5 G B. It will thus give two-station loud-speaker reception to a very large proportion of the population, while its acute selectivity enables 5 G B to be received even within a mile or so of 2 L O.

After many months practical trial in the WIRELESS CONSTRUCTOR laboratory, a very powerful mains unit for supplying high-tension up to 200 volts and with enough current to supply a push-pull amplifier, using super-power valves in the output, is described for the first time in this issue.

The article dealing with it should

More Mysterious Music



A French electrical engineer, M. Rene Bertrand, has invented the device shown above for producing musical sounds electrically. The instrument is easy to play, and he claims it has greater range and power than the apparatus of Professor Theremin, recently demonstrated in this country.

The Editor's Chat—*continued*

be carefully studied by all readers who are interested in problems of high-tension supply, even if they do not intend to construct the unit in question, for it shows the practical application of the principles described in the last three articles on how a mains unit works.

The careful investigations which have been carried out by this journal into the working of dry high-tension batteries has aroused a great deal of interest not only at home but abroad. The current issue contains a further article which explains many points which have puzzled users of these devices, and will certainly help to a more economical use of dry batteries in the future.

Further Experiments

Continuing this investigation into the source of current supply available for wireless-set users, the WIRELESS CONSTRUCTOR is now carrying out experiments with dry cells as a source of filament current—not because such a source is one to be particularly recommended, but because enquiries show that a large number of two-volt-valve users rely on a couple of bell-ringing cells as their source.

Furthermore, we must not suggest the importance of such forms of supply for portable sets. An article dealing with the cost of running, average life, reliability and any other features of dry cells as a source of filament current, will appear in an early issue.

The laboratory is at present planning a number of special receivers for publication in early issues. These include all kinds of sets from economical single-valve receivers to a multi-valve super-heterodyne for long-distance reception with a frame aerial. Readers who feel that they have yet to see their ideal receiver described in this journal, and who particularly desire a description of some special form of set, are invited to send a postcard to the Editor with the following information:

1. The general type of set in which they are most interested.

2. Which set recently published comes nearest to what they desire.

THE "CONCERT FOUR."

Dear Sir,—Although you know just what your sets will do, yet I am sure you are pleased to hear of their success in the hands of amateurs.

The "Concert Four" is a real winner. I made it as a "hook-up," and did not include the D.P.D.T. switch. Result, I have to take the aerial off for 2 L O, and with a touch of reaction I can get 5 G B clear and at good L.S. without any aerial!

Lists of stations received can be very misleading, but I have received the following on the "Concert Four": Bordeaux, Leeds, Vitus, Cologne, Lyons, Newcastle, Dublin, Breslau, Bournemouth, Konigsberg, Cardiff, Stuttgart, Toulouse, Hamburg, Frankfurt, Manchester, Glasgow, Rome, Langenberg, 5 G B, Brussels, Milan, and others I have not recognised. I was surprised to get Stuttgart clear from 2 L O, but can do it often in daylight.

Wishing you luck.

Yours sincerely,

Mitcham, Surrey. H. R. ODAM.

3. What special features they would like to see incorporated in WIRELESS CONSTRUCTOR receivers.

All postcards received will be carefully studied and classified, and the suggestions made will as far as practicable be incorporated in the laboratory designs now being prepared. Please send the information as briefly as possible on a postcard addressed to The Editor, The WIRELESS CONSTRUCTOR, Tallis House, Tallis St., E.C.4. It is particularly requested that postcards be used rather than letters as this greatly simplifies the classification and filing of these communications.

Most flattering reports are coming in regarding the achievements of The "Concert Four"—the new WIRELESS CONSTRUCTOR Envelope No. 2. One reader purchased the envelope from his local bookstall, collected all the parts, took them home and within twenty-four hours had completed the set and received thirty-five stations on the loud speaker. Being quite a beginner in the art of construction, he is delighted not only with the large number of stations he can get, but with the remarkable selectivity of the set and the great simplicity of construction.

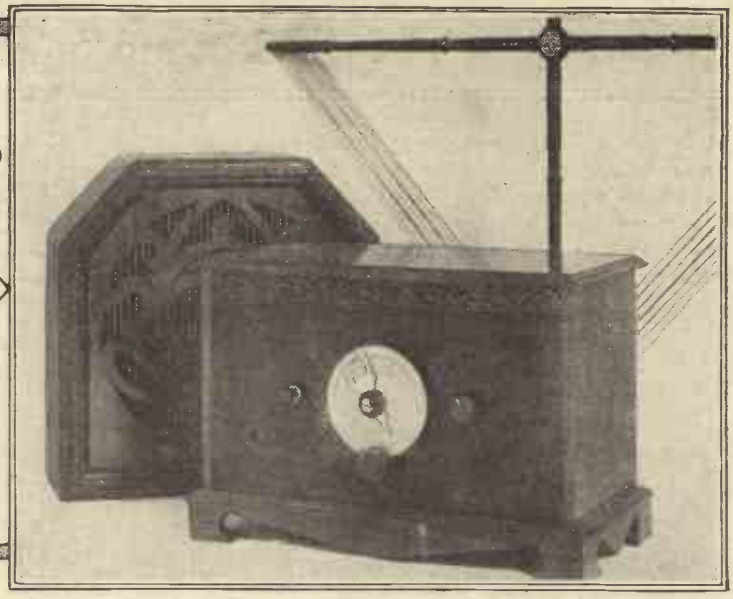
A Popular Set

The "Radiano Three" Envelope, which has been published in response to demands from all parts of the country for a reprint of the original WIRELESS CONSTRUCTOR article, is still proving extremely popular, particularly as the use of two transformer stages of note magnification gives a greater volume than is possible with one transformer and one resistance stage. Many readers say they prefer the "Radiano Three" to any other receiver published, because a change from one component to another (such as the trial of a new kind of transformer) is effected in a few seconds by unscrewing the flexible Radiano leads and reconnecting them to the new instrument. Such a rapid exchange is impossible with any of the stiff wiring systems without spoiling the appearance of the set.

"For the twentieth time—'Are you coming home to-night?'"

The "DIAMOND" THREE

by PERCY W. HARRIS M.I.R.E.



A novel three-valve set which will appeal to all constructors. An efficient frame-aerial pick-up is employed which enables the set to have remarkable ranges of reception and wave-length.

FROM time to time we see sensational newspaper reports according to which some inventor (usually a foreigner and frequently a priest!) has evolved a receiver which dispenses entirely with the aerial and earth, and their attendant disadvantages. Generally, on investigation, such receivers prove to be nothing more than ordinary sets, with conventional circuits, used so close to a broadcasting station that the connecting wires on the receiver itself pick up all the energy that is required. Or else the receiver conceals a frame aerial of particularly small dimensions.

Two Alternatives

The general principles of wireless reception are by now fairly well understood. Improvements come along the line of increased efficiency of individual parts, and much more rarely by anything which demonstrates a new principle. We know, for example, that once we have picked up a signal, however minute, we can magnify it many thousand times, so that, in general, we have the choice between

(1) Picking up a loud signal and magnifying it a few times, and

(2) Picking up a weak signal and magnifying it a great deal.

So far as the necessity for magnification arises, and assuming we want the same strength of output, there is little difference between a set with a very small and inefficient aerial near to a broadcasting station and a set with a large and efficient aerial at a much greater distance. The nearer we are to a station, the smaller the aerial we can use to get quite good results, so that a mile or two from a main station a few inches of wire connected to the aerial terminal of a good receiver will be all that is necessary to pick up the energy needed.

Indeed, such is the efficiency of receivers that, provided the set is equipped with several valves, properly used, and is near to a station, the internal wiring will actually provide the necessary aerial effect, which is why a number of enthusiasts proudly boast that their special receivers will get the local station without any aerial at all.

Compact Installations

I have frequently received letters from readers, particularly in such areas as London, Manchester, and Glasgow, asking for more designs of sets that can be used in single rooms or houses where it is not practicable to erect an outside aerial, and where

LIST OF COMPONENTS

1 Panel, 14 in. × 7 in. × ¼ in. or ⅜ in. (Resiston). (Ebonart, Trolite, Becol, etc.)

1 Cabinet with 7-in. baseboard (Artcraft). (Camco, Caxton, Pickett, Makerimport, Raymond, etc.)

1 Ebonite strip, 13 in. × 1½ in.

13 Terminals. In the instrument shown, three terminals for the frame aerial have been chosen of a distinctive pattern, but all terminals can be alike, or all indicating, as desired (Belling-Lee, Eelex, Igranic, etc.).

1 ·0005 variable condenser (Ormond). (Bowyer-Lowe, Cyldon, Igranic, Jackson, Keystone, Raymond, Ripault, etc.)

1 Vernier dial for frame (Ormond). (Any of the many excellent vernier dials will suit here.)

1 Panel-mounting neutralising condenser (Igranic Micro). (Cyldon Bébé, Keystone Midget, Ormond reaction type, etc.)

1 On-and-off switch (Lotus). (Benjamin, Lissen, Bowyer-Lowe, Igranic.)

3 Valve holders (Lotus). (Benjamin, Bowyer-Lowe, Magnum, Pye, etc.)

1 Radio-frequency choke (R.I.-Varley). (Bowyer-Lowe, Magnum, Climax, Igranic, Lissen, Marconiphone, Metro-Vick, etc.)

1 Fixed condenser, ·0001 mfd. (Lissen). (Dubilier, Atlas, Mullard, T.C.C., etc.)

1 Fixed condenser, ·0003 mfd., with 3- or 4-megohm grid leak (Lissen). (Mullard, Dubilier, Atlas, T.C.C., etc.)

1 R.C.C. unit (Dubilier). If interchangeable values are used, a ¼-megohm anode resistance and 2 megohms for the leak. (Lissen, Atlas, R.I.-Varley type B, Marconiphone type B, Mullard, etc.)

1 Good low-frequency transformer (Igranic type G, 3·6 to 1). (Bowyer-Lowe, R.I.-Varley, Mullard, Marconiphone, Pye, Ferranti, etc.)

1 2-mfd. fixed condenser (Lissen). (T.C.C., Dubilier, Mullard, Ferranti.)

Wire for wiring up.

Centre-tapped frame (Bodine, Rothermel Corporation). Can be home-constructed if desired, as described below.

The "Diamond" Three—*continued*

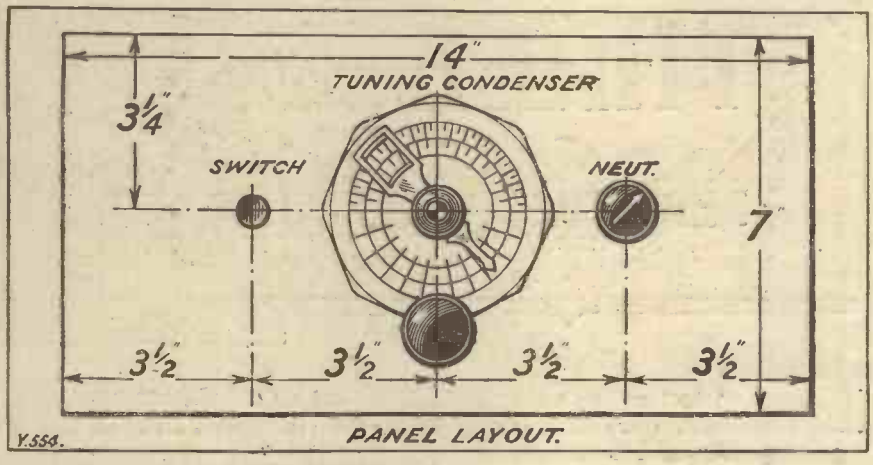
it is not convenient even to instal an indoor form, such as a wire round the picture-rail.

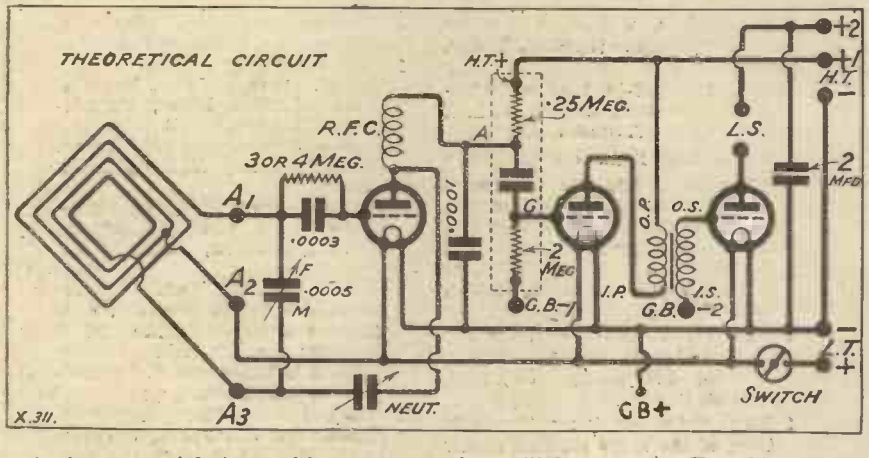
Many readers imagine that frame-aerial reception is only practicable when one has a multi-valve receiver such as a super-heterodyne, whereas actually if one is prepared to confine oneself to one or two stations, such as the local and 5 G B, a properly designed three-valve set will give all one desires both in strength, selectivity and purity.

First-Class Quality

The "Diamond" Three is a set I have worked out specifically for the reception of the local and the alternative station, with first-class quality on the loud speaker, using a small frame aerial. It is not claimed that it will receive a number of distant stations on such an aerial, although when conditions are good several may come in; but as a receiver primarily designed for the local and the alternative, possessing great simplicity of handling and high quality, it can be recommended with every confidence.

Care has been taken to make the set of pleasing appearance, while keeping the cost down to a modest figure. Whether or not this has been achieved the reader can judge himself by scanning the front cover of this issue and the list of components in this article.





A frame aerial is nothing more than a large tuning coil, across which a variable condenser and the first valve of the set is connected, so arranged that the moving field of the electric waves from the broadcasting station cuts the windings and induces a current in them, just as the moving coil in a dynamo cuts the stationary field from the field magnets resulting in a current being set up in the coils.

To produce an electric current the field and the windings must cut one another, and it obviously does not matter whether the field is stationary and the coil moving, or the coil stationary and the field moving. We might almost say, in the case of frame-aerial reception, that the frame itself resembles the armature of a dynamo, the field of which is provided by the broadcasting station.

With a given field the strength of current set up in the coil will depend largely on the size of the coil and its resistance, and the lower the resistance the greater the current that will be set up. For this reason the introduction of reaction into a frame aerial, thereby reducing its effective damping, is a very great advantage. The "Diamond" Three is so arranged that progressively variable reaction on the frame aerial is provided.

The circuit itself will be seen in the theoretical diagram, the reaction being controlled by a very small "neutralising" condenser, the knob of which appears on the right of the tuning dial on the front panel. The detector is resistance-coupled to the first note-magnifying valve, which in turn is transformer-coupled to the output valve, so that after the detector the circuit is the same as in F5.

The circuit itself differs somewhat from that of F5, and has been chosen as particularly suitable for frame-aerial reception, as there is no separate reaction winding on the frame, which would have been necessary if the F5 circuit had been used.

Small Receiver

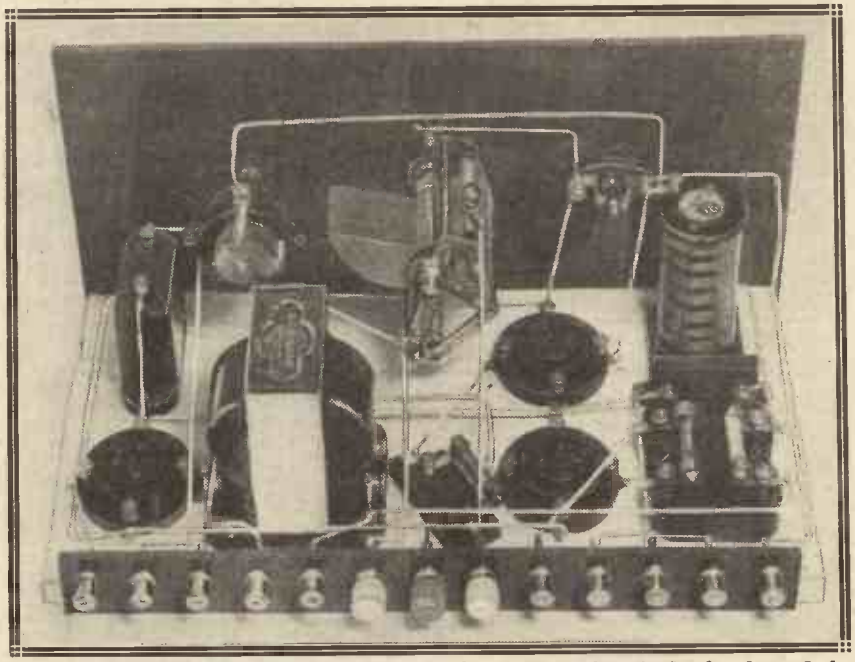
Mechanically, also, the receiver has been arranged quite differently. It has, for example, been possible to make it more compact, for there is no internal tuning coil, the frame itself acting as such. The layout, indeed, is particularly simple, as the wiring diagram will show. As the receiver is not a compromise, but a particular set specifically designed for frame-aerial reception, the terminal strip is arranged quite differently from normal.

The three terminals for the frame (two ends and a centre-tap) are placed in the centre of the strip, and short leads being brought across to the tuning condenser, which can now be placed quite efficiently in the centre of the panel. The other terminals are arranged in positions to suit the internal connections, and to simplify the wiring.

The component parts required are given. For many of the components a wide variety of alternatives

The "Diamond" Three—*continued*

exist. The actual components used in the set are named in brackets after each item, while the names following are approved alternatives.



Showing the well-spaced wiring. Note the three centre terminals A_3, A_2, and A_1, for the aerial.

The selection of the parts actually used must not be taken to indicate anything more than that these are typical first-class components. They are not necessarily better than the alternatives named.

The first step should be to drill the front panel and to mount the tuning condenser, the reaction condenser, on-and-off switch, and vernier dial in position. The method of mounting the vernier dial is different with different types, but in each case full instructions are given with the dial. If an Ormond dial is used, pay particular attention to the maker's instructions as, unless these are followed, certain parts of the dial may become detached at an awkward moment.

The Earthed Screen

In the case of the Ormond dial a special earth screen is provided which does not make contact with either fixed or moving plates. This, as will be seen, is connected to the nearest filament potential point, which, in this case, is the on-and-off switch. If a dial other than the Ormond is used, this connection is omitted, and in no case should any part of the metal dial connected to the fixed or moving plates be earthed. The Ormond dial is the *only* one in which the connection between the earthing screen and the filament switch should be made.

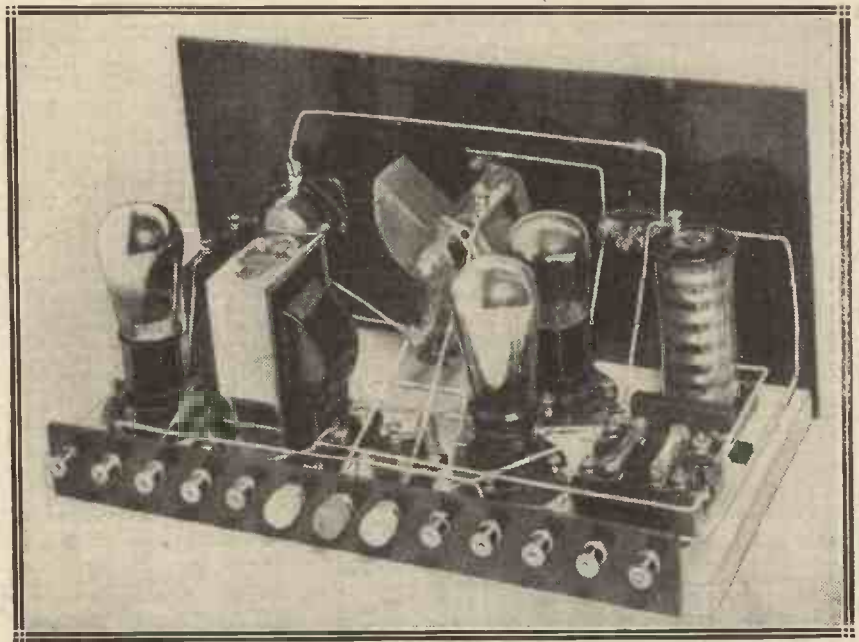
The top connection shown goes from the dial to the filament, and should not be confused with any terminal on the variable condenser.

Before fixing the panel to the baseboard, fix all of the other parts in position, following the layout very carefully. Notice that the terminal attached to the frame of the Igranic low-frequency transformer is joined to one of the filament wires for earthing purposes. If the transformer you use is not provided with a frame terminal, this connection should be ignored.

Wiring Up

It will be noticed that no filament resistances, either fixed or variable, are provided, as statistics show that the greater proportion of valves now sold are of the 2-volt variety, which do not need any such resistors. Indeed, it seems commonly agreed among the valve makers that resistors can now be omitted with modern valves, without sacrifice of efficiency, although in my opinion the valves will probably last longer if they are used.

It will be found convenient to wire up the set as far as possible without attaching the front panel, and when this has been done the front panel should be attached and the remaining wires soldered into position. Be sure that the wire joining the top of the radio-frequency choke with the upper terminal of the reaction condenser is high enough to clear the moving



With valves in position. Note that there are no internal tuning coils, the frame aerial being the only tuned inductance.

The "Diamond" Three—*continued*

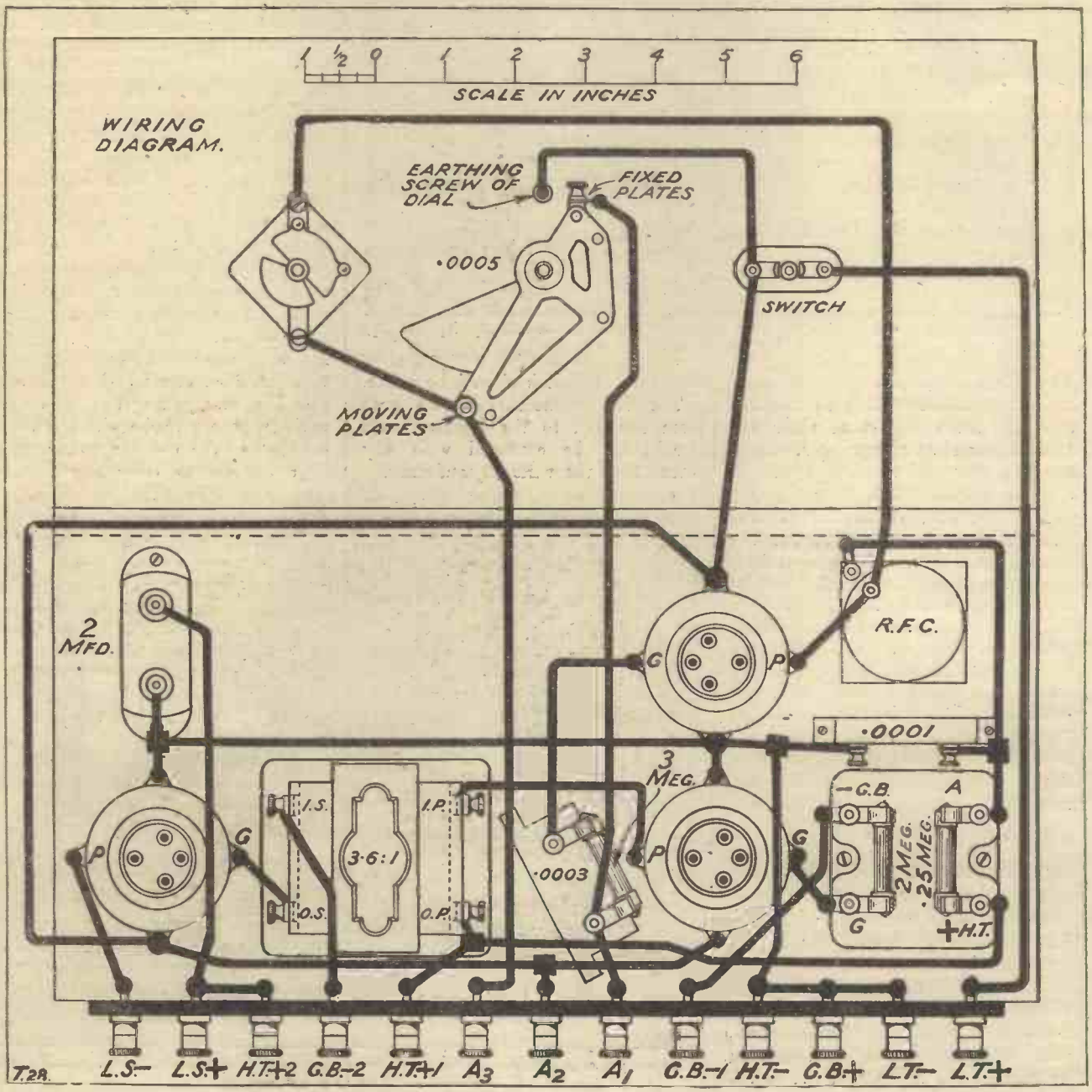
plates of the variable condenser, at whatever position they may be set. The exact angle of the variable-condenser frame should be so arranged that it does not foul any of the valves in their sockets.

We now come to the consideration of the frame, which can be bought ready-made or put together by the constructor himself. A frame aerial is a very simple device to build, and it can be made up in many ways. If you buy a ready-made frame it will be necessary to see that it has a centre-tap, without which it cannot be used with the present receiver. A very good frame aerial which has the advantage of being collapsible when not required is the Bodine, obtainable from the Rothermel Corporation, and illustrated on the cover of this issue. This is provided with a centre-tap, as required.

The Frame Aerial

To build your own frame aerial take, first of all, a fairly heavy base. This can be a block of wood measuring not less than 6 in. square, such as two pieces of inch board 6 in. square, screwed or glued together to make the block 2 in. thick. It will be an advantage to cut away part of the underside and fix in some pieces of scrap lead, so as to give weight and consequent stability.

On this base you will need to mount a vertical piece and a cross-arm. The vertical piece should be 3 ft. long and the cross-piece slightly less, say 2 ft. 9 in. Two pieces of well sandpapered broomsticks,



The "Diamond" Three—*continued*

fastened in the middle by cutting away half of each and securing with a screw, will serve excellently; or your carpenter can fix you up with a simple frame of the dimensions given. The cross-piece should be arranged so that the top arm and the two side arms are all of the same length.

Winding

After the vertical piece has been mounted in the base-block by any convenient means, such as drilling a large hole the same diameter as the vertical piece and making a driving fit, the next step is to hammer into the extremities of the frame (that is to say, the extreme ends of the horizontal arms and the top and bottom of the vertical piece) a number of small brass brads. Starting at the end of one of the cross-arms, hammer in a brad about half an inch from the end, leaving about $\frac{1}{8}$ in. projecting, and then five other brads half an inch apart along a line towards the centre.

You will then have six brads on this extremity. Repeat this process on the other arm, at the top of the vertical piece, and at the bottom, and then turn the frame round and do the same on the other side. Fasten three terminals to a small ebonite strip screwed to any convenient part of the base-block, and secure one end of a reel of No. 24 D.C.C. wire to the first of the three terminals.

Now take the wire and pass it round the bottom brad on the front of the frame, take it up and pass it round the back brad of the left cross-arm, from there to the front top brad, then to the right-hand back brad, thence to the bottom back brad, from there to the front left brad, from that point to the top back brad, thence to the front right-hand brad, from there to the second brad from the bottom at the back of the frame, and then carry on through the second front brad on the left-hand arm.

Making the Tap

The wire goes from here to the second back brad on the top of the frame, after which you will see how to complete the rest of the winding, as the wires go from front to back giving a kind of weaving effect. Keep the wire tight while winding, and when you come to the end secure the wire firmly and solder to the *third* of the three terminals, leaving the centre terminal free for the moment.

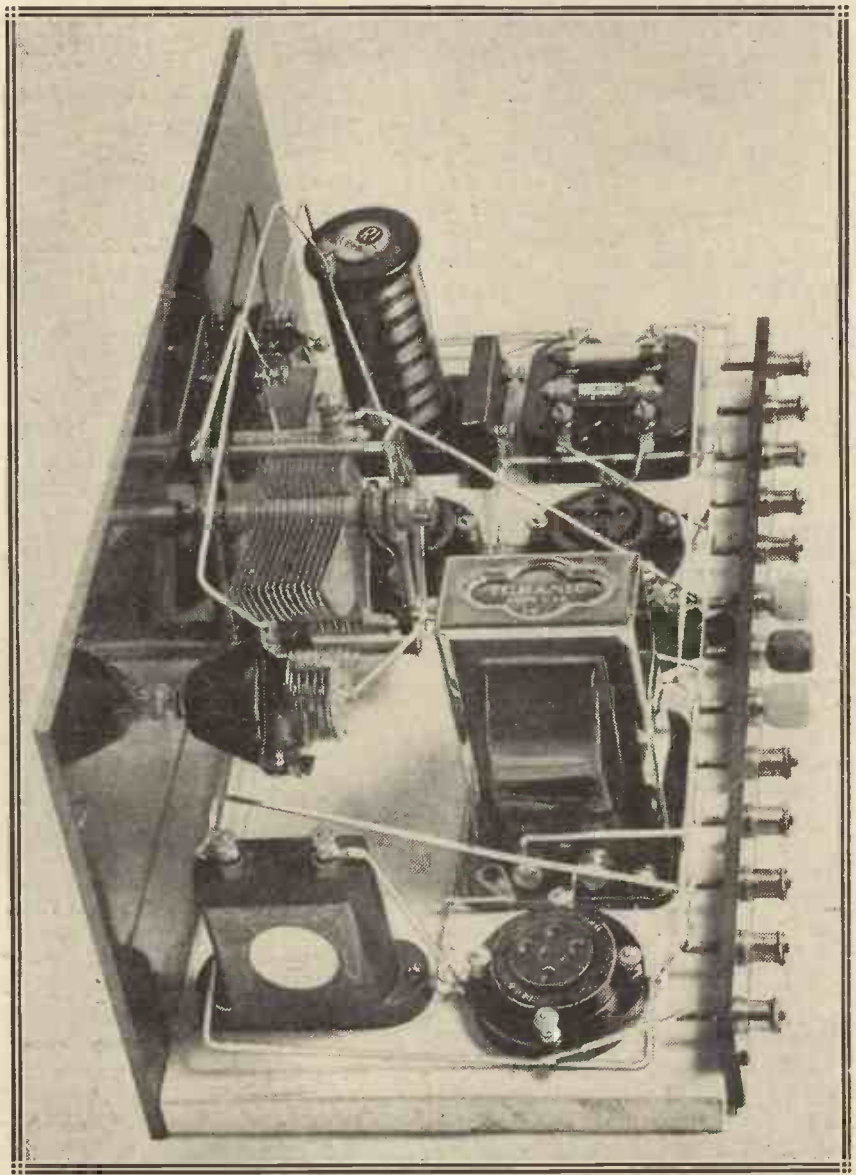
It is not a bad plan at this stage to take some shellac varnish and paint it on to the turns of wire where they touch the wood of the frame. When this is dry it will help to keep the turns in position, although normally the tension of the wire will do this.

The next step is to count inwards until you come to the sixth turn (the middle turn), and carefully bare the insulation from this and solder a short wire, taking the end of this wire to the centre terminal of the three on the frame base. This will give you the necessary centre-tap.

Suitable Valves

If it is desired to finish the frame with wood stain or varnish it is advisable that this work should be done *before* the wire is wound on. The appearance of the frame will be improved if, instead of using the No. 24 D.C.C. wire already mentioned, you use a special frame-aerial wire which can be purchased from the London Electric Wire Co., Messrs. Ward and Goldstone, Ltd., and other firms. The efficiency will be slightly greater with this wire, but not much

(*Continued on page* 136.)



A clear photograph of the set showing the layout of all components, and the long terminal strip employed.

Broadcasting and Education

The results of the Hadow Committee's deliberations appear to forecast more talks.

By a Special Correspondent.

EVERY reader of the WIRELESS CONSTRUCTOR is well aware of the controversy which often rages round the question of the appropriation of time from the B.B.C. programmes for educational purposes, and with the publication of the B.B.C.'s latest handbook, entitled "New Ventures in Broadcasting," that controversy has been fanned into fresh flames by the suggestions made by Sir Henry Hadow and the committee which has been inquiring into the problems of broadcasting and adult education.

Write to the B.B.C.

A good deal of the committee's report is very verbose and unoriginal, and, in fact, very far from interesting, but it must be borne in mind by readers that, in all likelihood, these recommendations will be carried out unless there is a strong and spirited public protest from listeners.

In this article we intend giving a short synopsis of the recommendations with incidental comments here and there, but it must rest with listeners in general whether these recommendations are adopted in full or in part. If the recommendations do not appeal to readers of the WIRELESS CONSTRUCTOR (and they number well over 100,000, let it be remembered), they should write on a post card to the B.B.C. concisely, if pungently, giving their opinions for or against the recommendations made by the committee. Naturally, the B.B.C. has not put up a committee which has laboured for eighteen months on the question with the intention of entirely ignoring its recommendations, and so it may be taken for granted that, in some way or another, those recommendations will be put into force in the near future.

Recreation or Education?

Briefly, they are that the provision of recreation and entertainment being one of the main functions of broadcasting should be extended and developed. That starts well, but then there follows the rider that it is impossible to draw a hard and fast line between recreation and education, and it reads rather like sophistry when the report continues to the effect that to many recreation includes the best music and drama, general talks, debates and readings which keep them in touch with all thoughts and affairs. Incidentally, there are many thousands of listeners who regard classical music, talks, etc., as distinctly and purely educational.

Highbrow Tendencies

The report abysmally fails to draw a distinction between educational entertainment and that type of light entertainment which is perhaps best described as the sort of entertainment Gilbert and Sullivan made peculiarly attractive and famous in the 'nineties. The committee report that there is an impressive and growing demand

A section of the radio installation at the Pennsylvania Hotel, New York.

that broadcasting should provide facilities for more specialised adult education, and that as broadcasting is a public service the case is strengthened for using it more in the interests of national education.

It is a peculiar fact, which no doubt many readers have noticed, that any form of public service, whether it be specially designed for entertainment or not, usually gets highbrow ideas and believes that it has an important educational mission to spread. There are many theatres in London to-day which are suffering because certain critics in the newspapers have plagued managers and almost bullied them into putting on plays which, although bad for the box office, satisfy the intellectual conceit of those concerned in the production. The B.B.C. first of all must be regarded as an entertainment concern.

Only Superficial Benefit

We are not so silly as to suggest that it should not provide educational facilities, but the report recently issued by the B.B.C. does indicate that more and more programme time will be encroached upon in order to satisfy the recommendations of the Hadow Committee.

We doubt very much whether the committee is right in its facts when it says that a much larger proportion of listeners than is commonly supposed have particular interests to which special items could make appeal. We have not the slightest doubt that there are hundreds of thousands of ordinary listeners in this country who are very keen on getting extra educational facilities, but we doubt whether they want those facilities via broadcasting, and we doubt even more so whether those facilities can have anything but a superficial effect.

Education by broadcasting can never in its wildest dreams hope to rival the educational facilities of the night classes, or, say, a series of lectures given in the various technical institutes or even by a specialised home course of study. Education by a series of broadcast talks cannot have the desired effect unless listeners are sufficiently conscientious to make notes and are ready to apply themselves as if they were in a lecture room. In short, broadcast lectures can only have, in the majority of cases, a superficial effect, and therefore we doubt whether the disposition of a considerable proportion of programme time to educational courses will ever achieve its aims and objects.

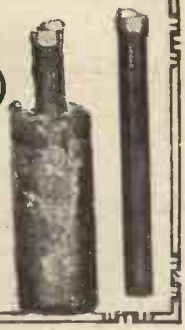
Dependent on Regional Scheme

The committee suggests that the provision of this adult educational system by broadcasting is dependent for its full development on the policy of alternative programmes. But we must realise that the Regional Scheme is still very much in the air, and that

(*Continued on page* 138.)

INSIDE THE H.T.B.

Facts which will interest You.



Some secrets of the "make-up" of the ubiquitous dry high-tension battery.

By R. W. HALLOWS.

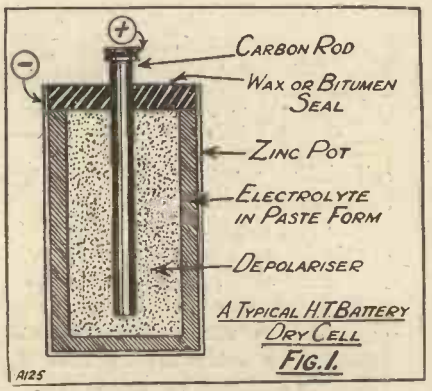
FOR a high-tension battery to be able to give long service under a suitable load two things are essential. The cells of which it is built up must be fitted for the work in hand, and the insulation between them must be as good as it is possible to make it. The ordinary dry cell contains four main parts: the zinc pot, which forms the negative electrode; the electrolyte, consisting of sal-ammoniac and water in paste form; the depolariser (manganese dioxide), and the central carbon rod which is the positive electrode.

The interior of a cell is shown diagrammatically in Fig. 1. Zinc naturally contains a great many impurities which it is most difficult to eliminate. Should these be present to any great extent in the metal which forms the pot of a dry cell, local chemical action is likely to take place, which will result in a serious shortening of its useful life owing to the erosion of the metal.

Exceedingly Complex Action

The kind of paste used varies greatly in different makes of cell. Upon the chemicals which it contains and upon its moisture-retaining qualities the life of the cell depends to no small extent. In order to reduce internal resistance the depolariser is usually mixed with powdered carbon, which is an excellent conductor.

The action which takes place within the dry cell when the battery is supplying current is exceedingly complex, and a full description of it would be out of place here. The process is, however, extremely interesting, and the reader may care to have, shorn of complexities, a rough account of it which will give him a working idea of what goes on within his high-tension battery whilst reception is in progress.



It will be simplest if we consider the paste as consisting simply of sal-ammoniac and water—these in any case are its two most important constituents. Sal-ammoniac (NH_4Cl) is a compound of ammonia and hydrochloric acid. Each molecule consists of one nitrogen atom, four of hydrogen and one of chlorine.

The Discharge Process

We may divide the discharge process in a dry cell into five stages. The first of these takes place when the paste is placed in the zinc pot. The hydrochloric acid in the electrolyte attacks the metal and begins to dissolve it by tearing out atoms. But zinc when attacked in this way has a very peculiar property. Its atoms cannot leave the body of the metal in their normal state. They must part with one or two of their electrons whilst doing so. Now an atom that has lost one or more electrons is positively charged. It follows that in a very short time the electrolyte becomes positively charged owing to the number of positive ions that it receives.

Three Forces

On the other hand, the zinc itself becomes negatively charged, for it has an excess of electrons owing to those left behind by departing atoms. Since like charges repel like the solution is now unable to receive any more positive ions from the zinc, and as the metal can pass into it only in the form of positive ions it is unable to attack the zinc further and the action ceases.

The second stage occurs when the cell, completed and sealed up, is left upon open circuit. It should now theoretically remain in a stable condition, and its potential due to the excess of electrons in the zinc and the excess of positive ions in the solution should stay constant.

Three forces are, however, at work to bring about changes in its constitution. These are (1) local chemical action, which occurs through the presence of impurities in the metal; (2) minute leakages from negative to

A standard capacity cell (left) compared with two undersized foreign cells.

Bitumen sealing with waxed millboard separators, and a treble layer of waxed millboard below the bottom of the cells.

Inside the H.T.B.—*continued*

positive electrode, since no insulator is perfect; (3) the evaporation of water from the electrolyte. The average open-circuit life of a good dry cell of "standard capacity" size ($\frac{3}{4}$ in. diameter by $2\frac{1}{8}$ in. height) is from nine to twelve months.

When the battery is placed in a closed circuit the third stage is reached. The crowding electrons upon the zinc rush through the circuit to the positive pole where they meet positive hydrogen molecules which they join and neutralise. Since its positive charge is lowered the solution can now attack the zinc again.

More and more electrons reach the positive element; more and more hydrogen molecules arrive. If nothing were done to disperse the latter they would collect in a film round the carbon rod, increasing the internal resistance of the cell until this became so high that no current could pass. The cell would then be polarised.

The Depolariser

The fourth stage is depolarisation, which in actual practice occurs simultaneously with stage No. 3. Molecules of manganese dioxide (MnO_2) readily give up one negative oxygen atom which combines with a molecule of hydrogen consisting of two positively-charged atoms. The result of this combination is a neutral molecule of H_2O, or water. The hydrogen is thus got rid of and the water produced serves a useful purpose by helping to keep the interior of the cell moist.

Ideally the depolariser should be able to deal with the hydrogen just as fast as it is formed. Could this state of affairs be achieved, there would be no marked fall in potential whilst the battery was under a suitable load. As matters are, it is not found possible to make the depolariser disperse the hydrogen as quickly as it arrives at the positive electrode.

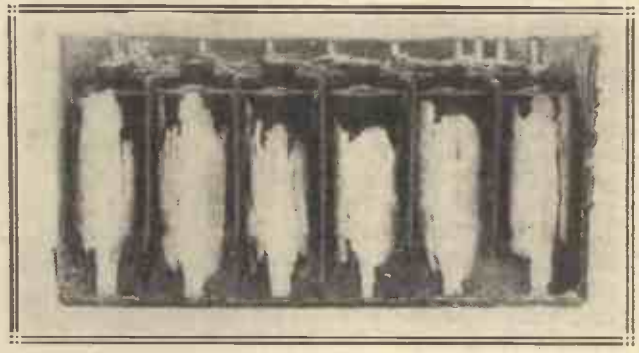
The Last Stage

The result is that so long as current is flowing there is a small but steady increase in the amount of hydrogen that collects; the internal resistance of the cell thus grows gradually greater, and its potential falls off. When the cell is rested by being placed upon open circuit the accumulation of hydrogen is slowly dispersed; the cell picks up, returning to a considerably higher terminal voltage.

The last stage in the discharge of a cell is its running down. In a wet Leclanché cell, such as those used for ringing electric bells, this is due generally to the electrolyte having reached its limit in the matter of dissolving zinc; or if the cell has been recharged several times previously, it may run down because the zinc is entirely eaten away.

In the dry cell matters are rather different. The amount of liquid in the electrolyte is very small, and this either becomes saturated or dries up, It is comparatively rare for the zinc, at any rate of a small H.T.B. cell, to give out under normal discharge, though it may be eaten away by local action if the battery has been standing for months upon the shelf. Another cause of running down is exhaustion of the depolariser. This is brought about by its having parted with all available oxygen atoms.

A little thought will show that one of the main problems before the battery maker is to keep the initial resistance of his cells as low as possible and to prevent it from rising too rapidly when the battery is under load.



No top seal is used here. The partitions are heavily waxed and the cells stand upon a layer of wax.

In an average H.T.B. of standard capacity size the internal resistance is usually between ·25 ohm and ·3 ohm per cell. In certain especially good types of cell, however, the initial resistance may be as low as ·18 ohm. By the time that the E.M.F. of a small cell has dropped to the neighbourhood of 1 volt, the internal resistance may have risen to more than ten times the original figure.

Exceedingly Important Point

The importance of this will be realised when the reader remembers that in order to obtain 120 volts for his note-magnifiers he must use 120 cells if the E.M.F. has so fallen, and that this may mean in the battery a direct current resistance in the neighbourhood of 300 ohms.

Now this is an exceedingly important point, though its importance is frequently overlooked. In probably more than 90 per cent of wireless receiving sets in use at the present time, a common high-tension battery

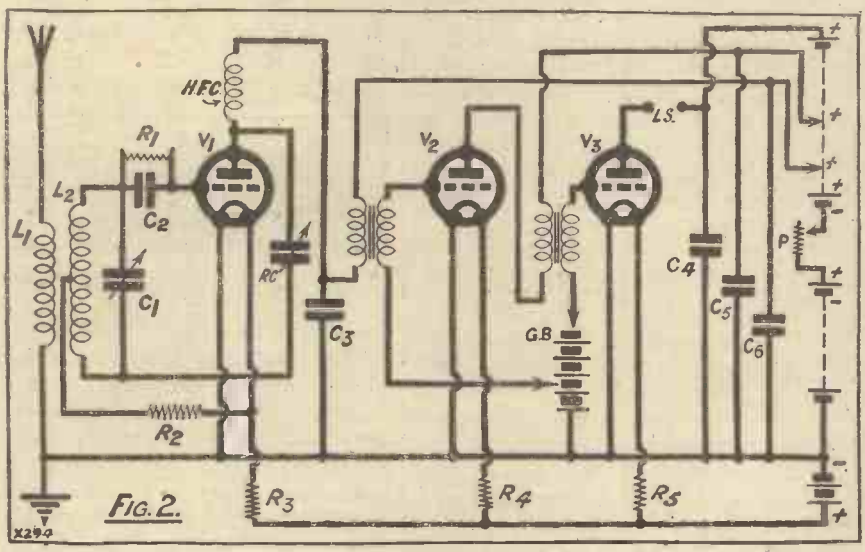
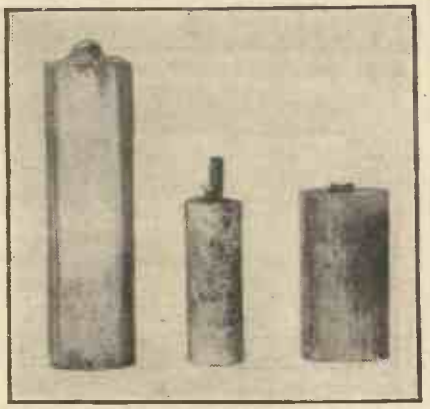


FIG. 2.

Inside the H.T.B.—*continued*

is employed which serves all valves, high-frequency amplifiers, rectifier and note-magnifiers.

The presence of a comparatively large resistance in this battery may give rise to the most mystifying troubles, owing to the unwanted couplings which it causes between valves. Its effects are at their worst, as a rule, in a circuit such as that seen



Super, standard and medium capacity H.T.B. cells.

in Fig. 2, where two note-magnifiers are used in cascade. A coupling then exists between the note-magnifying valves V_2 and V_3. When the battery is new its internal resistance is small (for 120 volts with a new battery, only 80 cells will be required, and at ·25 ohm per cell the total resistance is but 20 ohms); its effects are usually insufficient to give rise to any unpleasant symptoms.

With the rising resistance, however, what frequently happens, particularly if a high degree of amplification per stage is aimed at in the note-magnifiers, is that there is a feed-back from V_3 to V_2. The latter valve oscillates and may actually produce an audio-frequency howl. In most cases, however, the howl does not take place, but there is a noticeable " woolliness " in reception.

Easily Proved

Any reader who desires to satisfy himself upon the evil effects produced in a two-valve note-magnifier by a battery resistance can very easily do so next time he installs a new battery, in the way shown in Fig. 2. If the high-tension battery is composed of two or more units, connect a potentiometer as shown in the drawing. If it is " all in one piece," place the potentiometer between H.T. negative and either L.T. negative or L.T. positive, according to the connection used.

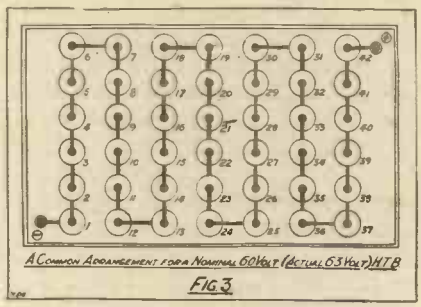
Set the potentiometer slider first of all so that none of the resistance is in circuit and tune in the local station. This having been done, move the slider gradually so as to bring more and more resistance into circuit. It will be found that the quality very soon begins to suffer, and probably an L.F. howl will take place when the resistance in circuit reaches a fairly high value.

Advantage of Big Cells

This is one of the strongest arguments against the use of batteries built up of cells of the standard capacity size in multi-valve sets. The bigger the cell the easier it is to make its initial resistance low and to keep the resistance comparatively small during discharge. In cells of the " medium capacity " size the initial resistance averages about ·18 ohm, and when the E.M.F. is down to 1 volt per cell the resistance in the case of good batteries will probably not exceed about ·8 ohm.

This means that for 120 volts obtained from cells run down to 1 volt apiece the total resistance will be 96 ohms. This is on the high side, but it is very different from the figure shown by the " small capacity " battery.

In the " super capacity " battery, the initial resistance of the cells is in most cases of the order of ·14 ohm, though in certain cases it may be as low as ·1 ohm, or even a little less. When an E.M.F. of 1 volt per cell is reached, the resistance in a battery composed of these cells will not in the majority of instances exceed ·5 ohm, and it may be considerably below this figure. With 120 cells, therefore, the total resistance should not be more than 60 ohms, a figure which is not excessive.



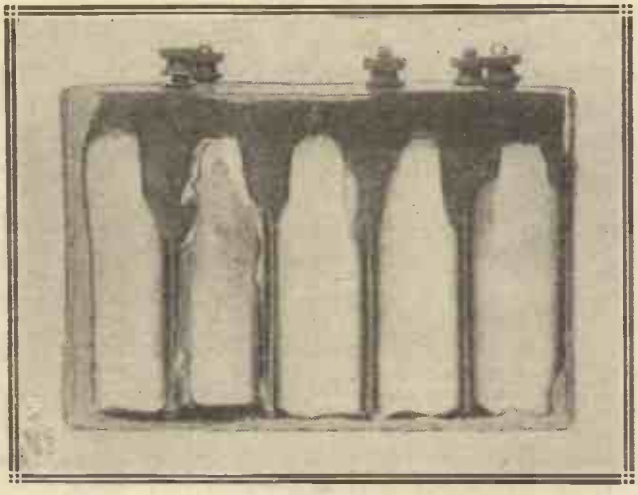
A COMMON ARRANGEMENT FOR A NOMINAL 60 VOLT (ACTUAL 63 VOLT) H.T.B.

FIG. 3.

It has been said again and again by various writers that the effects of rising resistance in a partially run-down battery may be minimised by the use of large shunting condensers.

Shunting Condensers

All that I can say is that on numerous occasions I have tried capacities up to 6 microfarads or more, and have never found that they made any appreciable difference to the back-coupling effect produced by battery resistance. If the reader thinks of making the test indicated in Fig. 2, he can very easily try out the effect of shunting condensers.



Here each cell is separately wrapped in waxed paper. The covering of the second cell from the left has been torn away to show the air space between the bottom of the cells and the case.

To do this C_2, C_5 and C_6 should be removed, and the results of increasing the resistance carefully noted. The condensers should then be replaced and the test conducted once more. There may be a small difference with them in position, but, as a rule, it will be a very slight one.

Inside the H.T.B.—*continued*

Nor will it be found in most cases where there is a high degree of amplification in the note-magnifying stages that *any* increase in the shunting capacity suffices to annul back-coupling effects.

We come now to the second essential in a dry-cell high-tension battery—good insulation. Only the other day a friend said to me, "Why bother so much about insulation, since the E.M.F. of the cells is only 1·5 volt. Almost any kind of insulation should surely be good enough for such a small potential?"

The truth is that the potential difference of adjacent cells is something very much larger in the high-tension battery. Fig. 3 shows a common arrangement for a battery with a nominal E.M.F. of 60 volts. It is composed of 42 cells, and the actual initial E.M.F. is—or should be—65 volts. The cells are arranged in seven rows of six each, the connections being as shown in the diagram. An inspection of Fig. 3 will show first of all that the zinc pot of cell No. 2 is at the same potential as the positive carbon rod of cell No. 1.

Cell Separation

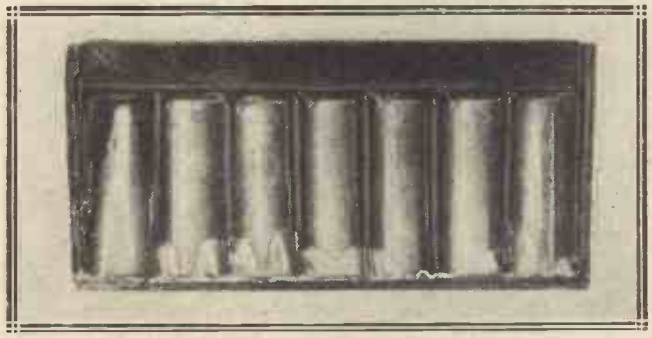
In the same way, the pot of No. 3 is at the same potential as the rod of No. 2, and so on. Now look at the positions of cells No. 1 and 12, 7 and 18, or 13 and 24. They are next door to one another in the battery case, and when the battery is new the potential difference between any two of these pairs of pots is no less than 16½ volts, or eleven times that between the pot and the carbon rod of each individual cell.

In the dry-cell high-tension battery two kinds of insulation are necessary. We must in the first place insulate properly the positive of each cell from its negative. All good cells are individually sealed with a topping of wax or of bitumen. In the case of certain cheap batteries, however, individual sealing is not used. The cells are simply placed vertically in their compartments and melted bitumen is poured over them, forming a seal for each cell and for the whole battery. This is thoroughly bad practice, and it is, fortunately, not often seen nowadays.

Insulation Between Cells

The second kind of insulation is that between cells. The most usual modern practice is to place each cell in a separate rectangular compartment made of millboard. This mode of construction is illustrated in several of the photographs. The photographs also show several variations, so to speak, on this theme.

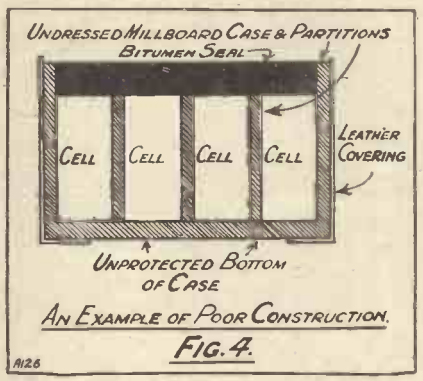
In one each cell is seen to be wrapped separately in waxed-paper, with an air-space between it and the bottom of the case. In another, the cells stand on a layer of wax. A third photograph shows a battery in which no sealing layer of bitumen is used above the tops of the cells. In the front are seen cells provided with a waxed millboard "floor" between them and the outer case. Where millboard compartments are used, the material should most certainly be thoroughly impregnated with wax. This is done in all batteries of good quality, but in poor batteries the board is often left undressed.



In this battery the cells stand upon a bed of paraffin wax.

Since the heart does not grieve over what the eye does not see, the makers of cheap foreign batteries often use every endeavour to make them look a great deal better than they really are. Fig. 4 shows how this may be accomplished very easily. What the eye sees is a neat case covered probably with leatherette of some attractive colour and provided with a sealing of shiny bitumen in which the sockets for wander plugs are embedded.

A careful examination of the drawing shows that, despite its appearance, this battery is a whited sepulchre. Let us pull it to pieces in imagination. On removing one of the ends with a sharp knife we notice first of all that the leatherette cover, which is more or less waterproof, does not extend right across the bottom of the case, and that this latter is made of thinnish millboard.



AN EXAMPLE OF POOR CONSTRUCTION.

FIG. 4.

By tearing off a piece of the board and lighting it with a match we soon satisfy ourselves that it is unimpregnated with wax. Impregnated millboard burns very readily, and a line of melted wax can always be seen just in advance of the forward edge of the flame. Now the eye would very probably have thought at first glance that that battery was more or less immune from the effects of atmospheric dampness. On careful examination we find that though the tops of the cells are well protected their bottoms have practically no protection at all.

Unimpregnated millboard is a hygroscopic material which soon collects moisture. We find, too, that the partitions between the cells are also made of undressed millboard, and it becomes evident that if the air is damp the interior of the battery will rapidly collect moisture, in which case the insulation will be far from perfect. We may look to such a battery for a short-service life, and almost certainly for noisiness when it has had a certain amount of use.

Voltage Markings

Another point which requires watching in certain foreign batteries is the maker's habit of marking at the wander-plug sockets voltages considerably lower than those which

(*Continued on page* 139.)

A CHAT ON CONDENSERS

Do you know exactly what is a "Log Mid Line" variable condenser? Can you differentiate between an S.L.F. and an S.L.W. type? The "mysteries" of these and other interesting variable pointers are dealt with in a simple and interesting manner in the following article.

By H. J. BARTON CHAPPLE,
Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

HAVING occasion to pay a visit to the north Midlands a short time ago, I had prepared myself for the four or five hours' journey when, just as the train was about to leave, the carriage door opened and in stepped a friend of mine. Ere long I found that he had recently become initiated into the joys of wireless.

Amongst other things, he expressed difficulty in understanding where the vital differences lay with the four types of variable condensers and asked me to enlighten him.

"Are the wave-band limits of a tuned circuit altered by employing different types of variable condensers, i.e. straight-line capacity, straight-line wave-length (square law), straight-line frequency and log mid-line?" he asked.

Concerning Capacities

"Provided the maximum and minimum capacities of the four variable condensers are the same, then the total wave-band covered when tuning the same coil is identical," I replied. "Of course, different makes of variable condensers do not necessarily have the same maximum and minimum capacities, but working on the assumption that the rated maximum capacity is as stated on the condenser, say ·0005 mfd., while the capacity value when the moving values are completely unmeshed is the same and reasonably low (in some makes this may be as high as one-tenth of the maximum), then the answer to your question is undoubtedly in the negative.

"The actual maximum and minimum capacities of the condenser are always *in effect* increased as far as tuning range calculations are concerned when using a coil of a given inductance, owing to the self-capacity of that coil and the capacity introduced by the wiring, the valves and components employed, and that is why this external capacity should be kept to the lowest limits by a proper design of the receiving set. That is perhaps a detail, by the way, but it should always be borne in mind, as it may upset any theoretical calculations you may have made."

"What, then, is the reason for the so-called shaping of the plates in variable condensers?" was his next question.

Meaning of "Square Law"

"Well," I said, "during the last few years there has been a considerable development in all components and accessories used in wireless receivers, and variable condensers have not been exempt for very good reasons. We first of all had the condenser with semi-circular plates where the capacity is proportional to the dial reading, but this type is hardly ever used now. It was superseded by what is known popularly as the "square law" condenser or straight-line wave-length (S.L.W.).

"No doubt in the course of your search after information you have heard that the wave-length of a station is proportional to the square root of the capacity in the tuning circuit, so by making the condenser capacity increase more rapidly at the end of the dial than at the beginning it was possible to overcome the difficulty of having to increase the dial reading, say, four times to double the wave-length. If we were to plot on a piece of squared paper an actual graph between wave-length and dial reading we should be able to draw a straight line through the points.

"As I mentioned earlier, however, this is only strictly possible if due allowance is made for the stray external capacities introduced by the wiring and set components in the tuning circuit. This proved to be a very popular type of condenser, but as time went on it was found necessary to allocate a definite frequency difference between the various broadcasting stations. Now for a given *frequency* difference the *wave-length* difference is less on the shorter wave-lengths than it is on the long wave-lengths, and in consequence when this scheme became operative you will realise that there was a certain amount of crowding of stations on the bottom portion of the tuning dial.

The four types of plate. Reading from left to right: Straight-Line Capacity, Straight-Line Wave-length, Straight-Line Frequency, and "Log Mid Line."

The "S.L.F." Type

"Condenser manufacturers resolved to meet this difficulty by making the capacity change still less at the bottom of the scale as compared with the top, and the straight-line frequency (S.L.F.) type was born, due allowance again being made with the plate shapes for the external

A Chat on Condensers—*continued*

capacity. They are recognised easily by their long, thin plates, and, of course, with such a small capacity increase at the lower end of the scale they prove very susceptible to outside capacities and the calibration line was frequently upset.

A Happy Medium

"Added to that, of course, we have to allow more panel space to accommodate the condenser, and, furthermore, some users complained that the stations now became more bunched at the top end of the scale, giving an apparent overcrowding.

"To meet the complaint of both sections it was thought advisable to strike the happy medium, and so we have on the market the fourth type, the log mid-line. With this particular condenser, the calibration curve plotted between dial reading and capacity lies between the S.L.F. and S.L.W. There is also another advantage about which I will tell you later."

"You have certainly made the situation much clearer to me now, but so far you have not shown how the different condenser types give improved selectivity," said my friend. "Surely that is an important aspect."

"You are not quite right there," I said. "Selectivity is essentially a function of the wireless set and aerial system and not of the tuning condenser, so that it is wrong to say that this or that condenser gives added selectivity. The dial separation for stations working on wave-lengths relatively close together is certainly altered according to the type of condenser chosen, and by this means better station distribution round the dial is found by using the straight-line or log types.

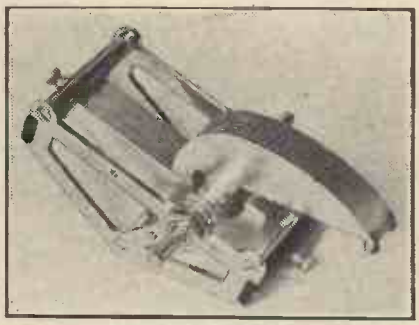
Separating the Stations

"The tuning, therefore, may *appear* to be easier, but whether your set will or will not separate the desired stations efficiently is not the outcome of using one particular type of condenser, assuming, of course, that they all conform to the laws of 'low loss.' The ease with which the stations are brought in on the loud speaker is a natural product of the efficiency of the set and your capabilities in undertaking the tuning operations.

"You should bear in mind that the advent of the straight-line types of condensers with corrections made for external capacities enabled the user to plot his own calibration curve. Take, for example, the straight-line wave-length condenser, it is only necessary to find, say, three settings on the dial for three different stations and, having logged them accurately, they may be plotted on a piece of squared paper with dial readings as the horizontal scale and wave-lengths as the vertical scale.

Facilitates Searching

"A straight line drawn through the three plotted points gives the required calibration curve, and the setting of the condenser for any particular station can be seen at a glance. Naturally, this facilitates searching for stations, provided your set is capable of receiving them satisfactorily."



A typical Straight-Line-Frequency variable condenser.

"Since the straight-line wave-length and straight-line frequency condensers appeared to perform their respective functions in quite an efficient manner, do you think the introduction of the log mid-line condenser was justified?" continued my questioner.

"Oh, yes," was my rejoinder. "With the modern multi-valve receiver using two, three or even four tuned circuits, you will appreciate readily that it would take some time to get thoroughly at home with the tuning operations when each dial may read differently.

Making Tuning Easier

"Using inductance coils which have been matched carefully was the first step to simplify the task, for under these circumstances each closed tuned circuit should have the same condenser dial reading when receiving any one particular station. But perfect matching is difficult, and the dial readings often vary slightly, but by tuning them with a log condenser we secure a marked advantage.

"When the circuits are all tuned to one particular wave-length the *alteration* in the dial settings when they are all tuned to another wave-length is the same with each condenser, i.e. equal wave-length changes are brought about by equal changes in the dial readings irrespective of what these readings were in the first instance.

"This particular feature readily accounts for the marked popularity of the log mid-line condenser, for you will see that it is possible to set these tuning condensers to read the same on any one wave-length, and they will then give identical readings round the whole of the tuning scale. Simultaneous tuning of all the circuits now becomes quite an easy matter with this arrangement, and in consequence the accurate matching is accomplished with comparative ease, thus making possible the use of double and triple gang condensers where the movement of one dial operates two or three sets of moving plates."

Our train had now reached its destination, so the conversation ended and we went our separate ways.

BOXING VARIABLE CONDENSERS

A FEW good variable condensers in wooden boxes are very convenient accessories on the wireless table. The boxes can be quite roughly knocked up, and should be just large enough to contain the condensers when the plates are "all out." Each box should be provided with an ebonite top (which can be cut from an old panel) and two stout terminals fitted, and soldered to the fixed and moving plates respectively of the condenser. Do not forget to mark which terminal is the "moving" and which is the "fixed."

If you have the opportunity, calibrate, or get calibrated, one of these condensers for comparison purposes. It is a good plan to fit the condenser with a good vernier dial, such as the Indigraph made by the Igranic Company, which has an opening to enable readings to be marked on a white scale.

BATTERY VERSUS ELIMINATOR

The subject is, as the author states, an example of "the eternal conflict between the old order and the new." But he is able to give you some very definite and useful information which will help you to make your individual choices.

By J. C. JEVONS.

A CURSORY survey of the various stages of wireless development will bring to mind many instances of the eternal conflict between the old order and the new.

For instance, the early spark-transmitter, when threatened by the high-frequency alternator and the arc Duddell, gained a fresh lease of life in the form of the quenched spark. It is likely that the latter would, in course of time, have been replaced by the Poulsen arc, particularly for telephony, had not the discovery of

An H.T. eliminator for D.C. mains is a comparatively simple article. All that it need embody is fixed condensers, resistances, and L.F. chokes.

reaction led to the present supremacy of the valve as a high-powered generator for radiating continuous waves.

Valve and Crystal as Rivals

In the same way, the original Fleming valve, which first came into existence in 1904, made no impression for many years upon the general use of the coherer and magnetic detector. On the other hand, Dunwoody's discovery of the rectifying properties of carborundum in 1906, and Pickard's invention of the Perikon detector about the same time, rapidly brought the crystal into formidable competition with all other forms of wireless detector.

The crystal and the valve still remain rivals to some extent, though Franklin's discovery of reaction in 1913 practically decided the issue in favour of the valve. At the same time, it is difficult to say that the contest between the two is finally closed.

Losser's recent discovery that the ordinary crystal will, under certain conditions, generate sustained oscillations capable of being used on the retroactive principle for high-frequency amplification, promised at first sight to open up a new career for the crystal. Although these expectations have not so far been fulfilled, the door is still open for further progress along the same lines.

Batteries or Mains?

At the present time the wireless industry is on the verge of another interesting conflict in a field that is of the greatest interest to all valve users. Issue has been joined between the wet- or dry-cell battery and accumulator on the one hand, and the mains-supply unit on the other.

For the last two or three years, the ideal of the battery-less receiver has been dangled before our eyes. The periodical replacement of the high-tension battery, and the constant recharging required by the filament accumulator, are defects that have naturally prejudiced the general public against both these accessories.

The idea of replacing them by an installation capable of supplying all the energy necessary to run a valve set directly from the electric-light mains is immensely attractive to the ordinary listener.

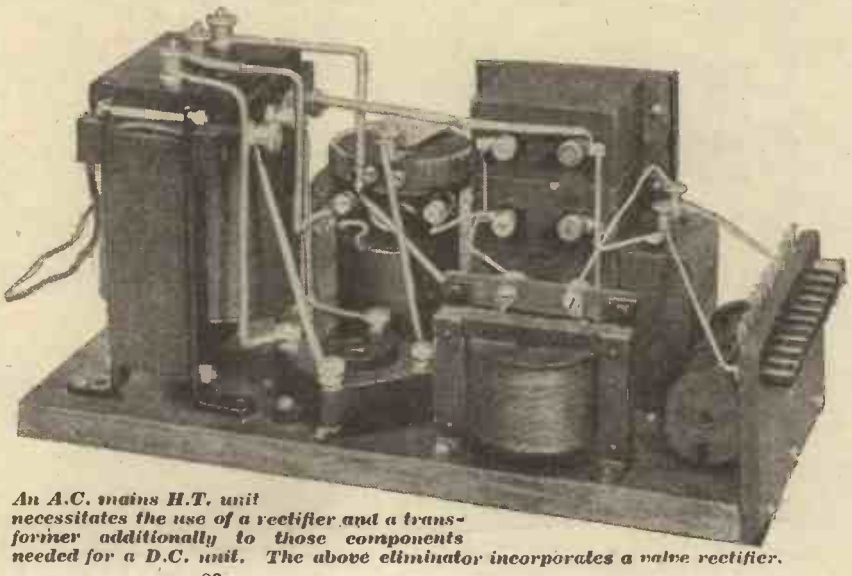
Result of Power Amplification

The necessity for some improvement in this direction has been accentuated by the growing popularity of the power valve as used for low-frequency amplification. These valves require both a high voltage and a comparatively large output current for efficient operation. For instance, 120 volts is the average plate potential laid down by valve makers for power amplification, as compared with 60 volts for the ordinary type of valve.

Again, owing to their low impedance, the plate current consumed by a power valve is more than double that taken by its predecessor. The ordinary type of dry-cell high-tension battery is unable to stand up against so heavy a drain for any length of time, unless it is made of large dimensions at a corresponding increase in cost. Even then the expense of periodic renewal is not avoided.

Primary Cells for H.T.

The first "reaction" to the new demands for high-tension supply led



An A.C. mains H.T. unit necessitates the use of a rectifier and a transformer additionally to those components needed for a D.C. unit. The above eliminator incorporates a valve rectifier.

Battery versus Eliminator—*continued*

to the introduction of the wet-cell type of battery, which may be either of the primary type, such as the new Darimont unit, or the older Leclanché cell, or of the secondary or accumulator type.

The advantage of the primary battery is that the cells do not require recharging by a dynamo or from the mains. Instead, they can be rejuvenated periodically simply by replenishing the ammonium chloride or other chemical content. In course of time, however, the zincs and depolariser also call for renewal.

Secondary-Cell H.T.

The secondary type of high-tension battery is merely a small replica in multiple of the ordinary accumulator. Although its life is very long when fairly treated, it suffers from the drawback that it requires recharging in the same way, though admittedly not so often, as the ordinary filament battery. Here, however, unless a special home-charger is installed, the problem of recharging is complicated by the task of transport on the one hand and the liability to damage unless the recharging is skilfully done on the other.

Finally, an outstanding objection to all types of wet-cell high-tension batteries is their bulkiness and the consequent difficulty of finding storage room for them in a place where they cannot be upset or cause damage to the household furniture.

The Mains Alternative

In considering the domestic mains as an alternative source of supply for running a multi-valve set, it will be found that the position is not yet one of overwhelming advantage.

If the listener's requirement is simply good-quality loud-speaker reproduction from the local station, any well-designed eliminator unit will serve his purpose admirably.

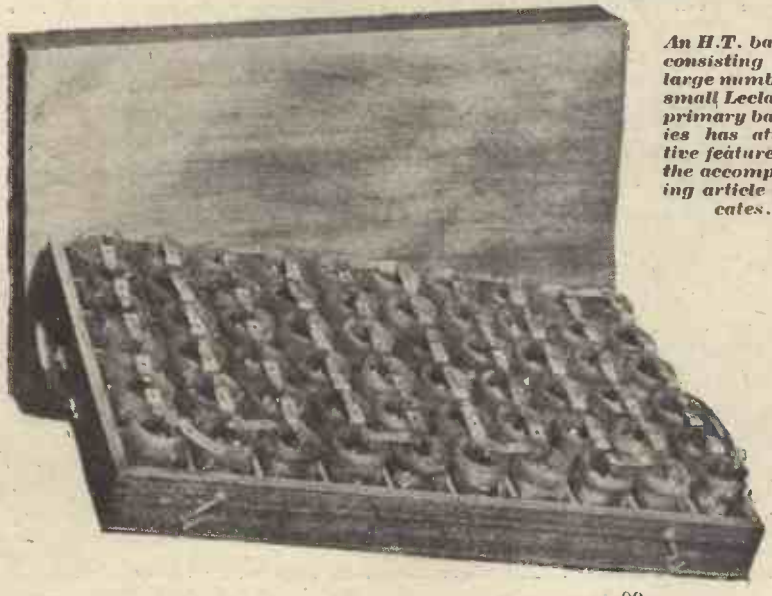
With powerful moving-coil loud speakers of the Rice-Kellogg, or similar type, the use of a mains unit again becomes almost essential owing to the heavy current expenditure required to run these high-grade instruments.

Where, however, it is a question of using two or more stages of high-frequency amplification in order to get loud-speaker reproduction from Continental and other distant stations, the listener must go warily before deciding to depend upon the mains for satisfactory results.

With such a multi-valve set it is extremely difficult, for the reasons stated below, to completely eliminate the various noises that are inherent in an electric power-supply service.

The ideal wireless equipment is one that is entirely independent of any battery. At the present time, so far as *filament* current is concerned, the most convenient scheme is to use the new type of indirectly-heated valve.

It is, of course, possible, either with direct or alternating supply mains, to design an eliminator unit capable of supplying both filament and plate current to the set, but as previously stated, such units have inherent limitations due to the difficulty of completely cutting-out commutator and similar noise, especially when H.F. amplification is used.

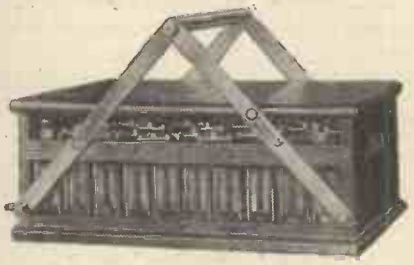


An H.T. battery consisting of a large number of small Leclanché primary batteries has attractive features, as the accompanying article indicates.

With the indirectly-heated type of valve, on the other hand, this limitation does not apply to the same degree, because although the energising current is taken from the mains, it is not applied directly to the actual electron-emitter or cathode of the valve.

Indirectly-Heated Filament

Instead the current is used to heat a comparatively massive "false" filament, and the heat inertia of the latter acts as a buffer between the mains and the electron stream.



An H.T. accumulator suffers from the disadvantage that it needs periodical charging.

Although the heating current may fluctuate in frequency, the average temperature of the false filament remains steady, or, at all events, a steady heat is radiated by it to the tone cathode, so that the electron stream is isolated from any source of "noise" existing in the mains. In addition, such cathodes are equipotential, since there is no current flow to produce a voltage drop across their terminals.

When rectified or "reduced" current is applied from the mains directly to the actual electron-emitting cathode of an ordinary valve, any noise or perturbation that is not cut out in the filter circuit associated with the "eliminator" must affect the electron emission and will, therefore, appear in the loud speaker.

Mains units, whether used for the plate supply alone or for both plate and filament, can be divided into two types according to whether the primary source of supply is alternating or direct.

Direct-Current Units

Direct-current mains-supply units simply consist of some form of voltage reducer, usually a high-resistance potentiometer, from which the necessary voltages are tapped off, combined with a filter circuit for cutting out noise. As there is no

(*Continued on page* 144.)

HOW TO BUILD A POWERFUL A.C. MAINS UNIT

By the Editor

A unit capable of providing sufficient H.T. current from A.C. mains to operate the largest of sets. Safety, simplicity, versatility, and inexpensiveness, are strong features of this very efficient design.

IN three previous articles I have explained in detail the principles upon which "mains units" work—what we have to aim at in order to obtain efficiency, and just what we may expect in given circumstances. In the present article I want to describe to you a powerful A.C. mains unit in which the various ideas explained in the previous articles are applied in practice, and which will give a thoroughly adequate supply of high-tension current for operating multi-valve sets with super-power valves in their output stages. Incidentally, the unit serves excellently as a source of high-tension for the Push-Pull High-Quality Amplifier described in the March issue of this journal.

Special Design

It is a simple matter to design and build an alternating current mains unit which will supply a few milliamperes to a small set, but in my experience the man who owns a small set with modest high-tension demands can run it quite satisfactorily with the modern high-tension dry battery; or, better still, with a good high-tension accumulator. In these circumstances he does not feel justified in going to the expense of a mains unit. It is the user of the powerful multi-valve set, and the man who desires to get the really first-class quality which high voltage on a super-power output valve or a "push-pull" amplifier will give, who feels the need for a proper mains unit of adequate capacity.

COMPONENTS REQUIRED

The components needed are comparatively few, and are as follow:

1 Cabinet to take a 16 in. × 8 in. panel with 8½-in. or 9-in. baseboard (Camco, Caxton, Artcraft, etc.).
1 Panel 16 in. × 8 in., either black or mahogany finish (Ebonart, Resiston, Trolite, etc.).
8 Insulated terminals marked as follows (Belling Lee):
  2 for L.T. −.
  2 for L.T. +.
  1 H.T. −.
  1 H.T. + 1.
  1 H.T. + 2.
  1 H.T. + 3.
1 Double-pole double-throw lever switch (Utility).
1 Climax "Auto-Bat" transformer, double-wave (Type 110).
2 12-henry smoothing chokes (R.I.-Varley).
1 Power-pack eliminator condenser unit (Hydra).
1 20,000 potential divider (Climax).
2 Antiphonic valve sockets (Lotus, Benjamin, Bowyer-Lowe, Igranic, etc.).
1 Ebonite strip, 2 in. × 5 in. × ¼ in.
Small wood blocks of dimensions shown in drawings.
9 Clix "parallel" sockets.
2 Clix "parallel" plugs.
Stiff insulated wire for wiring up, such as Glazite.
1 Lamp-socket plug and length of silk or cotton-covered electric-lighting flex.
2 Short lengths of rubber-covered flexible wire.
2 Standard china fuse boxes (5-ampere) and fuse wire.
2 Mullard D.U.10 valves.

In setting out to design a powerful mains unit for WIRELESS CONSTRUCTOR readers, I looked upon the following as essential requirements:

(1) The unit to be operated from A.C. mains of any standard voltage.

(2) Ability to supply at least 50 milliamperes without overloading the rectifier.

(3) A good high voltage at *full load*.

(4) Safety and convenience in operation

(5) Three high-tension tappings with adjustable voltage on two of them.

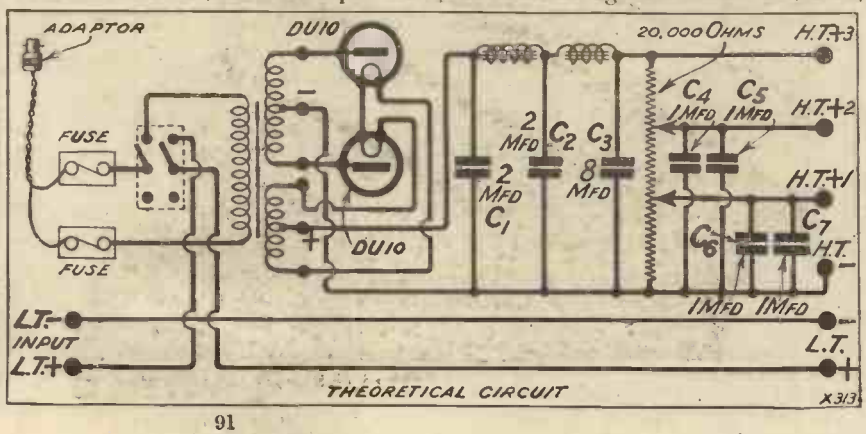
(6) Really adequate smoothing, giving a hum-free output at *full load*.

A Novel Feature

When working out the design, it occurred to me that I could introduce a feature into this eliminator which I believe is entirely new in home-constructed mains units.

Indeed, I do not remember having seen it in any mains unit, factory or home-built. It is a double switch, so arranged that both the low-tension and the high-tension supplies are switched on simultaneously, so that one cannot be turned on without the other. One or two separate relays exist for the purpose of effecting this, such as the excellent "Lotus remote control."

This latter, however, is designed for controlling sets from a distance,



How to Build a Powerful A.C. Mains Unit—*continued*

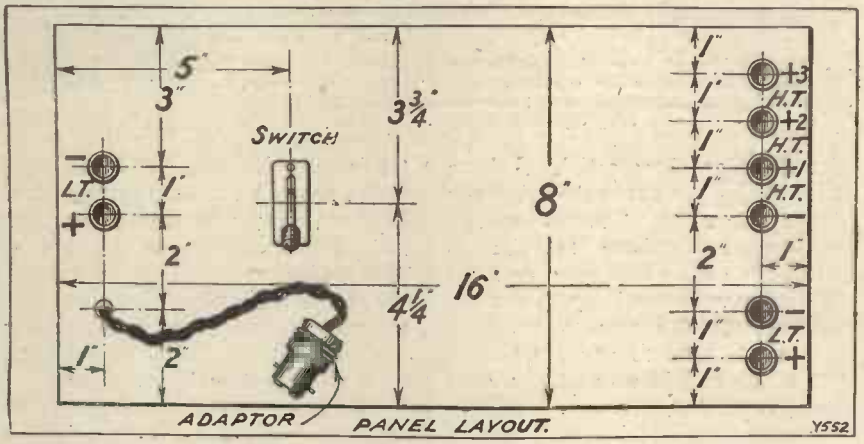
turning on both the high- and the low-tension simultaneously, whereas the device incorporated in the mains unit to be described has the switch on the eliminator itself. In my scheme both input and output terminals are provided on the mains unit for low- as well as high-tension, and we take the leads from the accumulator to the input side and the low-tension leads to the set from the output side of this unit. When the switch is in the "off" position the valve filaments are switched off, and the high-tension unit is also turned off.

Two Rectifiers

When the lever is pressed down both valves and high-tension are turned on. This gets over a difficulty which often occurs when a mains unit is installed. Generally the receiving set has been in use for a long time before the purchase of the mains unit, and the family have acquired the habit of turning the set on and off with the usual switch. With the advent of the mains unit the set is still turned on and off with the usual switch, the mains unit being forgotten and left on.

In the WIRELESS CONSTRUCTOR mains unit the switch on the set is always left on, and the set turned on and off by the lever on the front of the mains unit. This also obviates the risk of the mains unit being switched off and the accumulators left on all night.

Those readers who perused the previous articles will need no description of the general principle of this unit other than that it is a full-wave rectifier using two Mullard D.U.10 rectifying valves, which are rated to pass 50 to 60 milliamperes each, if required; the high voltage being applied to the plates of these valves from the secondary of a transformer. The transformer also carries a low-tension winding supplying current for the two filaments of the valves *in series*. The rectified current then passes through a filter consisting of three condensers and two chokes. The first two condensers are of 2 mfd. each, and the third of 8 mfd., while the chokes have been specially chosen after test as possessing very low ohmic resistance (giving very small voltage drop for this reason) and high inductance under load.

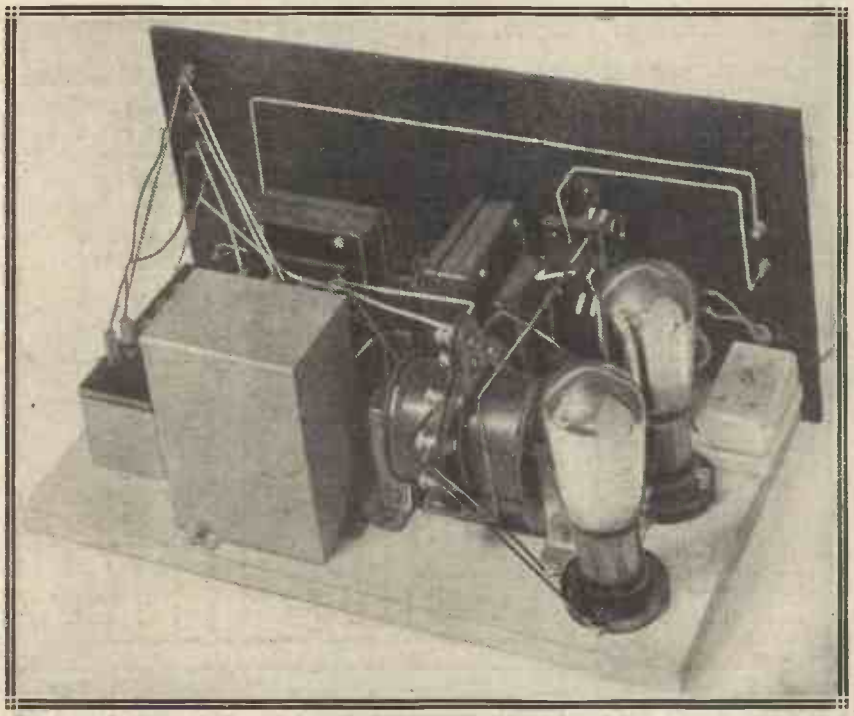


Although their rating is only 12 henries each, the actual *working* inductance under load is many times that of several chokes which have passed through the laboratory marked "20 henries." The D.C. resistance of each choke is 120 ohms, and it will thus be seen that the voltage drop in the two chokes when a current of 60 milliamperes is passing (50 milliamperes external load and 10 milliamperes for the potential divider) is under 15 volts.

Voltage Variations

The potential divider consists of a tapped resistance of 20,000 ohms, nine equally spaced tappings being provided. There are four high-tension output terminals, one for common negative and three positives. The highest positive takes the full voltage of the device, and two positive tappings are provided inside the set with plugs which fix firmly into the sockets chosen.

There are thus nine possible voltages for H.T.1, nine for H.T.2, and one (maximum) voltage for H.T. positive 3. What these voltages will actually be in practice depends, of course, upon the load you place upon the mains unit. This has been clearly explained in a previous article. Every user of a mains unit should provide himself with a

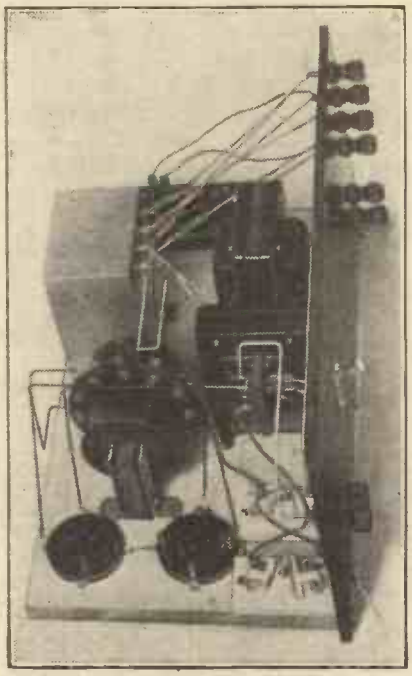


In this view of the unit the valves, transformer, and back of the condenser block can very clearly be seen.

How to Build a Powerful A.C. Mains Unit—*continued*

voltmeter which will give accurate readings.

Do not forget that the ordinary high-tension voltmeter is useless for



This photo shows the input fuses with covers removed. Notice tappings on the front of the condenser block.

the purpose, and readers are referred to the April issue for full details of voltage measurements. In that article I explained how to construct a fairly inexpensive mains unit voltmeter with a 100,000 wire-wound resistance and a 0 to 5-milliampere meter, and pointed out that the special very high-resistance voltmeters for testing voltages on mains units are rather expensive instruments.

A New Meter

A slight correction is necessary here, as Messrs. Ferranti, Ltd., have pointed out to me that they are now supplying their excellent voltmeters with a resistance of 1,000 ohms per volt, specially for testing voltages of mains units. The price of the Ferranti meter which takes just the same current as the home-constructed device is but £2 15s. for an instrument with a triple range, for 10 volts, 50 volts, and 250 volts, and this cost is thus very little more than that of the home-constructed device described. The firm in question have kindly sent me one of these for test and, after trying it out in a variety of ways, I can fully recommend it as an excellent instrument at a particularly reasonable price.

I have chosen the "tapped potentiometer" method of voltage control for several reasons, and while continuously variable resistances give, within limits, continuously variable voltages, the adjustment of the voltage can be made once and for all on the tappings of the potentiometer, and there is no need to alter it once the best adjustment has been found. In the WIRELESS CONSTRUCTOR mains unit, once the voltages have been set by means of a voltmeter, or by trial, they can be relied upon to remain dead constant, and the adjustment cannot be altered without deliberate interference with the set.

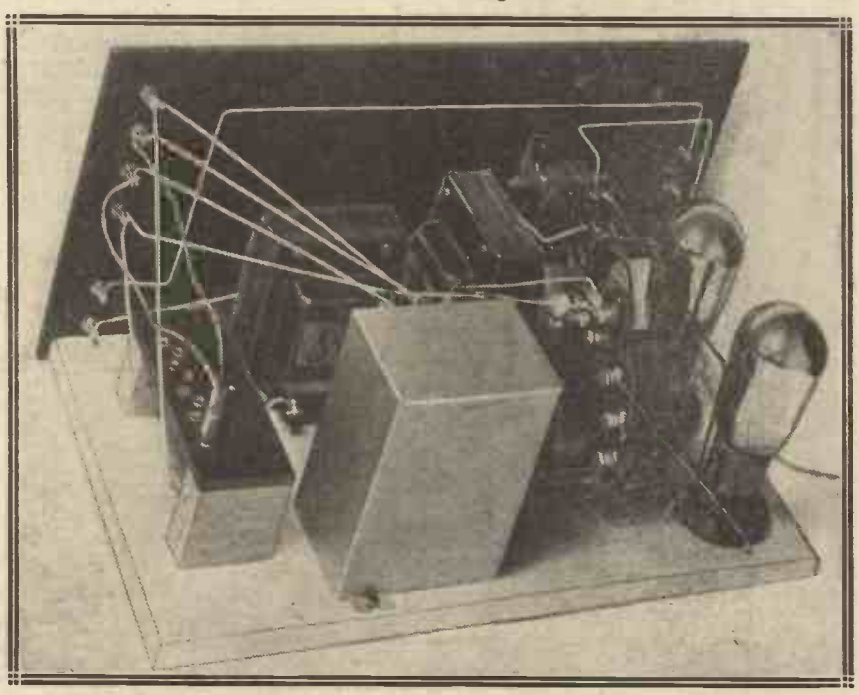
"Foolproof"

On units with a voltage control which is variable continuously by a knob from the front of the set there is always the risk that some member of the family will turn the knob to "see what happens," and the adjustment of the receiver will be upset. In my experience, too, one maximum voltage for the output valve and two other adjustable voltages are all that one needs on practically any set.

The full voltage tap, being across the 8-mfd. filter condenser, needs no separate shunting condenser, but the two variable voltages need their own shunts, and these are provided in this instrument in the condenser "block" shown. This latter is designed to supply all the capacity needs of the mains unit in one case. As four separate 1-mfd. condensers are provided for use across four adjustable tappings if required, and as there are only two adjustable tappings in the present unit, two pairs of 1-mfd. condensers are paralleled, giving 2 mfd. across each adjustable tapping.

Thoroughly Tested

In order that the unit may be thoroughly reliable, it has been submitted to continuous use for several months on all kinds of sets at big and small loads, and with various circuit arrangements, some of which tend to instability when used with mains units. The instrument passed all tests thoroughly satisfactorily, and is as hum-free as any mains unit yet tested in this laboratory. In fact, it is hard to distinguish, on such a set as The "Concert Four," whether one is using high-tension accumulators or the unit, and on the "Super-Quality Amplifier" described in the March issue one cannot distinguish any hum, even when a high-grade moving-coil loud speaker is being used.



The voltage divider is conveniently tapped in order to facilitate voltage adjustments.

How to Build a Powerful A.C. Mains Unit—*continued*

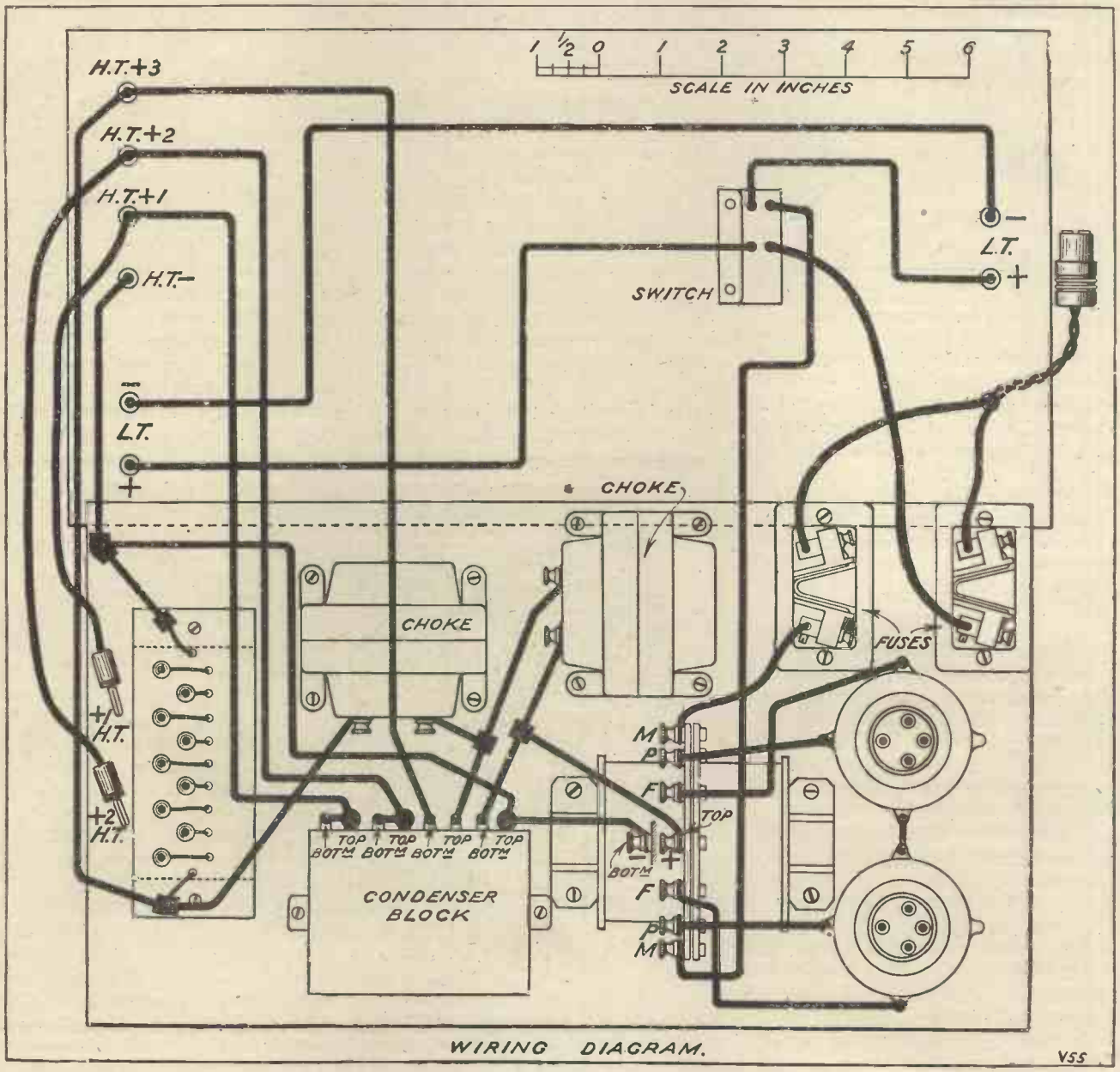
If the unit should be used for telephones, following a stage of note-magnification on a set near the reaction point, a very slight hum may be heard, but this applies to every mains unit we have tried. On a set using two stages of note-magnification and a loud speaker, even when the detector circuit is used on the edge of reaction, one cannot hear any hum unless the ear is placed close against the speaker itself.

Safety and simplicity of operation have been carefully looked after in this mains unit. It will be noticed that a flexible lead from the electric-light socket passes right into the cabinet itself, and thus it is impossible for anyone operating the set to get a shock from the mains unless they open the cabinet and deliberately put their hands right inside. By the use of insulated terminals the risk of shock by the hand accidentally coming against the high-tension side is also obviated. Two fuses are provided inside the set, one in each input wire, ordinary household fuse wire being used.

Alternatives

This is not a set in which a large number of alternatives are available, but the discriminating reader can make his own selection among several parts. For example, there is no need to use a complete condenser block, although this saves a great deal of space, and the set will work just as well if separate high-voltage condensers are used. The use of such separate high-voltage condensers will, however, probably necessitate a bigger cabinet. Again, in the matter of chokes several alternatives are available. Messrs. Ferranti make excellent chokes of high inductance under load, and a pair of the Ferranti B.2 chokes will give excellent results in this receiver.

Do not, however, attempt to use



WIRING DIAGRAM. V55

How to Build a Powerful A.C. Mains Unit—*continued*

any valves other than the D.U.10 for this eliminator, as the transformer is designed to supply filament current for two D.U.10's in series, and the filament voltage and current may be wrong for other makes of valves. This transformer and the D.U.10's go together. If you desire to use other makes of rectifying valves, then you must obtain a transformer designed to operate them.

Watch Those Condensers

If you use separate *high-voltage* condensers, those made by Dubilier, Lissen, Telegraph Condenser Co., and Hydra, can all be recommended after thorough tests in this laboratory. Do not under any circumstances be tempted to save money by using *ordinary* Mansbridge type condensers, even if they are made by the makers named, for the ordinary types are *not* made to withstand the high voltages of the mains unit. This warning has been made in every article so far, and its constant repetition is necessary, as we still find constructors who try to build mains units with the ordinary low-voltage types of condensers.

Constructional work presents no special difficulties. The panel should first be drilled for the terminals and cut for the switch, and these mounted in position. Particulars of how to mount the Utility switch will be found on the box. The next step should be to drill the holes for the Clix sockets on the small ebonite strip, and when these are in position to mount the potential divider on the underside of the strip and to solder the tapping wires to the sockets. Do not forget to tighten up the lock-nuts of the sockets after you have soldered the wires and the sockets have cooled down, as the heating up of the sockets cause a shrinking of the ebonite and loosens the lock-nuts.

Be careful to leave the two extreme end wires of the divider free, for these are not taken to sockets but are joined directly, one to high-tension positive 3 terminal, and the other to high-tension negative.

Completing Assembly

When you have fitted the divider and the sockets to the ebonite strip (a single screw will hold the divider), secure the strip to the small wooden blocks and fasten the whole device to the baseboard in the position shown, by passing two wood screws into the blocks through the underside of the baseboard. Now mount the valve sockets, transformer, condenser block, fuse blocks, and the two chokes in position, and carefully wire up according to the diagram. Pay particular attention to the connections on the condenser block and on the transformer. Notice that the grid terminals of the valve sockets are not used.

Some readers may wonder why antiphonic valve sockets have been specified, seeing that there can be no question of microphonic noises! The reason is that such sockets are preferable to the fixed sockets as there is no risk of the valves being wrenched and the bulbs loosened when they are withdrawn from the socket at any time, and, furthermore, such sockets lessen the risk of the valve filament being injured by vibration.

An Important Point

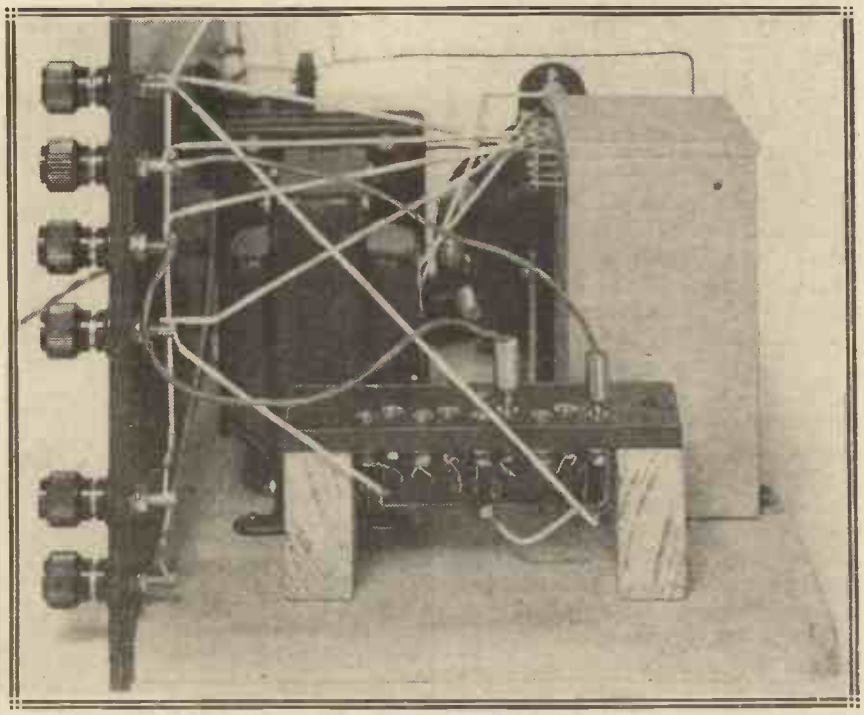
It will be noticed that flexible rubber-covered leads are soldered to high-tension positive 2 and high-tension positive 1, and that these terminate in Clix plugs. Notice, too, that the flexible leads coming from the lamp socket pass through the front of the panel, and that a knot is tied in the cord after it is passed through the hole in the panel to prevent it being pulled out. Inside the box the flex is opened up and each lead goes to its own fuse block.

Preliminary Tests

When everything has been wired up, and you have carefully checked your wiring with the diagrams, insert two pieces of fuse wire in the two fuse blocks. Place the on-off switch in the "up" position, insert the two D.U.10 valves in their sockets, take your voltmeter and join it between H.T. negative and H.T. positive 3. For the time being you can place H.T.2 and H.T.1 in any of the intermediate sockets. Do not attempt any adjustment inside the set with the plug in the lamp socket, even though the switch is off. So far, of course, you have not connected any load to the set, and the voltmeter will show the full open-circuit voltage, which will probably be in the neighbourhood of 250 volts.

For this, of course, the lever switch must be in the down position, and the plug in the lamp socket. If you get this reading all is well, and the unit is functioning. Switch off, remove the plug from the lamp socket, and join your accumulator to the input side and the low-tension

(*Continued on page* 143.)



A "close-up" in which the way the voltage divider is mounted can be seen. Note the plugs and sockets provided for voltage adjustment purposes.

WITHIN THE VACUUM

Are there too many valves?—A simple method of clearing up the present chaos due to the many different ways of denoting and classifying receiving valves.

By KEITH D. ROGERS.

ACCURATE figures of the sales of a popular commodity are always difficult to obtain, and this is no exception when we come to the question of radio receiving valves.

There are over two million licences issued for receivers in this country, which means probably that there are at least one and a half million valve sets in use.

This means that there probably are about three million valves turned on and off every night—assuming that nearly all our listeners listen to at least one item each evening.

Now, as there are well over 300 different valves available for ordinary radio reception, this means there would be only 10,000 people using the same kind of valve—assuming sales of the various valves to be equal. In other words, only one man in every three hundred uses a certain type of valve, his neighbour another, and so on, until we come to number 300 before we again find a man who uses the same sort.

Far Too Many

The above is not necessarily the actual state of affairs, but it goes to emphasise the fact that there are far too many valves on the market. We need a certain amount of choice and variety, but not anything like the confusion of types and classes that at present exists.

I have already pointed out elsewhere the fallacy of having three separate filament-voltage groups of valves. We do not really need 2-, 4- and 6-volt types. The intermediate voltage could be done away with quite easily, and this would to some extent reduce the confusion that exists in the mind of the average man when he comes to choose a valve for his new set or to replace one or more of those that have grown out of date.

Shall he use a P.M.6, a D.E.5, or a Cossor 610 L.F.? He does not know whether these are interchangeable or whether one will give better results than another. In fact, without studying the makers' specification, he is hopelessly at sea. And then, in the midst of his deliberations, a friend will suggest a B.4 as equally good.

The poor man has either to go to a dealer, write to the manufacturers of each valve, or consult a friend who is a radio fan before he can settle his problem.

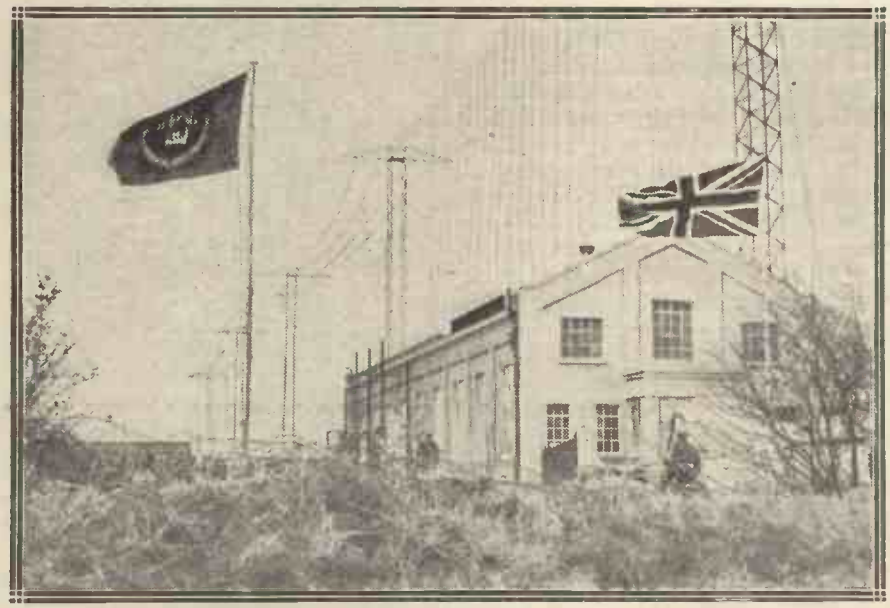
If, on the other hand, valve manufacturers would get together and use a common method of denoting their valves all this confusion—which is quite unnecessary—would be done away with, and the valve's nomenclature would tell the man in the street at a glance whether any valve was suitable for any particular purpose.

A Simple Scheme

The four types mentioned above are more or less interchangeable, but they are not quite identical in characteristics, and these differences could easily be denoted so that one could tell at a glance exactly where one was with regard to the valves.

A scheme I would suggest, and upon which I should be glad if readers

(*Continued on page* 142.)



During his recent visit to this country the King of Afghanistan paid a visit to the Dorchester Beam station, which is here shown flying both the Union Jack and the Afghan flag.

Using the Thirty-One Tested Circuits.

In this, the fourth article of a series by the Editor dealing in detail with the "Thirty-One Tested Circuits" Booklet, presented free with the February issue of the "Wireless Constructor," the three-valve circuits are explained. This series of articles, together with the gift booklet, should be studied by every home constructor, and new readers are advised to obtain the back numbers through their newsagents.

CONSIDERATIONS of space and the desire to make the gift circuit book representative of all kinds of circuits made it necessary to limit the number of three-valve circuits to four, although it would not have been difficult to fill the whole book with interesting three-valve arrangements. Fig. 1, on page 19 of the gift booklet, is a particularly good all-round circuit, combining pure quality and powerful signals from the local station with very considerable distance-getting properties.

It is, however, a circuit which wants careful laying out so far as the first two valves are concerned, for unless one is careful all the pains taken to provide an accurately neutralised circuit will go by the board, owing to unwanted interaction effects. The neutralising scheme adopted—known as the "split primary"—is, in common with all other neutralised circuits, designed only to balance out the unwanted reaction effects in the *valve itself*, and will not, any more than the other neutralising schemes, compensate for interaction between the coil L_1 and the high-frequency transformer with its connections 1, 2, 3, 4, 5, and 6.

Very Different Coils

The best way to make up this circuit is to use a pair of standard six-pin coils, L_1 being the split-primary aerial coil, the three windings 1, 2, 3, 4, 5, and 6 being wound together as what is known as a "split-primary transformer." Do not confuse the "split-primary aerial coil" with the "split-primary transformer." They are quite different coils, although externally they look the same.

A cabinet not smaller than 16 in. by 8 in. by 7 in. should be used for this, and in the layout arrange the detector and low-frequency valve, first of all, on the right of the base-board, so as to give as much space as possible between the first two valves. Either a standard screening box (which includes coil, neutralising condenser, and valve holder) should be used, to incorporate the detector stage with the high-frequency transformer, or else a single vertical metal screen about 7 in. high and 7 in. from front to back, or, if one decides to dispense with screening, the coil should be of the binocular or other "fieldless" variety.

A Popular Set

The circuits F2 and F3 both incorporate two stages of note magnification. F3 needs very little explanation, as a practical design incorporating almost the same circuit (the only modification was explained in the article) was described under the title of "F5" in the April issue.

Do not fail to keep your booklet, for further articles from the Editor's pen discussing the various circuits included will appear from time to time.

It has not been, of course, possible to incorporate every modification in every circuit, and the resistance R_2 shown in F2 can be placed either between OS of the first note-magnifying valve and its grid, or between OS and the second note-magnifying valve grid. A great deal depends upon the actual layout used. Its presence, cannot, in any case, do harm, and many constructors like to incorporate it between the OS terminal of the low-frequency transformer, and the grid of the first note-magnifying valve in any set, in case there should be any possibility of a high-frequency current getting through from the detector valve into the note-magnifying stages.

In F2 the value of coil L_2 is important, and will vary with different aerials. A poor and heavily damped aerial will require a larger coil—even up to a No. 75—than an aerial which is well set up and is used in conjunction with a good earth. The aim should be to choose a coil which will bring the set in and out of oscillation smoothly and without a "plop" at any adjustment of the condenser C_1.

It will always be found that more reaction is required at the maximum of C_1 than at the minimum, and therefore in choosing the coil it is just as well to set the condenser C_1 at its maximum and then to see whether the set can be brought in and out of oscillation by bringing the coil L_2 close to and farther away respectively from L_1. If smooth reaction is obtained at a maximum of C_1, it will usually be found to be generally satisfactory over the whole range.

A resistance-capacity coupling unit can be substituted for the first low-frequency transformer, but if this is done the condenser C_3 should be reduced in value to ·0001 mfd., and care should be taken that the anode resistance in the R.C.C. unit is not too high—not more than quarter megohm at the most, and preferably 100,000 ohms. When an R.C.C. unit is used here, it will be found generally that a larger reaction coil L_2 is needed, and probably reaction will not be so easily controlled.

R.C. Coupling

If it is desired to use one stage of resistance-capacity coupling and one stage of transformer coupling, it is much better to use the circuit shown in F3, which, however, is a little more expensive owing to the additional variable condenser C_5 required, together with the radio-frequency choke R.F.C. The R.C.C. unit may be cheaper than the transformer, so that there will be a small saving here, but the saving will not be sufficient to compensate the additional cost of the parts needed.

Circuit F4, when carefully made up and properly laid out, is a splendid receiver for long-distance work, but it will *not* give adequate loud-speaker results on any station without a stage of note-magnification added. For proper results this circuit requires expert layout, and should not be attempted by the beginner without a complete constructional design.

Some typical faults and remedies reviewed.

By P. R. BIRD.

PROBABLY every wireless set in the kingdom has some little peculiarity of its own if we were sharp enough to notice it. Some sets, ordinary in appearance, will behave in a way that is almost unbelievable.

A very good instance of this kind came to my notice last year when a fellow I know inquired whether his set was haunted or bewitched. It certainly appeared to be one or the other. The receiver was a det. and two L.F. of a conventional if somewhat old-fashioned type, and was installed in Surrey.

Peculiar Behaviour

Originally it was intended to get the London programmes on the loud speaker. But when 5 G B started up the owner discovered that with a little wangling of the tuning and reaction he could get alternative programmes from that station. (The reason that reaction was necessary was because an indoor aerial was used. This took the form of insulated flex, which ran from the set round a picture rail and out through a doorway to a hall, and eventually to the rafters of the bungalow.)

This set had one amazing peculiarity. When tuned to London reception was strong, clear and good, the set behaving just like an ordinary good little set will when conditions are suitable for it. When tuned to Daventry (5 G B) it would reproduce the Daventry programmes perfectly for a time, but, for some apparently uncanny reason, directly somebody opened the door to come into the room or to leave the room the set let out a howl which made the welkin ring.

When London was tuned in you could go in and out of that doorway without it making the slightest difference to the programmes. But if Daventry was being received, as soon as the door was opened the set started to shriek. If the door was held open the set continued to shriek, and not until that door was safely shut again would it reproduce the programme, when it would go on just as before without any tendency to howl or shriek or misbehave in any way—until the door was opened again.

Needless to say, the owner of this receiver was very interested in all this, but after a time, when the charm and novelty had worn off, it grew monotonous, and he began to hanker for a set which would allow people to come into the room, and to go out of it, without howling its head off at them. When the probable cause of the trouble had been pointed out to him he was able to cure it in two or three minutes. Can you guess what the cause was?

In case you have never heard of a similar instance I will explain at once that the key to the whole mystery lays in the indoor aerial. For appearance sake this was concealed behind the picture rail, and it ran along this and over the doorway in its journey from the set to the rafters. On the door itself was a brass curtain rod with curtain rings on, and when the door was closed this came to within about 2 in. of the aerial wire, although the latter was not visible, being hidden by the picture rail.

Effects of Curtain Rod

Now it is pretty generally known that the presence of metal near to an aerial is detrimental, as this absorbs some of the energy which is flowing backwards and forwards in the aerial. When signals from London were being received a small proportion of the energy in the aerial was undoubtedly lost owing to the proximity of the metal rod along the doorway, but as the signals were strong ones this was not of such importance, and the effect of opening and closing the door was never noticed on the London programmes.

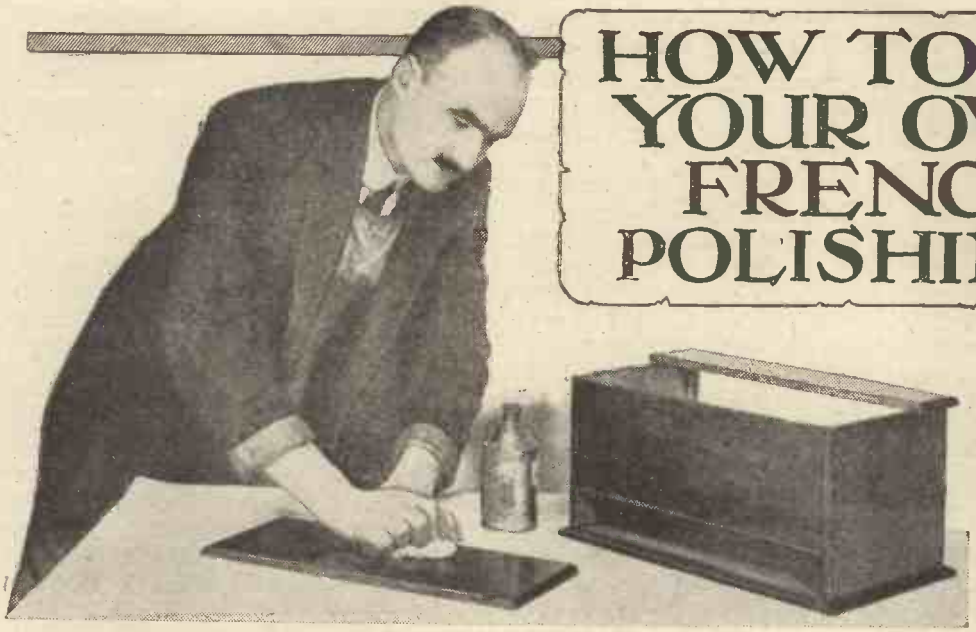
In order to receive Daventry, however, it was necessary to use a good deal of reaction. Within certain limits reaction will make up for a bad aerial system, so that when the door of the room was closed and the curtain rod was *close* to the aerial, it was necessary to adjust the reaction to a certain critical point before the losses in the aerial due to the presence of the metal curtain rod were overcome, and signals were strong enough to be heard in the loud speaker.

Why Reception Varied

When this correct reaction adjustment had been found the 5 G B programmes would come in well until somebody opened the door.

The mere opening of the door took away the curtain rod from the aerial and thus increased the efficiency of the aerial itself by reducing the damping. Consequently the reaction, which had formerly been just sufficient, became excessive, and the set would start to howl and to continue to howl until the door was closed again.

HOW TO DO YOUR OWN FRENCH POLISHING



The process is quite simple if you know the right way to go about it. Moreover, it enables the amateur to impart the real professional finish to his cabinets.

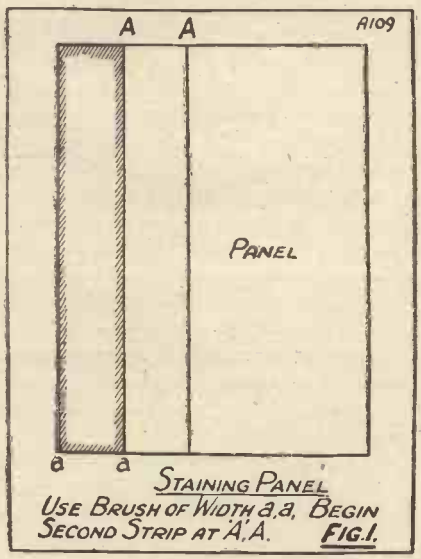
By H. T. DAVEY.

NEARLY all amateurs who have had little or no proper training find difficulty in producing good results in finishing a cabinet by the common process known as French polishing. Indeed, many a good cabinet has been spoiled by poor finishing.

French polishing and staining is an art, and without proper instruction and care in observing vital points leads to certain disaster. The difficulties encountered by the inexperienced are principally due to wrong impressions of the methods of producing the finished surface.

Three Stages

The actual process of French polishing a surface can be divided into three stages: (*a*) preparing the wood surface; (*b*) bodying in; (*c*) spiriting up.



To obtain the best results all quirks and mouldings should be removed, together with any decorations and fittings, and whenever possible panels should be polished before being finally fixed into place. It is extremely difficult to get into corners and polish successfully, hence the reason for polishing panels before fixing into frames.

It is of primary importance that no matter what kind of wood is to be polished that a perfectly flat and smooth surface be obtained. Any marks, particularly scratches, are intensified as the result of polishing.

Hence, using a *cork* block and fine cut glass paper, paper down all surfaces, using finally the finest glass paper until a smooth surface free from scratches is obtained. Work the glass paper in the direction of the grain of the wood throughout. Nos. 1 and 0 or 00 glass paper will be required, procurable together with the cork blocks from any good ironmonger who stocks carpenter's tools.

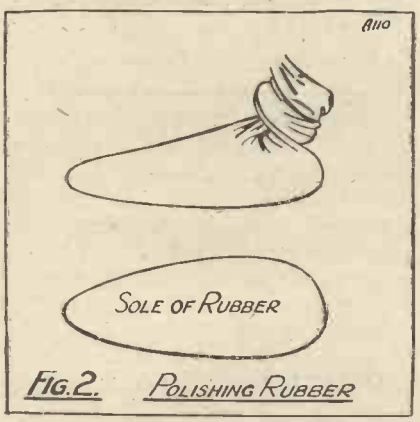
"Filling-In"

The next step is to "fill in" the grain by using some suitable kind of "stopping." This process is not always necessary, but depends upon the kind of wood and its condition. For instance, a hard, close-grained wood will "fill" during the bodying-in process, and needs no special treatment. Some varieties of oak have very open grain, and, in fact, most varieties of oak need special treatment.

To "stop" a grain very fine plaster of Paris is used, the variety sold as dental plaster is best, since it is very finely ground. Mix this with a little French polish (or, if the wood is to be stained, use the stain in place of the polish) until a thin mixture results. Apply this to the surface, using an old rubber, and working across the grain of the wood.

The Staining Process

Good Spanish mahogany, which at present is both difficult to obtain and expensive, is often of suitable colour for polishing, and does not need staining or stopping, but the wood now sold in many instances as mahogany is really African bay wood, and has very open grain, needing well stopping as described.



Having filled in the grain, leave the wood to thoroughly dry, having removed the surplus stopping with a piece of rag. When quite dry, paper down with fine cut glass paper until smooth, working in the direction of the grain only.

If the wood is to be stained to bring it to some desired colour, then this is the next process.

How to Do Your Own French Polishing—*continued*

The staining or dyeing of wood is an art, and perfect results can only be achieved by care, experience, and practice. All polishers of standing have their own methods and materials for producing any desired result, and are artists in the use and selection of the various pigments which are available for staining. However, good results can be obtained by an amateur with a little care and guidance.

Mahogany and Oak

There are two kinds of stain which can be used—water stain and spirit stain. Either gives good results, the former being rather more apt to bring up the grain than the latter, but, on the other hand, it is easier to apply with success. Both varieties can be purchased ready mixed in colours to suit particular requirements. The recognised colours are light and dark oak, mahogany, ebony, etc. It is important, of course, to specify the particular variety required when ordering.

If one prefers, the following can be easily made up for staining mahogany: Dissolve bichromate of potash crystals in methylated spirit or water, using sufficient potash to produce the desired intensity of

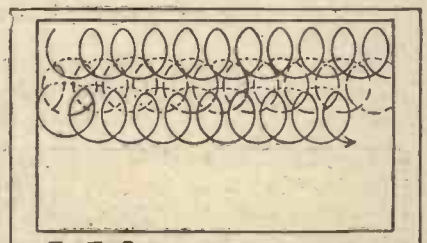


FIG. 3. DIRECTION OF MOTION OF RUBBER FOR APPLYING POLISH DURING BODYING. A111

colour. Use an odd piece of wood for trying the colour repeatedly. For a light oak (fumed) or medium colour mix Brunswick black with turpentine until thin enough to suit colouring effect.

Careful Application Required

All stains should be applied with a brush, using it in the direction of the grain and working in sections. Complete one piece before starting another, and do not apply more than one coat at a time. That is to say, do not allow overlapping when working on a wide panel, or similar piece; the method is indicated in Fig. 1.

Having applied the stain allow the wood to thoroughly dry. It will be probably found that the grain has "come up" after drying, or in other words the surface has roughened. If this is so, reduce by using very fine glass paper, preferably an old piece which has had some wear, and use *two* or *three spots* of linseed oil on the paper to prevent "pulling." Avoid too much pressure when papering, otherwise light patches will appear due to the removal of the stain. After papering down it may be necessary to give another coat of stain to restore an even surface colouring.

Having stained the wood, the next step is to "body up." At this stage the preparation of the surface for polishing begins. The actual process is to form a good foundation of polish and then polish the foundation. It is in this stage that most amateurs make mistakes; they try to polish the wood rather than produce the foundation or body.

The First Polish

For mahogany, oak, and other dark woods, French button polish is generally suitable. If button polish is used it should be remembered that the polish itself has a darkening effect on the wood. Hence for polishing white wood, or if the natural colour of the wood is not to be changed, then transparent polish should be used, and not French button polish. There is also a white polish made for use on white woods.

Polishing and bodying must be done in a warm atmosphere of about 60° F., and free from dust. To secure good results all work standing for drying should be carefully protected from dust by coverings. The "bodying in" is carried out with a rubber made from a piece of good soft linen or calico about 5 in. or 6 in. square, and free from any "dress," and a wad of cotton wool. To ensure the material is free from "dress" it should be boiled before use, and dried.

The cotton wool should be rolled into a shape like an egg with a fairly long point, and placed in the linen square. Gather in the corners of the linen to form a rubber, as shown in Fig. 2. For small work a smaller rubber is desirable.

To hold the rubber correctly grasp the ends of the linen low down so that the heel of the rubber is in the palm of the hand, and extend the first and second fingers over the toe of the rubber. The shape of the rubber is important as is also the method of holding.

To charge the rubber, saturate the cotton wool with polish and squeeze out the excess. Roll up again to shape as indicated.

Three or Four Coats

To body-up, work the rubber across the wood as indicated in Fig. 3, working across the grain, using as little pressure as possible, and finishing up in the direction of the grain.

After one coat of polish has been

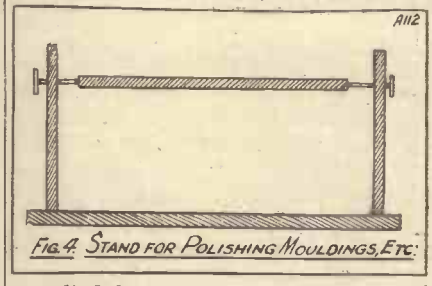


FIG. 4. STAND FOR POLISHING MOULDINGS, ETC. A112

applied leave for ten minutes or so until dry, and add another coat as before. Give three or four coats, allowing time in between for the surface to set, and then lay aside for twenty-four hours or longer if possible. Work should be kept under a dust cover in a moderate temperature when standing aside for drying.

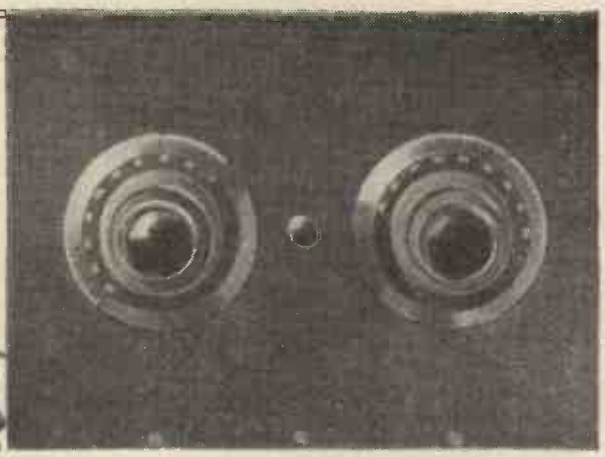
Reducing the Grain

It is important to realise at once that a brilliant polish must not be aimed at in this stage; in fact, the surface should be dead and, of course, will be full of rubber marks. After standing for a day or so, obtain a piece of very fine glass paper, preferably an old piece which has been used previously, and put two or three spots only of linseed oil on the paper, and with the aid of the cork block rub down the surface of the wood which has been treated as directed until it is again quite smooth. This will reduce any grain which may have "got up," and will give a level surface for further treatment. When papering down a surface which has been treated with polish use very light and even pressure with only a very small quantity of oil.

Now, using the rubber as before, continue to give three or four more

(*Continued on page* 141.)

The "ALL-WAVE" ONE



A set on which you will be able to receive short-wavers as well as the ordinary broadcasters.

By L. H. THOMAS.

THE cheap and simple one-valve receiver described in this article was designed chiefly for the benefit of those who are in need of a set on which they can receive not only local broadcast but also a fair amount of short-wave traffic, without sacrificing efficiency on either side. It should appeal to those readers in the Colonies who would like to listen to 5 S W and the other broadcasting stations, the set on which they do it still being useful for other purposes. In every sense of the term it is an "all-purpose" set.

For the circuit I have gone back to the old original "Reinartz"

COMPONENTS REQUIRED

- 1 Panel, 12 in. × 8 in.
- 1 Baseboard, 12 in. × 9 in., and cabinet to take panel.
- 2 ·00035 slow-motion condensers.
- 1 Valve holder.
- 2 Clip-in condenser bases and various condensers.
- 1 H.F. choke.
- 1 Baseboard mounting rheostat.
- 1 Five-pin base and three or four five-pin plugs.
- Insulating tubing.
- 1 Grid-leak holder and 5-meg. and 2-meg. leaks.
- 1 Six-terminal strip.
- 1 Two-terminal strip.
- 1 Push-pull switch.
- Wood-screws, wire, etc.

Note.—Any good makes of components can be used for this set.

arrangement, which was in use, principally for short-wave work, long before any of the many so-called "Reinartz modifications" or "Hartley-Reinartzes" or "Reinartz-Zenith" circuits came into vogue. The feature to note about the circuit is that the aerial winding is virtually a continuation of the grid coil, a tight-coupling effect being obtained, in contrast to the more usual "auto-coupling" effect produced by connecting the aerial to some point in the tuned grid coil.

Capacity Effects Avoided

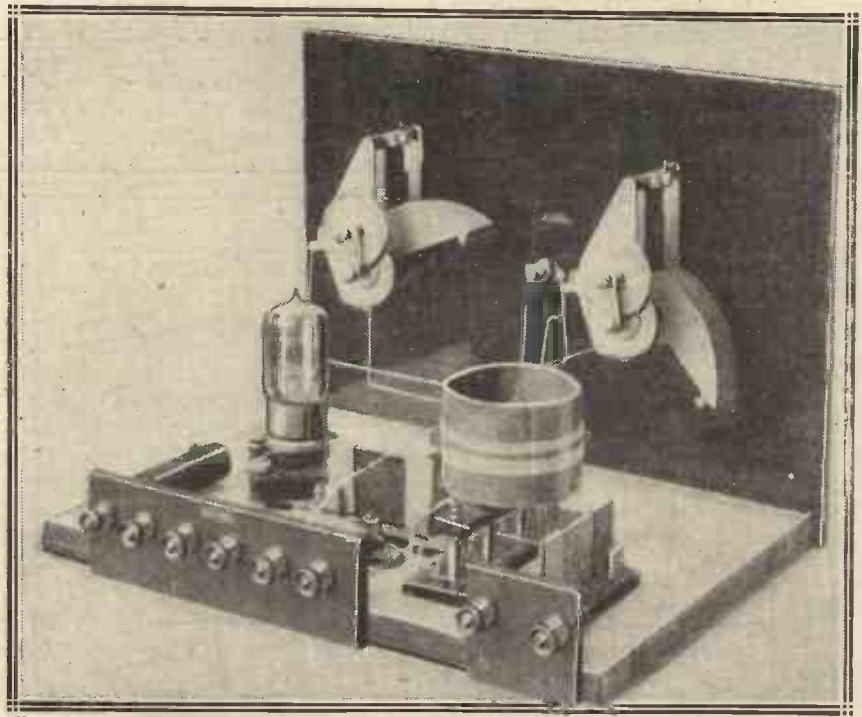
The reaction coil is a separate winding, although it is, of course, wound on the same former and closely coupled to the other, and reaction is controlled by a variable condenser so arranged that its moving plates may be connected to the filament circuit, capacity effects thus being avoided.

This, I think, sums up the chief points about the set.

Now with regard to the coils. Some time back a five-pin former enjoyed great popularity, its chief use being in connection with neutralised H.F. receivers. The Peto-Scott Co. still produce the five-pin bases (i.e. sockets) and also a five-pin "plug" for use with them. It is very convenient to wind one's own coils on suitable formers, pleasing oneself with regard to the design, and to bring out the five necessary points in this circuit we are employing to the five pins on the plug.

The Coils

One of the photographs shows a coil that is used for the broadcast band of wave-lengths. This, and most of the other coils used with this particular set, is wound on "Pirtoid" tubing, which is mounted vertically on the plug. Four of the connections from the coils—the two ends of each winding—are then taken down inside the former; the fifth, which is a tapping, being taken outside. More detailed references to the coils will be made later.



The receiver is an extremely simple and inexpensive one to build. It makes use of a home-made coil, full constructional details of which are given.

The "All-Wave" One—*continued*

The panel and baseboard are reasonably small, and the baseboard used was of sufficient thickness to support the panel without brackets. It will be seen from the photographs that the baseboard layout is far from crowded; this is, of course, a most desirable feature if the set is to be used for short-wave work.

The coil used for the reception of the ordinary broadcast wave-lengths. Note the spacing of the pins; the numbers are referred to in the text.

It is often a debatable point whether short wires and a cramped layout are preferable to longer wires and greater spacing, but this set seemed to fall almost naturally into a condition of short wiring *and* ample spacing, thereby solving the problem without further trouble.

Filament control is arranged by a rheostat mounted on the baseboard, only a push-pull switch being provided on the panel. Control is hardly liable to be critical, and the rheostat is provided chiefly as a convenience when 3-volt valves are in use with a 4-volt accumulator, or in similar circumstances.

With these few remarks before him the reader should be ready to commence the actual building of the set. Everything should be perfectly clear from the photographs and diagrams; the spacing of the components is quite clear and should be adhered to. Needless to say, both sets of moving plates on the variable condensers are connected to the filament circuit and earth.

Checking the Wiring

With different makes of variable condenser in use this is occasionally liable to involve some considerable alteration of the wiring, but the reader will be able to see that all is in order in this direction before completing the wiring. Probably it will be found best to wire up all the connections to the L.T. switch and the variable condensers first of all, and then no awkward corners will be found.

As a check on the wiring of the coil-base (and also the wiring of the coils to their plugs, when this is tackled) the following is the procedure. Beginning at the end of the base at which the three sockets are closely mounted, the first of these is taken to the anode terminal of the valve holder.

The second goes to the fixed plates of the reaction condenser on the panel; the third is taken to one side of the clip-in condenser, which has been included in series with the aerial.

The Interchangeable Condensers

Socket 4 goes to L.T.+ and to earth; socket 5 goes to one side of the grid condenser and to the fixed plates of the main tuning condenser C_1.

It is important that both the grid condenser and the aerial series condenser, if not of the clip-in type shown, be of an easily interchangeable nature. These are the only components that are liable to need alteration when changing over from broadcast to short waves, and it is not always found that even this is necessary. The provision, however, must be made.

All the constructional work being finished, the wiring should, of course, be carefully checked over in the usual way. The next piece of work is the construction of the coils.

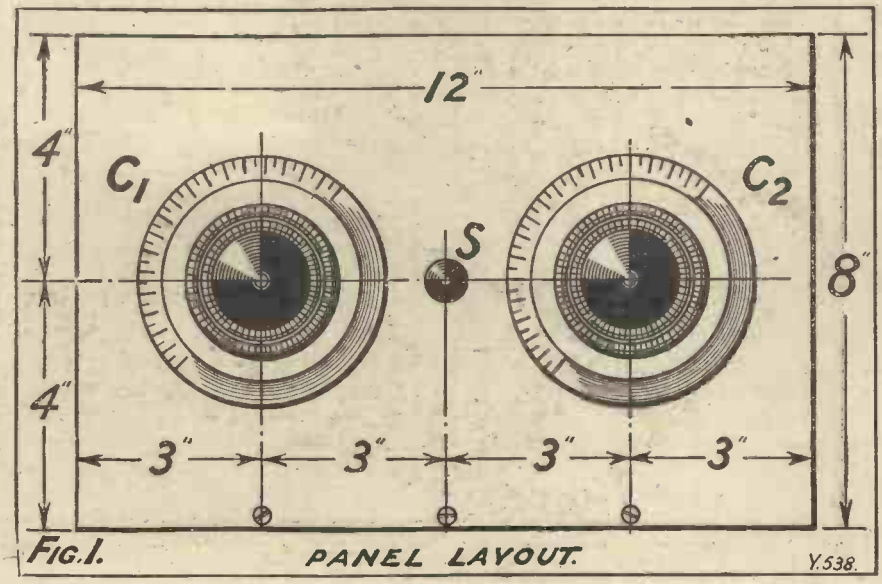
Most of this may be learnt from the photo of the broadcast coil and from the photo of the back of the set showing one of the short-wave coils in position.

Winding the Coils

Commencing with the former, the following is the necessary information: The wire used was No. 26 D.C.C., wound on a 2-in. Pirtoid former about 3 in. in length. The first connection is made to what we have previously called "pin 5." This is the end pin, at the end remote from the three that are grouped together. (This sounds rather complicated, but I cannot see any other way of explaining it!)

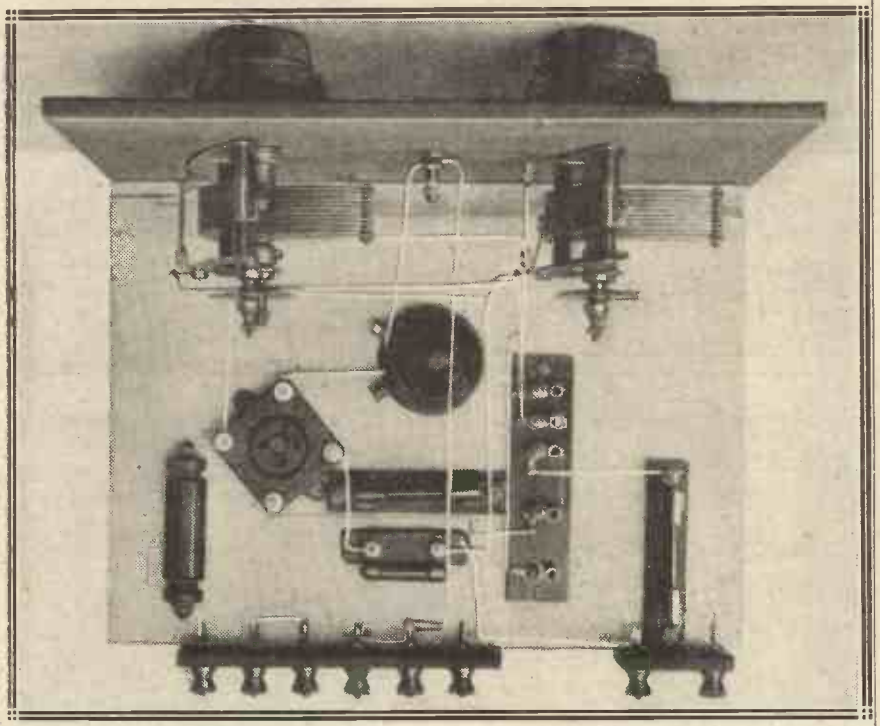
Sixty turns are now wound on, and when the sixtieth is arrived at, a small length of the wire is bared and a 3-in. length soldered on to it. It will be found best to twist the new wire round and then to solder it. The wiring is then continued for twelve or fifteen turns. For further remarks on this see later.

Take the end of the wire with which



The "All-Wave" One—*continued*

the tapping has been made to pin No. 4, and the end of the winding to pin No. 3. Now leave a space of about ¼ in. and start the reaction winding. Take the end of the wire from pin No. 2 up the inside of the former and through, wind on twenty turns, and take the other end to the remaining pin, No. 1. This coil should fill the former nicely.



This photo very clearly shows the disposition of components, and the routes of the majority of the leads also can be clearly seen.

With regard to the "twelve or fifteen turns," the size of this winding depends to a great extent upon the characteristics of your aerial. Generally speaking, fifteen turns will be satisfactory; if, however, your aerial is much longer or much lower than the average, or if a great amount of it comes through the house (i.e. if it may be described as a high-capacity aerial), twelve turns only should be used.

Selectivity and Sensitivity

As a matter of fact, those who are well placed and have very high aerials, as well as those whose aerials are very short or are small indoor arrangements, would do well to arrange twenty or even twenty-five turns.

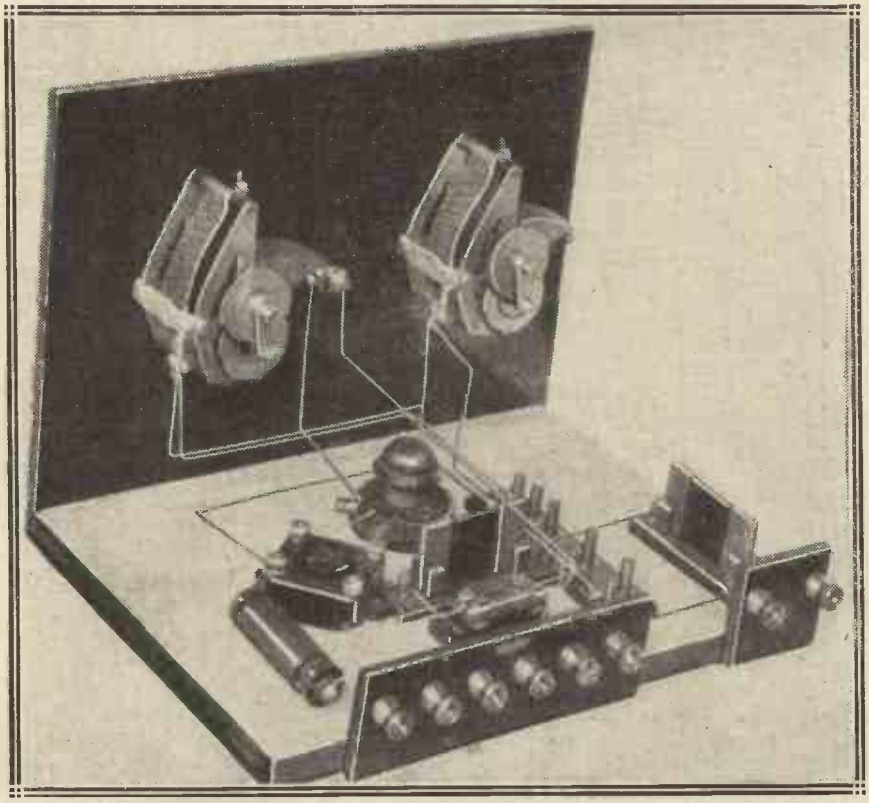
The whole thing is the old question of arranging a compromise between selectivity and sensitivity, and the clip-in condenser provided in series with the aerial does much to help the problem. If you wind on fifteen turns and find that the set is not sufficiently selective to please you, then try the effect of a small condenser (say ·0002) in this position. If selectivity is ample, you may either short the two clips or insert a very large condenser of the order of ·001.

Again, if you are so unfortunate as to be within half a mile or so of a transmitting station you are instantly able to adapt your set to the circumstances by reducing the number of turns in the aerial circuit still further. Generally speaking, however, the twelve or fifteen turns will be found the most satisfactory number.

A Concrete Example

To give one concrete example, my own coil had twelve turns in the aerial circuit. The set was used on an aerial 60 ft. long and 40 ft. high, at a distance of six miles from 2 L O. 2 L O occupied a very small band indeed on the ·0005 condenser, extending but four degrees on either side of the maximum, and Madrid could be received with no interference from him. Selectivity could quite well have been reduced in this particular case in order to give a little extra sensitivity.

For Daventry the following coil



The terminals from left to right are: 'Phones, H.T. plus, H.T. minus, L.T. minus and L.T. plus. On the small strip, Earth and Aerial.

The "All-Wave" One—*continued*

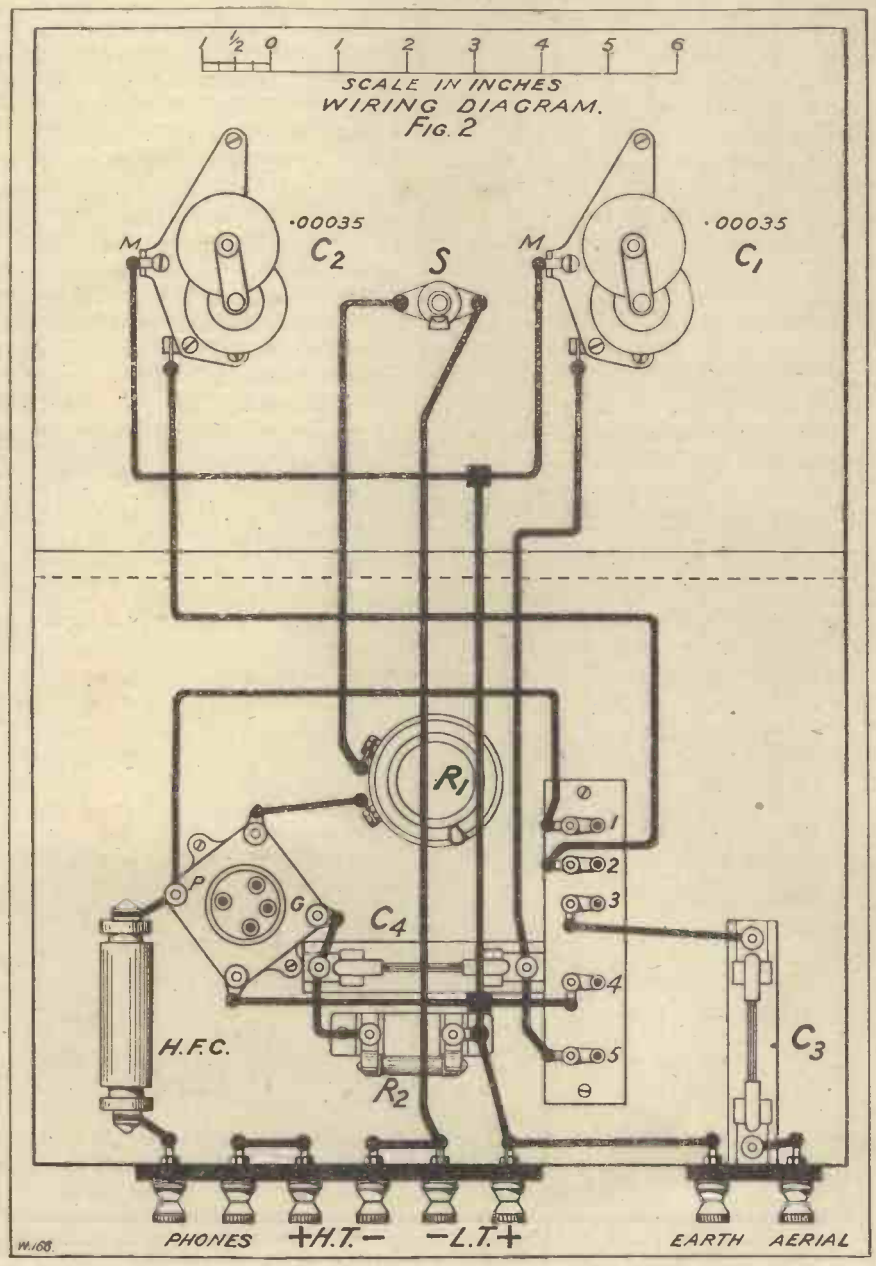
proved very satisfactory. The wire used was No. 32 D.C.C., and for the grid coil 200 turns were wound on, in the form of three layers of 67 turns.

Short-Wave Coils

You should, of course, wind on 67 turns commencing at the bottom of the former, then return to the bottom again and commence the 68th turn there, still travelling up the former, returning again for the 135th turn, and ending the winding at the top end.

For the aerial winding a further 60 turns are arranged, these also being wound in three layers. The tap which is taken to pin 2 is, of course, the connection common to the large winding and the aerial section. For the reaction coil another 75 turns wound in three layers is suitable.

Regarding the short-wave coils, much could be said concerning the relative merits of several different methods of winding. About six different types were tried out, and there really seemed very little to choose between the results. If anything, the best of all was the one shown in the photograph of the back of the set with the valve in position. This was simply wound straight on in a single layer in the same manner as the broadcast coil.



Improving the Reaction Control

Another good method is to wind on the reaction coil *first*, at the top end of the former, then to fix four small strips of ebonite down the sides of the former by means of some adhesive (not using too much of it!), the grid and aerial windings then being wound on over these strips. This method has two advantages, namely, the fact that the aerial and grid windings are well held out from the former itself—although in practice this seemed to matter very little—and the more important fact that, the reaction coil being very tightly coupled to the other coil, it may consist of fewer turns.

The coils should be arranged so that the lower end of the reaction coil is just underneath the tap going to pin 2 (filament and earth). If it is possible to arrange a coil like this, in such a way that there is very little capacitative coupling and a great amount of inductive coupling, the reaction control will always be much more satisfactory, in that it will have little or no effect upon the wave-length.

Nothing is more annoying in a short-wave set than to find a signal when the set is oscillating a little hard, and then to have to chase it half-way round the dial while the reaction is being reduced! This certainly does not occur with the coils arranged in the manner just described. For the "straight-on" coil and similar coils, the short-wave winding details are given elsewhere.

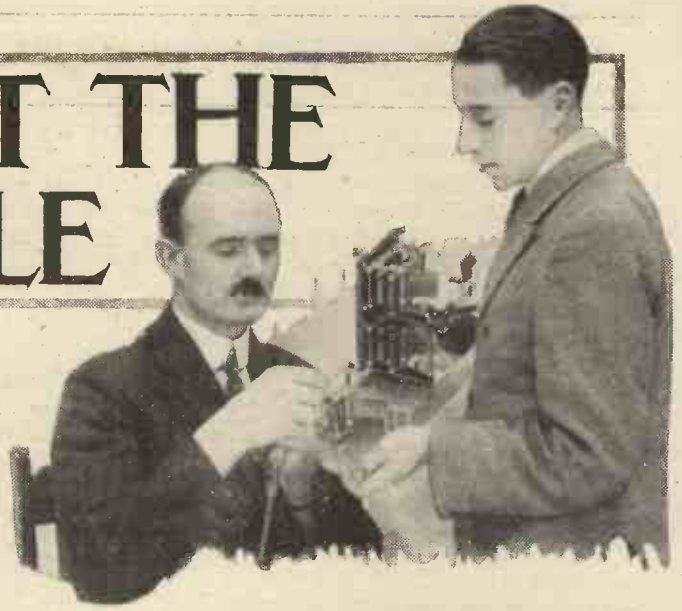
Other Type of Coil

The wire generally used is No. 22 D.C.C. It is, of course, realised that these figures for the wave-length range (with a ·00035 condenser) are only approximate.

The figures for the other type of coil (i.e. with the reaction coil flat on the former and the others wound over it and spaced out by ebonite strips) are roughly one more turn in every case except reaction when it is one less.

(*Continued on page* 140.)

CHATS AT THE WORK-TABLE



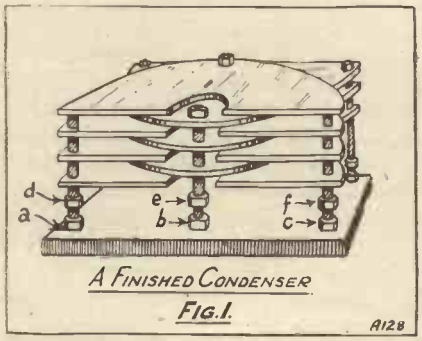
Many points of practical interest to all radio constructors are dealt with under this heading. This article is devoted to Fixed Air Condensers.

By R. W. HALLOWS, M.A.

Fixed Air Condensers

In the short-wave set, which has to deal with enormously high frequencies, and to receive long-range signals, often with very low power behind them, it is desirable to cut down all possible sources of loss to a minimum. For this and for other reasons, into which it is not necessary to enter here, I much prefer to use in such a receiving set air fixed condensers instead of those with a mica dielectric in certain important positions.

The three most vital fixed condensers in the short-wave set are: (1) That in series with the aerial lead-in. Not all short-wave sets



A FINISHED CONDENSER

FIG. 1. A128

incorporate such a condenser, but to my mind it is almost an essential fitting if perfect control of oscillation is to be ensured with *any* aerial. (2) The grid condenser. (3) That shunting the potentiometer to which the grid-leak return is made.

Shunting the Potentiometer

This, again, is not seen in all short-wave sets, for in many of them the low potential end of the grid leak is connected directly to the positive filament leg. Besides enabling one to get the very best out of any particular valve when used as rectifier, the potentiometer is also a great help in obtaining smooth reaction.

Whenever such a potentiometer is fitted, a fixed condenser should be shunted across it between the slider and the terminal connected to low-tension negative. There is probably no short-wave set which does not employ cumulative grid rectification, so that every short-wave enthusiast, whether his set contains the other condensers mentioned or not, will be interested in the component now to be described since it forms the finest and most reliable grid condenser obtainable for the purpose.

Old "Variables"

No doubt many readers have ancient straight-line capacity variable condensers (or, at any rate, bits of them) either stored away on their shelves or reposing in the junk box in the workshop. No matter how inefficient an old condenser may have been when used as a variable, its dry bones may be made to live once more and to give very useful service as an air dielectric fixed condenser.

The only condition is that the fixed vanes must not have become bent or buckled, for these, together with the spacer washers, are the sole parts of it that we require to use. Fig. 1 shows how an excellent fixed condenser may be made from these vanes, whilst Fig. 2 makes plain the way in which they are arranged.

The foundation of the home-made fixed condenser is a small piece of ebonite *of the very best quality*, whose dimensions will depend upon the size of the vanes available. The size required can be readily ascertained by laying two of the vanes in the position shown in Fig. 2 on a sheet of paper, and then ruling off a rectangle which will contain them with a margin of a quarter of an inch or so all round.

Assembling the Plates

The rectangle is then measured, and a piece of ebonite is cut to this size. Drilling is best done by using the vanes as jigs. Lay one of them in position and make first of all the hole marked A in Fig. 2. This will, in most cases, be 2 B.A. tapping size (No. 26 Morse drill) since the majority of old vanes are made to slip on to 2 B.A. supporting pillars.

Tap the hole and insert a short length of studding into it. Having fitted a vane on to this, drill and tap the hole B, fixing the vane as

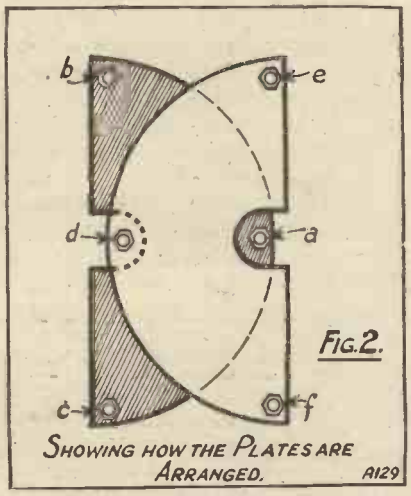


FIG. 2.

SHOWING HOW THE PLATES ARE ARRANGED. A129

before with a small piece of studding. The third hole can then be drilled in exactly the right position.

A second vane is now placed carefully upon the first, after which hole D

Chats at the Work-Table—*continued*

is drilled and tapped. Having secured the vane as previously described with a piece of studding, drill and tap hole E, and finally that marked F in the diagram. The next process is to remove all superfluous ebonite from the base. This is most easily done in the way shown in Fig. 3, by drilling a number of ¼-in. holes. Only sufficient material to ensure the necessary strength should be left.

If the constructor is sure of his ebonite and possesses a small keyhole saw he may still further reduce the

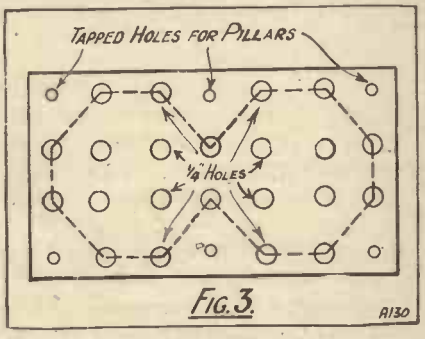


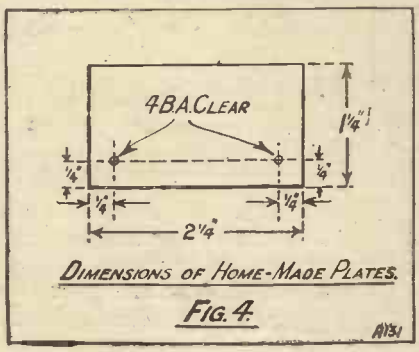
FIG. 3. A130

amount of solid material in the base by cutting out the webs as indicated by the dotted lines in the drawing. The base finished, the assembly of the condenser follows.

Assembly

Six suitable lengths of studding are cut off and trimmed up. One of these is screwed into each of the tapped holes, being locked in position by means of a nut (A, B, C in Fig. 1). A second nut (D, E, F) follows, then the first vane is slipped on. Spacer washers having been placed on all the pillars, the second follows.

One can now roughly adjust nuts D, E, and F so that the two vanes are just clear of one another and both are perfectly level. The rest of the vanes with spacer washers between them are put on to the pillars, after which the top securing nuts are



DIMENSIONS OF HOME-MADE PLATES.
FIG. 4. A131

turned down loosely. Fine adjustments in the position of the plates are now made with nuts D, E, and F, after which the top nuts are screwed firmly down and the job is finished.

Adjusting the Vanes

Care should be taken to see that when the condenser is held up edgewise between one's eyes and the light the spaces between the vanes are exactly equal. When old vanes are used, select only those that are absolutely straight. All plates should be thoroughly cleaned before assembly takes place, for any dust or dirt between them will seriously affect the efficiency of the condenser.

The capacity obtained when a condenser of this kind is made up will naturally depend upon the size and number of the plates and upon their distance from one another. Spacer washers, $\frac{1}{16}$ in. in thickness, can be obtained from most shops which stock small wireless parts, and if these are used in conjunction with old variable condenser vanes of average size it will generally be found that two plates meshed with three, or three with four, give a capacity suitable for the short-wave set's grid condenser.

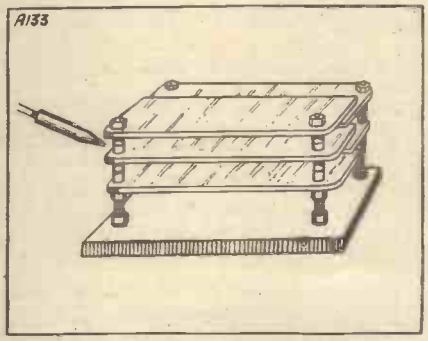
The aerial series condenser may consist of two plates meshed with three, or of two with two. For shunting a potentiometer a larger capacity is required. The air condenser here may have from fifteen to twenty plates on one side, and the same number plus one on the other.

The drawback to the use of air dielectric fixed condensers of the type already described is that they take up rather a lot of room on the baseboard of the receiving set. A much more compact model can be made up by any constructor who cares to cut his own plates from sheet brass or sheet zinc. The dimensions of these are given in Fig. 4.

Convenient Material

Personally, I prefer zinc to brass for the job, since it is much easier to flatten when cutting, trimming and drilling have been done. Simply lay each plate in turn on a smooth metal surface, and iron it out with an old flat-iron that has been made considerably hotter than the lady of the house would approve—if, of course, she knew anything about it!

With these vanes, the dimensions of the base need not exceed 2 in. by 2½ in. It is cut out and prepared in the way previously described, except that the tapped holes for the pillars are 4 B.A., and that there are only four of them instead of six. These holes are drillled so that the centres

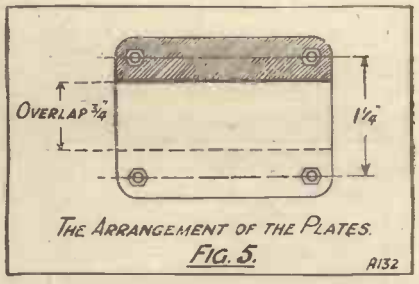


The plates may be soldered to increase efficiency.

of those for one set of plates are 1¼ in. distant from the other set.

Compact Condensers

This gives an overlap of ¾ in. (Fig. 5). If $\frac{1}{16}$-in. spacer washers suitable for 4 B.A. pillars cannot be obtained, ordinary 4 B.A. washers may be used, three being placed between each pair of vanes. With a ¾-in. overlap this arrangement gives a capacity of roughly ·0001 microfarad for each four dielectrics; in other words, this capacity will be furnished by two plates meshed with three. For the series aerial condenser, therefore, this number will suffice, and for the grid condenser four plates meshed with five, or five with six, will be generally satisfactory.



THE ARRANGEMENT OF THE PLATES.
FIG. 5. A132

For the shunting condenser of the potentiometer a capacity of roughly ·001 microfarad can be obtained by meshing twenty plates with twenty-one. Even such a capacity as this, however, does not make for a very bulky condenser. The length and width will be the same as with smaller capacity condensers.

RADIOGRAMOPHONICS

A new series of articles, specially written for the constructor who wishes to use his radio receiver and loud speaker for the reproduction of gramophone records.

By A. JOHNSON-RANDALL.

I HAVE recently been conducting experiments with two transformer-coupled L.F. stages used in conjunction with a pick-up, in order to see whether the reproduction showed any improvement upon the ordinary gramophone and sound-box.

If two really first-class transformers are employed, the quality is surprisingly good. If the instruments are of a mediocre type the result is a loss of the lower frequencies, thus giving a high-pitched effect, and the benefits of electrical reproduction are lost.

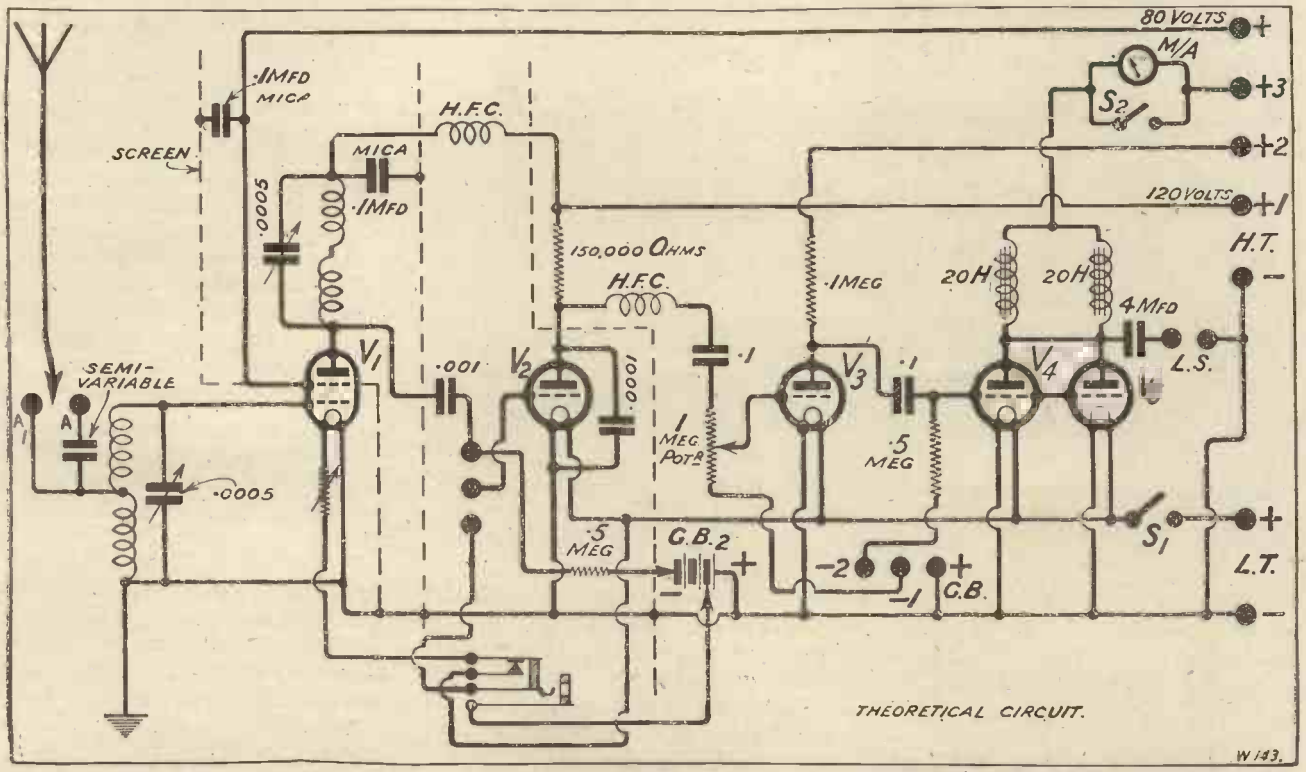
The chief trouble with a couple of transformers is the tendency for L.F. oscillation to occur. The greater the efficiency aimed at, the more difficult becomes the task of maintaining fairly even amplification of the musical frequencies. L.F. oscillation, in its worst form, appears as a continuous howl. When this happens it is quite obvious to even the veriest novice that there is something seriously amiss. There is another type of L.F. trouble which is far more difficult to detect, and that is, certain musical notes are amplified out of all proportion to the others. The amplifier, so to speak, is "peaking" on certain frequencies, and this has the effect of spoiling reproduction.

Combined Coupling Easier

For this reason I always consider that it is a much easier matter for the average listener to obtain first-rate results with a combination of resistance and transformer coupling, because there are so many little snags in getting two highly efficient transformers to work properly together.

Of course, in the hands of a skilled experimenter, wonderful reproduction can be obtained with two, or even three, transformers, but it is essential for all coupling and other effects to be eliminated, and it is this which renders it so difficult for the average constructor to do justice to the transformers at his disposal. Therefore, for gramophone reproduction I strongly recommend either a combination of resistance and transformer, or pure resistance coupling.

For the more ambitious listener



This is a very good circuit for combined gramophone and radio work, the change-over being easily made by means of the simple switch shown.

Radiogramophonics—*continued*

the circuit shown takes a lot of beating. As will be seen it consists of a screened-grid H.F. valve, followed by a detector and two R.C. stages.

It is an ideal arrangement for those who wish to combine high quality from the local station with realistic gramophone reproduction.

Switching Over

The change-over from radio to gramophone can be made by throwing over the single-pole change-over switch, and plugging in a telephone jack to which the two pick-up leads are connected. This operation converts the anode rectifier into an L.F. valve by altering the grid bias to its correct value for the purpose, and thus three stages of the R.C. coupling become available for pick-up work.

Volume is controlled by means of a 1-meg. potentiometer, such as the G.E.C., and the coupling condensers are ·1-mfd. mica. The object of connecting the two output chokes in parallel is to reduce the voltage drop across the windings—an important factor with two paralleled valves working on high anode voltages—and also to minimise the chances of an excessive loss of inductance such as might be the case if only one choke were employed.

The jack shown is an Igranic P.66, but only four of the contacts are used, the second from the bottom and the top one being left blank. The action of inserting the telephone plug switches out the H.F. valve. As to valves, I suggest an "H.F." type, impedance 20,000 ohms, amplification factor 20, in the detector socket, an L.F. valve in the V_3 socket, and two super-power type valves for V_4 and V_5. For moderate volumes V_3 can be an "H.F." type valve, but there is a danger of overloading on very strong signals. The dotted lines indicate copper screening, and these are essential if perfect stability is desired.

In addition, the baseboard has a copper floor which extends to the L.F. side. It is advisable to use astatic coils in order to reduce screen losses, and these may consist of 70 turns wound in two halves of 35 for the aerial coil, and 80 turns wound in two equal halves for the anode coil. Each half is wound the opposite direction, 9/38 Litz wire being a convenient gauge; 3-in. diameter formers are suitable.

In my article last month I promised to give details of a simple switching scheme which could be used in the "Business Man's" Four, so that a rapid change-over might be made from radio to gramophone. I find that the method I intended to employ necessitates a slight modification to the layout, and I am, therefore, holding it over in the hope of devising an alternative method not involving this alteration.

From time to time one hears stories regarding the wear on records brought about by the use of gramophone pick-ups. I have been using a number of H.M.V. and Columbia records for some time in connection with my experiments, and I can honestly say that although I have played each record very many times, I have not as yet been able to detect any deterioration in the reproduction.

Possibly the use of "half tone" needles is a help. I always think that the "loud" and "extra loud" needles must tend to tear the records up to a greater degree.

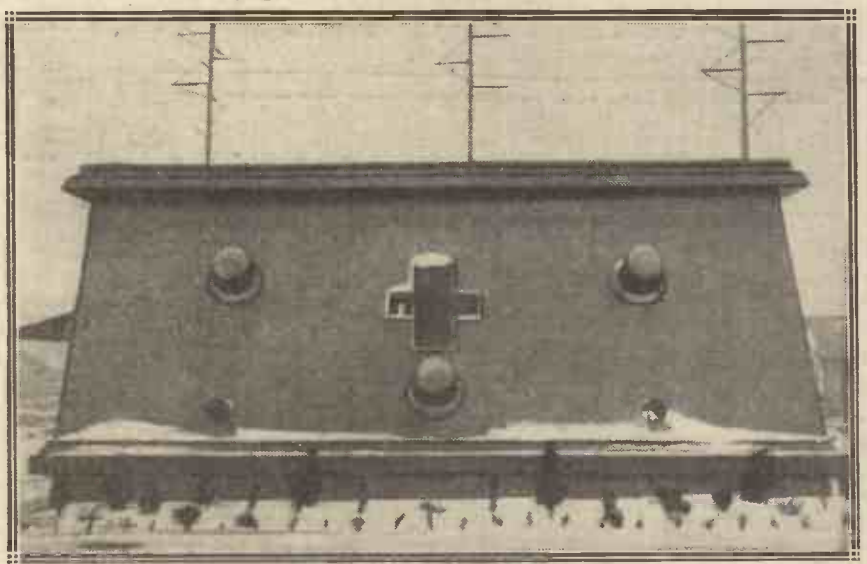
Home-Made Gramophones

A friend of mine asked me whether it would not be possible for him to make up his own gramophone attachment in order to avoid having to purchase the complete outfit. This is really quite a simple matter.

One only requires a clockwork motor, turntable, and tone arm. The motor and turntable can be mounted on a piece of plywood supported on four legs. The tone arm is then placed in a convenient position, and the arrangement is ready for use. Of course, if one desires, the attachment can be enclosed in a cabinet, but this naturally adds to the cost. All the parts can be purchased at any of the large stores, or they can be obtained secondhand. If price is not the primary consideration, I recommend the use of a double-spring motor in preference to one of the single-spring variety. One does not wish to have to re-wind the motor after each record. In addition, the speed is apt to be more constant with the double-spring type.

The Electric Motor

For those who have the electric-light mains there is also that excellent little motor and turntable which is marketed by the General Electric Company. With this it is only necessary to make connection to the nearest wall socket with the aid of a flexible cord. Moreover, the current consumption is very low, and the running costs should be negligible. An electric turntable of this type is a real boon to those who have the mains, since the trouble of always having to wind up the motor after every two records or so is completely eliminated.



The enthusiasm of a Portland (Oregon) radio firm has resulted in this amazing structure—a building designed to appear like a giant wireless receiver.

The "DUO-COIL" CRYSTAL SET

Here is just that inexpensive receiver you require on which to receive the alternative programmes. Its sensitivity and selectivity are both unusually attractive.

By C. A. J. MEADOWS.

Now that the B.B.C. has achieved its long-cherished object, and provided an alternative programme for the crystal users in the major part of the country, the trouble with many crystal sets is to tune in both stations without altering the coils or tappings, or in some way vitally changing the circuit each time it is desired to change from the local station to 5 G B.

A great number of sets, unless used on a full 100-ft. aerial, fall just short of Daventry Junior's wave-length, and this, of course, necessitates the inclusion of a loading coil, which, as it need only consist of a comparatively small number of turns, will probably have to be home-wound and fitted to the orthodox type of plug by the constructor.

LIST OF COMPONENTS.

1 Panel 6 in. × 8 in. × $\frac{3}{16}$ or $\frac{1}{4}$ in.
1 Cabinet, about 7 in. deep, to fit.
1 ·0005-mfd. variable condenser and dial (any good make).
1 Crystal detector.
4 Terminals.
2 Tapping clips.
Material for coil, wire, etc.

"By No Means Expensive"

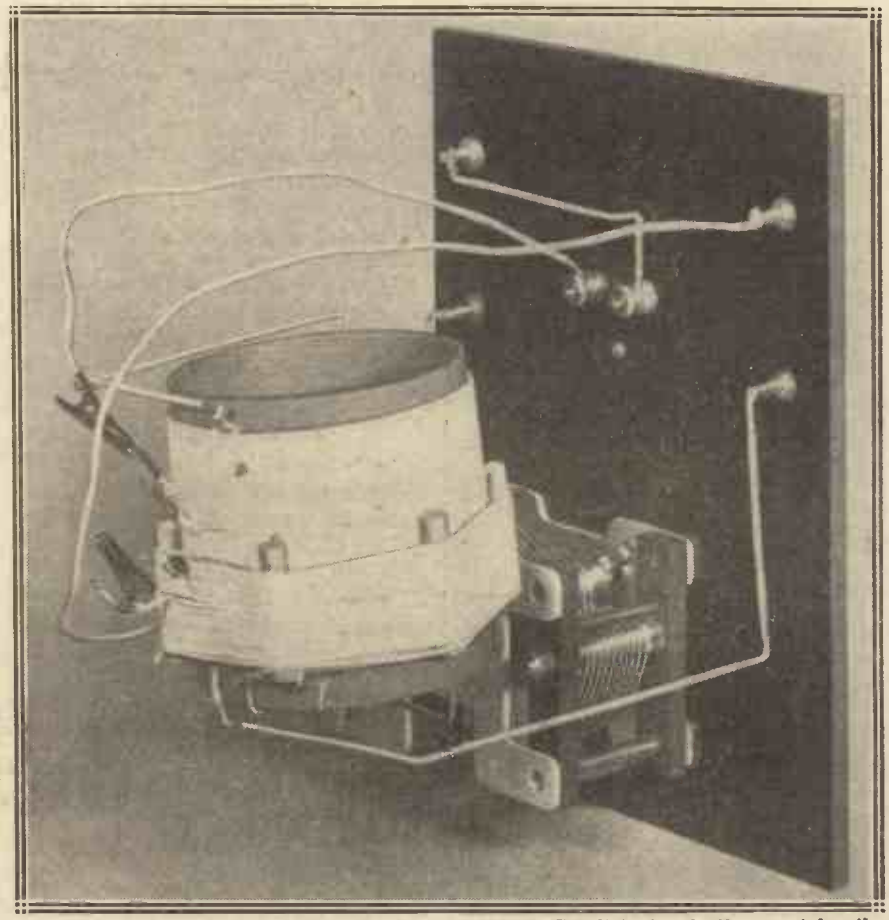
All these little jobs are of the sort which get carried over indefinitely, until at last they are rushed off in a desperate hurry and are a constant source of trouble afterwards. Although there is nothing wonderful in the little set described herewith, it has advantages which will appeal to the majority of crystal enthusiasts, from the experimenter to the listener pure and simple.

In the first place, it will comfortably tune in both the local station and 5 G B after preliminary adjustments have been carried out, and, secondly, the selectivity is of a high order for a crystal set, it being possible to tune out a station within five degrees of the condenser scale. Lastly, good signal strength is assured by the method of tapping the crystal-'phones circuit into the secondary at about two-thirds of the winding. Reference to the theoretical circuit should make this quite clear.

This set is by no means expensive; sixteen shillings should comfortably cover the cost of all the components, including a cabinet of the type used in the original receiver.

No Constructional "Snags"

An Ormond ·0005 square-law condenser is employed, the crystal detector one of the cheap dust-proof variety, and the coil can be easily constructed at home from the instructions given later in this article. There are naturally no snags in the actual construction of the set itself, but a little skill and patience is required when winding the coil,



The high degree of efficiency attained by the "Duo-Coil" is due to the special coil unit employed. But it is cheap and easy to make.

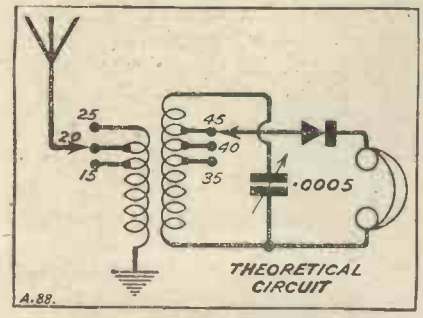
The "Duo-Coil" Crystal Set—*continued*

especially when winding and tapping the primary.

Assuming that the components have been obtained, the panel is first to be marked out and drilled in accordance with the panel-drilling diagram on this page. If a crystal detector is mounted on a base when purchased, the best plan, if appearance is any consideration, is to dismount the parts from the base and use the latter as a template, taking care to place the two holes equidistant from the centre line of the panel. In the case of many detectors, the distance between the screw-holes on the base vary slightly, and in such cases the measurements given on the diagram will not apply, and the constructor will therefore have to drill the panel to fit the particular type of detector he obtains.

"Why the Boss?"

The mounting of the components is next proceeded with, and one point in this connection is worthy of mention. It is concerning the $\frac{3}{8}$-in. nut for fixing the variable condenser. This nut has a large boss on one face, while the other is quite flat, and this is a source of considerable perturbation to some people, who are undecided as to the correct way round for the fitting, as if the boss is towards the panel the other face of the nut will project for some distance, and at the



same time a good grip cannot be obtained. Obviously to secure a good grip the flat face should be to the panel, but the query still persists, "Why the boss?"

Those constructors who are sufficiently fortunate to possess a full set of drills should drill, instead of $\frac{3}{8}$ in., $\frac{1}{2}$ in. for the variable condenser bush. The boss will then fit this hole and a most secure grip will result, likewise the nut lies almost flush with the edge of the panel, enabling a dial to be fitted so that it almost touches the panel face.

When the crystal detector is being assembled on the panel, the two fixing-screws-cum-terminals are best

The completed set ready for use.

mounted with the terminal heads at the back to facilitate connections. The back-of-panel photographs will make this point quite clear.

The dial indicator is simply a matter of taste, many people preferring a transfer arrow. Either is satisfactory if fitted accurately, and whereas a transfer if wrongly placed is easily renewable, a slip when fitting the dial indicator means permanent disfigurement of the panel. If it is placed well on the centre line, there is nothing to worry about, as if it happens to turn a little out of truth, this may be put right without any trouble.

Making the Coil

As with other items, individual taste is responsible for the type of indicator employed, and as there are a number of different types available, no provision is made on the diagram for this fitting. If it is mounted dead on the centre line, it is not essential that it should be absolutely on top of the dial, as the tuning is not likely to be so sharp that hairbreadth settings are required.

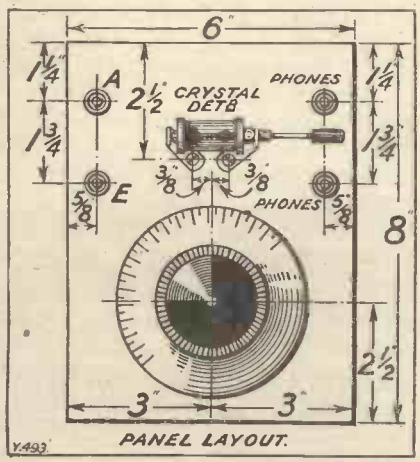
The next item to occupy attention is the construction of the coil. This is wound on a $3\frac{1}{2}$-in. Paxolin or Pirtoid former with 22 S.W.G. D.C.C. wire, and is in two sections.

The first to be wound is the secondary, which consists of 60 turns, tapped at the 35th, 40th, and 45th turns. The primary is wound over the secondary, and supported on six pieces of wood $\frac{1}{4}$ in. in diameter, which can be cut from the sticks included in Glazite packets to act as a stiffener. These pieces should be about $1\frac{1}{4}$ in. long, to allow for binding while the coil is being wound. This is likely to be a slightly tricky job, and needs some little patience, as very often the sticks slip as soon as the winding is commenced. To reduce this tendency, two or three rubber bands should be used at either end to hold them in position while a length of Glazite or similar heavy wire is looped round and tightened up by twisting the ends together by means of a pair of pliers.

The Primary Winding

When the supports are all firmly gripped the surplus ends of heavy wire may be cut off, as if left to hang about they are likely to foul something and be pulled off the edge, necessitating the repetition of the fixing operation.

The primary winding consists of 25 turns, tapped at the 15th, 20th, and 25th turns; or, to be more explicit, the end of the winding is not permanently connected to any part of the circuit, but is finished in such a manner that it may be brought into circuit by means of the tapping

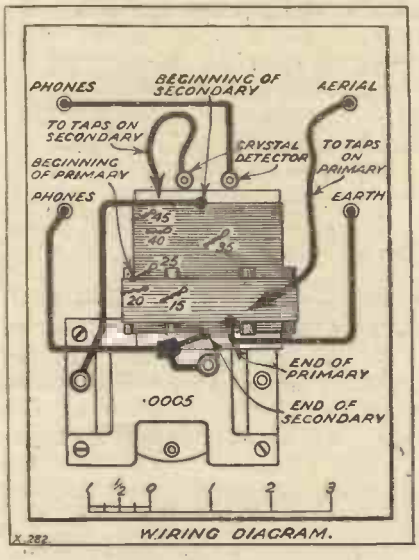


clip connected to the aerial terminal. When winding, a good tension must be maintained if the finished coil is to be efficient and good to look at.

Inadequate tension will mean that the wire may slack off when the ends are secured, and the coil will

THE "DUO-COIL" CRYSTAL SET—*continued*

be floppy and unevenly spaced, which naturally detracts from its efficiency.



Making the tapping points calls for care and patience, as the tension has still to be maintained while the wire is being twisted. Twist the loop so that the spiral which appears is close in formation, otherwise when the winding is continued the loop may untwist under the strain imposed on it.

The Wiring

When the coil is completed, a hole should be made near the edge of the former sufficiently large to take the terminal shaft of the variable condenser, the shaft inserted in the hole, the end of the secondary winding brought down and twisted round, and the terminal head screwed down firmly over all.

POINT-TO-POINT CONNECTIONS.

Aerial terminal via flex lead to tapping clip. Earth terminal to lower end of primary winding. Moving plates of condenser to lower end of secondary winding and to lower 'phone terminal. Upper 'phone terminal to one side of crystal detector. Other side of detector via flex lead to tapping clip. Upper end of secondary winding to fixed vanes of condenser.

The remainder of the wiring can be easily followed from the wiring diagram on this page, and from the several photographs.

There are only four stiff wire leads in the set, and two flex leads to which are attached the two "crocodile" clips for the aerial and crystal detector tappings respectively.

When the set has been wired and the wiring checked, connect up to the aerial and earth, with a pair of 'phones joined to the appropriate terminals. Tune in the local station, and try the effect of the three aerial tappings on the primary coil. After finding the best, repeat the process with the crystal detector tappings, and when the position has been found which gives the greatest signal strength try the aerial tapping again.

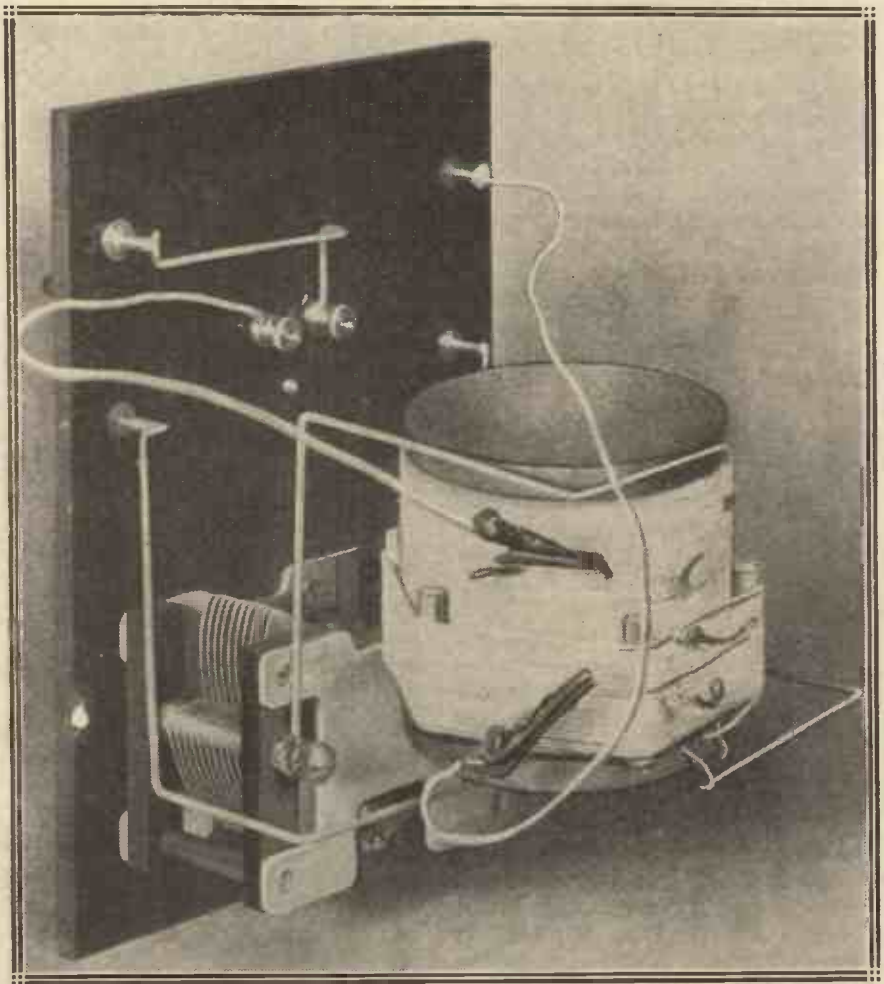
Tuning In 5GB

Alteration of the position of this clip will probably cause a slight alteration of the tuning, and the condenser dial should be moved slowly to ascertain if this is so. When the best positions have been found for both clips, the set will need no further attention except for adjustment of the crystal detector itself, and if within listening distance of 5GB he should be tuned in about 60 degrees farther round the condenser dial.

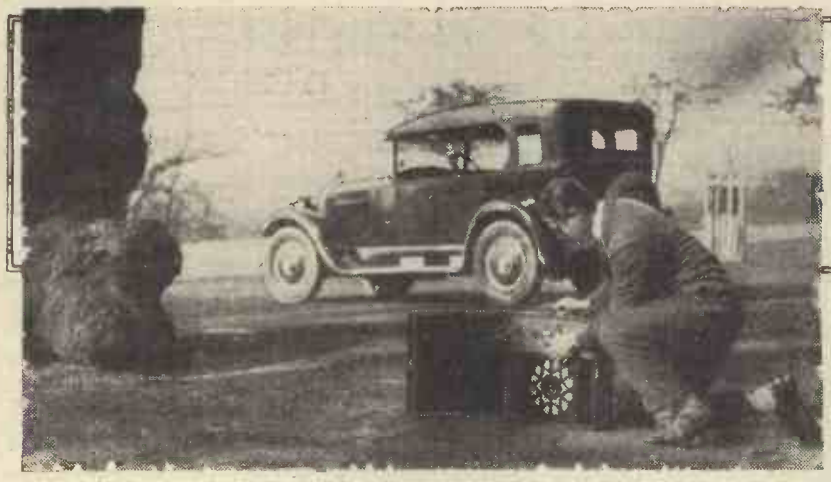
AN INDICATION OF OSCILLATION

VERY few people who have a milliammeter which will satisfactorily read between 0 and 10 milliamperes realise that it can provide a very interesting and certain indication of oscillation. One cannot be too certain that a set is not oscillating, because apart from the question of upsetting the reception of others, oscillation will cause distortion.

The meter is connected in the plate circuit of the detector valve, somewhere between the plate and the H.T. + lead. It must not, however, be in a common H.T. + lead. With detectors using a grid leak and condenser, as soon as the set bursts into oscillation, or gradually builds up towards oscillation, so the needle of the milliammeter will jerk to a lower reading or gradually fall, as the case may be.



There are three things on this page to help you with the wiring, viz., this photo, the wiring diagram, and the point-to-point check list. With all these your certain success in building the set should follow as a matter of course.



MORE ABOUT THE "ROADSIDE" FOUR

Some useful operating notes are given, and some interesting experiments are described.

By The EDITOR.

VERY considerable interest has been aroused by the "Roadside Four," a description of which appeared in our last issue, and a number of readers have asked whether it is possible to use it at home in conjunction with an outdoor aerial, reserving the frame for "portable" use. There are several ways in which this can be done, but perhaps the most generally effective is to proceed as follows:

Take an ordinary standard 6-pin base and screw it to the inside of the lid which carries the frame aerial. Place the base in the upper right-hand side, so that it will come fairly near to the three sockets into which the leads from the frame are plugged. Obtain a 6-pin "Magnetic Reaction Transformer" (Lewcos type M.R.T.), plug it in, and make the connections from the 6-pin base as follow: Join terminals 6 and 1 and take a lead from these to a Clix plug, and insert this plug in the top socket nearest the hinge. Connect aerial to 5 and earth to 3.

Loose-Coupled Aerial

Take a lead from 2 and terminate this in a plug and insert it in the upper right-hand socket. Take another lead from terminal 4, fit a plug to it, and insert this plug in the bottom socket on the panel. The set can now be tuned and operated in the same way as if the frame were in use.

Note particularly that it is a special "magnetic reaction transformer" and *not* a standard Reinartz transformer or Reinartz aerial coil. Also note that the connections just given are different from those published by the London Electric Wire Co., Ltd., in their catalogue. This is not to say that the Lewcos catalogue is wrong, it is simply that I am using a different arrangement from theirs, suited to this particular set. It is not possible to use the ordinary standard Reinartz transformer with this set, owing to the fact that the reaction condenser is not large enough to give the necessary effect with the windings on the standard Reinartz transformer.

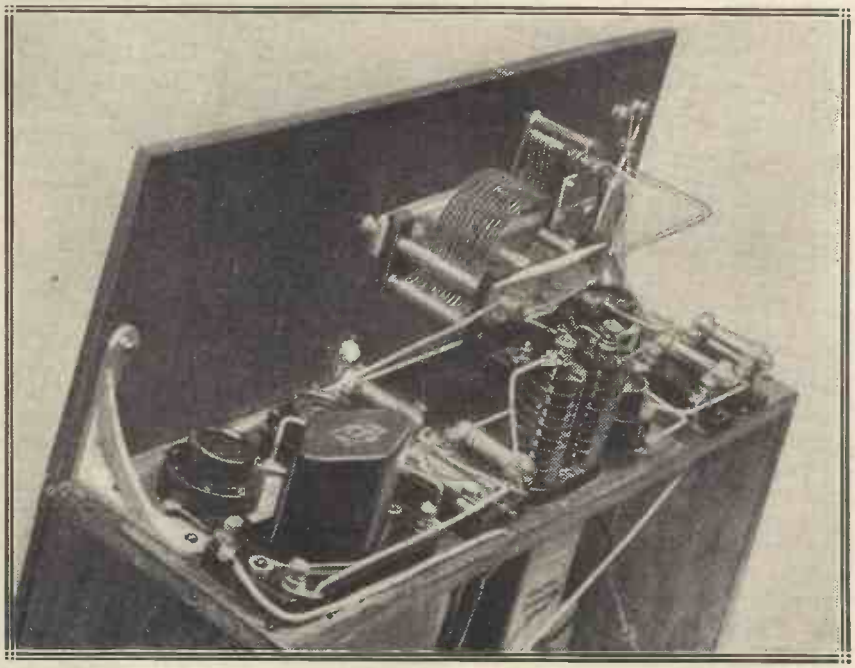
If, when using the transformer, it is found that the set cannot be brought up to the oscillation point when the reaction condenser is "full on," substitute a quarter-megohm anode resistance for the half-megohm in the set. Either the ordinary broadcast-band coil or the 5 X X range coil can be used, but, of course, the selectivity with this arrangement will not be so high as when the frame is used.

Another arrangement which the experimenter may care to try is to leave the ordinary frame connected and to wind a small coil of about five turns on a block of wood or a small interior frame with about 6-in. or 8-in. sides, placed centrally in the inside of the lid. The aerial should be connected to one end of this coil and the earth to the other. The frame aerial will now act as the secondary of a high-frequency transformer, the primary of which is the small new frame to which I have just referred.

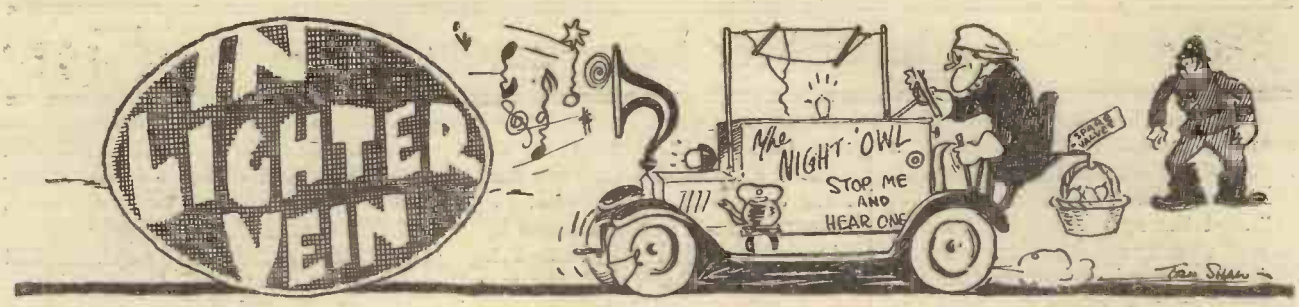
Another Method

The experimentally inclined may also try making a few additional tappings on the frame aerial, such as a tapping at two turns, three turns and four turns respectively, joining the aerial to one of these tappings (best found by trial) and the earth to the top left-hand socket in addition to the lead that goes to that socket. The tappings should be

(*Continued on page* 140.)



This is a view of the "Roadside" Four which shows the L.F. end very clearly. Note the L.F. transformer in the foreground.



"AND what," asked Professor Goop, "is the main objection to portable sets?"

This was rather a facer. The first thing that occurred to me was that you could not buy them at Woolworth's, but I did not feel somehow that this was the answer that the professor was looking for. Then there is, of course, the fact that so few of them incorporate Rice-Kellogg loud speakers. But I felt somehow that this could not be the reply that he wanted, and as there was a nasty war-like glint in his eye and he happened to be toying at the moment with a sash-weight, I thought that

. . . The professor hit my corn on the bull's-eye.

perhaps I had better give it up. It generally saves a lot of time and quite an amount of trouble to do so when you are asked conundrums.

"Leave it to you, partner," I murmured.

"The real bother," cooed Professor Goop, "is that the portable set requires, if I may so put it, to be ported. I have always had an idea that they were designed by a race of supermen, great hulking giants who could pick up a grand piano and think nothing about it."

"Yes, yes," I cried, leaping to my feet.

Cure for Corns

At this moment the professor dropped the sash-weight, and for some moments I talked rapidly in asterisks, daggers, curlywigs, exclamation marks, and things like that.

"I was about to say," I remarked, when I was myself once more, "that you had hit the nail on the head. Instead, however, you have hit the corn right in the bull's-eye."

"Stop!" said the professor, holding up his hand. "It is an insult to my reputation as an inventor for any friend of mine to have corns. They are caused, as you know, by pressure. To cure them all that one has to do is to relieve that pressure. This can be accomplished in the easiest possible way by walking upon the hands for a fortnight or so, and giving the feet a thorough rest. Walking on the hands is perfectly simple. All that you have to do is this."

Professor Goop leaned forward, stretched out his arms and did a kind of nose-dive towards the hearthrug. This skidded upon the polished boards beneath, and after some complicated convolutions he arrived sitting in the fireplace, in which the fire was unfortunately blazing merrily. It took me quite a little time to extract him, and when I had done so he seemed to have suffered a little. Anyhow, when he sat down again he leaped suddenly to his feet with an agonised yell. "The pain," I said, "is due entirely to pressure. The best way of relieving the pressure, if I may make a suggestion, is to sit face downwards for a week or two."

Problem Re Portables

The professor was too upset to continue, that evening, his discussion about portable sets, and when I left him he was busily engaged in designing a special face-downwards chair for the use of those who have been unfortunate enough to sit upon the fire.

At our next meeting he returned at once to the subject of portables.

"So far as they've gone," he said, "the designers of these things are entirely wrong. They make their sets chiefly with a view to their being carried into motor cars, taken by motor cars from place to place and then taken out of motor cars to produce music in the wilds. Of course, while they are in the car all is well, except that the passengers in the back seats have to hang their feet over the sides in order to have really ample leg-room. It is the carrying of the set to the car and the carrying of the set from the car that cause the trouble."

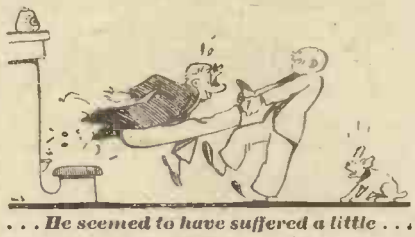
"Then what," I queried, "have *you* in view for the coming season of hail, rain, floods, gales, blizzards, cyclones, typhoons, and so on that the calendar indicates as summer?"

A Scientific Solution

"My idea," said the professor, "is that it is entirely wrong for the man to transport the set. What is really wanted is a set that will transport the man. To meet the enormous demand for something of the kind I have designed my 'Night Owl' Super-twiddler, which will be seen everywhere this season."

"And what," I asked, "is the big idea?" Long-standing devotion to my short-wave set has educated me up to the use at times of the English pure and undefiled that is spoken upon the far side of the Atlantic.

"Instead," went on the professor, "of making the set to fit into the car, or of building it into the car, I propose to build the car into the set. A moment's thought will show you how many extraordinarily attractive points this scheme presents. There is nothing to be carried about; no undignified labour to be done. The car is provided with a self-starter, whilst the wireless part of it has a self-stopper which comes automatically into operation as soon as a topical talker gets to work. The thing is also perfectly self-contained. The



. . . He seemed to have suffered a little . . .

usual dynamo charges up an accumulator which illuminates the side, head and tail lights, or heats the filaments of the valves as may be required."

"But how about high-tension?" I queried.

"Easy as π," exclaimed the professor. "In order to make the

In Lighter Vein—*continued*

sparking plugs spark we have a magneto, do we not?"

I agreed that we did.

"And the magneto generates current at a pretty considerable voltage?"

Again I agreed, having only the day before had the misfortune to make unintentional contact with my fingers with a sparking plug when the engine was running.

"And there you are," said the professor. "I simply arrange a battery eliminator which can be thrown into circuit with the magneto, and the high-tension problem solves itself."

I asked what the general lines of the "Night Owl" were likely to be.

A Nice "Brick"

"I was much impressed last summer," said the professor, "by certain neat little vehicles that I observed in the streets of Mudbury Wallow. Driven by attractively uniformed youngsters, they bore the legend 'Stop me and buy one.' Though I had longed to do so, I was always too nervous to stop one in order to see what he had for sale. One day, however, I happened to tread on a banana skin, with the result that I arrived upon the road immediately in the path of one of these vehicles. Such was the force of the impact that the driver dived into the receptacle in front of him and emerged covered with some yellowish-white substance. As soon as he had removed the traces, and had more or less regained his normal composure, I inquired what he had that I might buy. 'You can 'ave a nice brick

. . . I happened to tread on a banana skin . . .

for tuppence, guv'nor,' he told me. As a nice brick was exactly what I wanted at the moment, I purchased one and flung it at him. Unluckily this particular bullet missed its billet, but found a resting place upon the countenance of Police-constable Muddlewump, who had hurried up to the scene of the tragedy with his notebook. It was perhaps fortunate for me that Muddlewump is short-sighted and thought that the lad had flung the brick. At any rate, he was so very definite in his evidence before the court that I felt that I must certainly have been mistaken myself. As I have said, those little vehicles impressed me very favourably, and I have decided to make a popular model of my 'Night Owl' upon somewhat similar lines."

The "Night Owl"

"Tell me more," I breathed' "your tale interests me strangely."

"The 'Night Owl,'" continued the professor, "will have a box body, which will also serve as a body box, in case chickens, pigs, cows, or other *fauna* of the farmyard are inadvertently run over. In front of this will appear the mouth of the loud-speaker horn, whilst above its top the aerial will be suspended. The driver will sit in a comfortable seat astern and in front of him will be the simple controls necessary for operating the outfit."

I inquired what these would be.

He told me that he proposed that the clutch, one brake, the exhilarator, and the reaction coupling should be controlled by pedals. There would be two gear levers. The first of these would be responsible for the three forward speeds and reverse needed by the car part; the second would be a rather complicated arrangement, converting the set to a long, medium, or short-wave receiver, or a picker-up of gramophone records, according to its position.

* * * *

The Trial Run

A fortnight later I received a telephone message from the professor to the effect that the experimental model was ready. Would I come for a trial run? Since my daily paper insures me against everything from housemaid's knee to undertaker's jam, I decided that I would. Though the professor's steering is slightly erratic, we got along quite well for five miles or so until we arrived at what he described as a sylvan glade. The time had now arrived, he told me, to test out the receiving part of the vehicle. Fearing the worst, but hoping for the best, I agreed. Placing his driving gears in neutral, the professor fiddled with the other gear-lever and, after a masterly display of double-clutching, brought in 2 L O. "The subject of my talk this afternoon," remarked a wearying voice, "is Tripe."

"Here, here!" I cried. "But let us see what 5 G B is doing."

. . . The professor must have pushed the wrong knob . . .

The professor did all sorts of funny things with his feet and hands. He must, I think, have pushed the wrong knob, for when we came to ourselves again we found that we were lying amidst quite a collection of scrap metal at the foot of the trunk of a large and hefty tree. The world seemed then a cold, grey place. With great foresight, however, I had brought my largest flask along, and in a few moments we agreed that, despite the old proverb, one swallow, if it is big enough, emphatically does help to make a summer.

A RECTIFIER TIP

MANY who do their own charging from A.C. mains use the ever-popular vibratory rectifier, or else the type in which a synchronous motor drives a two-piece commutator.

One disadvantage of this type of rectifier is that it tends to spark badly, with consequent pitting of the contacts, as the back E.M.F. rises, i.e. when the charge is complete.

To overcome this difficulty, connect a Mansbridge condenser of large capacity across the contacts.

This condenser can conveniently be made up of the 5-mfd. condensers to be obtained very cheaply from ex-Army disposals dealers. A condenser of 4–6 mfds. will effectively cure sparking and lengthen the life of the contacts and collecting brushes considerably.

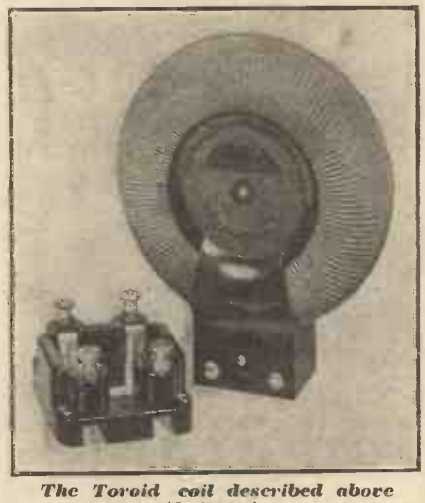
This method also reduces interference from generating sets, due to sparking at the brushes.

An Ingenious Toroid Coil

MESSRS. DUBILIER, LTD., are now marketing a very interesting Toroid coil (illustrated herewith), the field of which is so restricted that no appreciable interaction effect between a pair of these coils can be traced at the shortest distance that such coils are likely to be placed in an ordinary receiver. The high-frequency resistance of these coils is very much lower than that of many so-called fieldless coils, and mechanically they are particularly well made.

A special base is provided so that the coils can be rapidly interchanged when it is desired to go from one wave-band to another, and the mounting is such that the wires of the coil need not be touched at any time during the interchange process. The structure of the base is such that the losses in this portion of the circuit have been cut down to a minimum, and a good contact between the four points of the coil (two primary and two secondary leads) is assured by the construction of both the coil contacts and those on the base.

Both terminals and soldering lugs are provided and the coil is obtainable both in the ordinary 200–600-metre band and for the 5 X X range. The coil submitted to us was an ordinary high-frequency transformer, but we understand a centre-tap coil for neutralising circuits can also be obtained. These coils are very well made and can be recommended to all experimenters who are building apparatus in which the restriction of the magnetic field of the coil is of importance.



The Toroid coil described above (Dubilier).

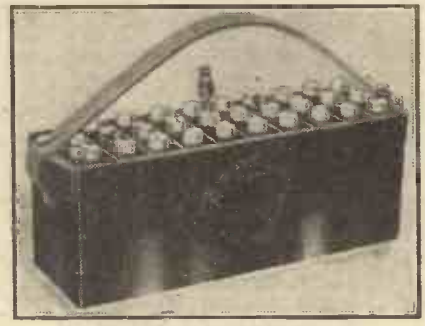
A MONTHLY REVIEW OF TESTED APPARATUS

(NOTE: All apparatus reviewed in this section each month has been tested in the Editor's private laboratory, under his own personal supervision.)

Interesting High-Tension Accumulator

From Messrs. C. A. Vandervell and Co., Ltd., we have received two examples of their new H.M.6 high-tension accumulator, the container of which is moulded in one piece and the general appearance of which can be gathered from the accompanying photograph. This particular form of moulding the container enables the bulk of the battery to be kept small while giving a reasonably large capacity to the cells. Each unit has 60 volts with tappings at every 10 volts, and a rated capacity of 3,000 milliampere hours.

To check this the battery was put on continuous discharge (after it had been charged and discharged once or twice to make sure that all plates were fully active) and the actual capacity found was very close to the figure named by the makers. The general appearance of this high-tension accumulator is neat and workmanlike.



This is the type H.M.6 C.A.V. accumulator.

Adequate gas vents and filling holes are provided so that the topping up which is required from time to time with every accumulator can be carried out quite easily. Strong carrying straps are provided, and as an inexpensive high-tension accumulator of reasonable capacity this H.M.6 type should prove very popular.

A Compact Double Choke

A compact and convenient double choke for mains units, loud-speaker filters, and other such purposes where a choke of medium inductance is required, has been submitted for test by the Igranic Electric Co., Ltd., of Bedford, and is illustrated herewith.

The Igranic double choke is wound in two sections that may be connected in series or in parallel.

The choke is wound in two sections, which may be connected either in series or in parallel. The effective inductance values of the choke, with the two sections in series, are claimed by the makers to vary between 73 henries with an anode current of 1 milliampere to 27 henries with a

What's New—*continued*

current of 20 milliamperes, while the corresponding figures for the two sections in parallel are 21 and 10 respectively.

This is a much better and more sensible way of stating the value of a choke than claiming "20 henries" without stating the current flowing when this measurement is made. Substantial terminals and soldering lugs are provided, so that series or parallel connections can be easily made. The choke should be useful to the home constructor who is building for himself a mains unit for supplying current up to about 20 milliamperes, for which purposes it can be recommended.

For use as an output filter the two sections should be connected in parallel. The inductance when used in this manner is a little lower than

This condenser can be recommended for all neutralised circuits, and particularly for those circuits such as the "Business Man's Four," where a condenser with fine adjustment and very low minimum is needed. The price is 5s. 6d.

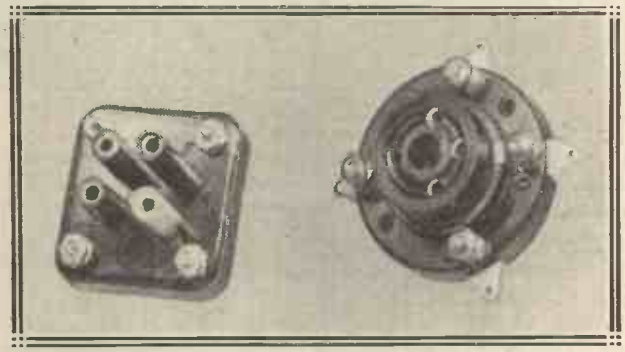
we prefer for a super-power valve, but the D.C. resistance is good, being only 240 ohms with the sections in parallel, so that there is very little voltage drop in the choke itself when a super-power valve is used.

A Neutralising Condenser

Messrs. Gambrell Bros., Ltd., have submitted for test their latest model of Neutrovernier condenser which has a number of features which will commend themselves to the discriminating experimenter. Many modern circuits require very accurate adjustment of neutralisation, and in such cases it is a distinct advantage to have an adjustable condenser which not only has a wide range of capacity, but also requires a number of complete revolutions of the knob to pass from minimum to maximum.

The Neutrovernier condenser admirably fulfils these requirements as six complete revolutions of the knob are required to pass from minimum to maximum. The makers claim that the capacity is approximately 2 to approximately 38 m.mfds. This was checked in the laboratory and found to be 2 to 36—a very close conformity to the stated rating.

Definite stops are provided for the maximum and minimum positions, the condenser is dust- and damp-proof, and it is impossible to short-circuit the two electrodes. Either one-hole-fixing panel mounting or baseboard mounting by screws through an insulating base can be used, or if desired a special small bracket can be obtained for mounting the condenser at the back of the panel.



To the left is shown the rigid valve holders for use where microphonic troubles are not likely to arise.

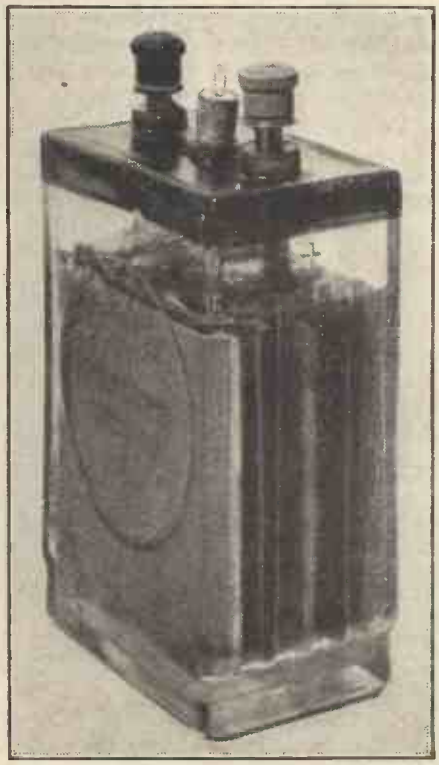
Two Good Valve Holders

From Messrs. Eric J. Lever we have received two valve holders, the Trix "red-leg" rigid valve holder and the Trix anti-microphonic valve holder, the former being, as its name implies, a plain holder for those purposes where the anti-ponging feature of the other type is not required. The anti-microphonic holder is somewhat smaller than usual in this type of holder—by no means a disadvantage—and supports the valve in a satisfactory springy manner.

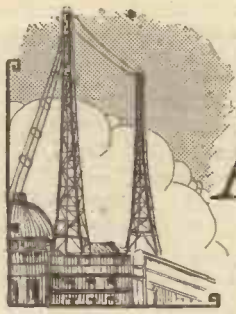
Mechanically both holders are well made, the rigid holder being so arranged that the metal portions of the socket are sunk below the insulating sleeve, thus preventing accidental burning out of the filament through contact with the wrong sockets. The terminals on the rigid holder might be bigger with advantage, but as the holder is inexpensive one must not expect too much. The anti-microphonic holder has both terminals and soldering lugs, while it has the commendable feature that the springs are soldered to the sockets, thus making perfectly sound contact.

A certain amount of solid material has been cut away from the centre of the anti-microphonic holder, and both holders when submitted to high-frequency tests were found to come well up to the standard set for such devices, being superior in this regard to many more expensive types.

(*Continued on page* 144.)



The "Lo-Ten" accumulator (Ediswan) is of British make throughout.



HAPPENINGS AT SAVOY HILL

By OUR SPECIAL COMMISSIONER

A New Muzzle at Savoy Hill

HAVING been unmuzzled on controversy, the B.B.C. appears to have set about finding a new form of muzzle for itself. From about the time of the Prime Minister's announcement in the House of Commons, the publicity spokesmen of the B.B.C. have told the Press practically nothing. There has been a general subsidence of B.B.C. news, and the alleged "Information" Department at Savoy Hill sits tight. No longer is there the ready response to intelligent and friendly questions about B.B.C. work.

Several old hands at the Press game have told me that in their opinion the Governors of the B.B.C. have probably given instructions for B.B.C. publicity to be handled after the model of Post Office publicity. This means that nothing is ever said on any subject of interest to anyone. If this is the new position, the result will soon be reflected in the licence revenue. Consistent and vigorous publicity has been an essential factor in the past success of the B.B.C.

Captain Eckersley's Hour Talks

The bold experiment of allowing Captain Eckersley to hold forth on 5 G B for an hour had an interesting sequel in the consequent correspondence. I understand that 2,349 letters were received within three days of his first long talk. An analysis of opinions expressed in these letters shows that just over 1,600 approved both the experiment and Captain Eckersley, thereby refuting the suggestion made to me at Savoy Hill itself that the Chief Engineer no longer possesses a personal following throughout the country.

The idea of a talk as long as an hour by the average talker was not taken favourably by corresponding listeners. There was definite evidence of keen demand for regular technical talks, not of the amateurish sort, but serious contributions to the science of radio.

Wanted—Fresh Nightingale Venue

The migration of motorists and sightseers to the Oxted woods to be present when Miss Beatrice Harrison did her annual nightingale-charming act has become so considerable and irritating that the B.B.C. is searching for a new area from which to convey the entrancing sounds of this elusive bird. As soon as the new venue is discovered, arrangements will be put in hand, but the B.B.C. will try to keep the location a secret. It will be interesting to see how the Savoy Hill engineers will manage so to camouflage their transport as to avoid detection.

A Brighter Radio Sabbath

Marvellous to relate, the B.B.C. at long last has been impressed by the growing public demand for brighter programmes on Sundays. The previous assumption that to cater for the "nonconformist conscience" alone was good business is now being modified under a mass of new evidence that the bulk of active listeners are not practising members of any religious communion and are heartily tired of being forced to take religion or nothing for their Sunday radio fare.

The first concession to moderation and common sense was the introduction of music during the hour 5.30 to 6.30. But a series of "uplifting" Bach recitals was hardly what was wanted. Now I understand that the Bach enthusiasts have suffered a reverse, and that we may have some really palatably pleasant music instead.

There is hope also during the time church services are going out some stations will radiate alternative programmes of music or literature. The humanising of the British wireless Sunday is long overdue. These are small but significant beginnings.

Sir Oliver Lodge at Stoke-on-Trent, where he recently received the Freedom of the City.

Happenings at Savoy Hill—*continued*

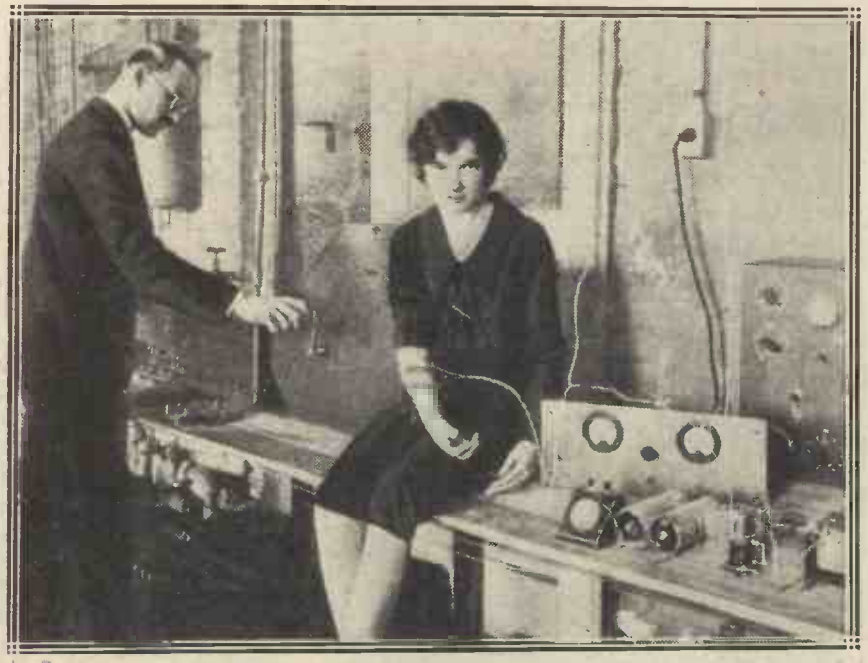
Less Internationalism

The protests and warnings of the WIRELESS CONSTRUCTOR about dangerous internationalist tendencies at Savoy Hill have had some beneficial results. I hear that the subject was raised at a Board meeting where it was laid down that the B.B.C. was to revert to a healthy robust national and imperialist policy more on the lines of the Italian broadcasters.

It is not known yet whether the Governors will tolerate continued membership of the Geneva Union.

Jack Payne's Success

Jack Payne is already accepted as one of the best regular broadcasters. His new band, known as the B.B.C. Dance Orchestra, is far and away the



A novel American broadcast was tried recently when the "noise" of the nerve current of a human being was broadcast.

Their decision on this will probably be taken for them by the Foreign Office which always looks askance at amateur competitors in the diplomatic field.

Savoy Hill Salaries

The refusal of the B.B.C. to give a salaries list to Parliament is having an unfortunate effect in the Lobby. It is argued that the staff of the B.B.C. are now virtually civil servants, all of whose salaries are published in "Papers." Moreover the keen opposition to publication gives rise to the suspicion in some quarters that there is a grave public scandal hidden in the B.B.C. salaries list. This suspicion casts an altogether undeserved cloud over Savoy Hill.

I know for a fact that the salaries are on the average much lower than either in business or in the service of the State. The only scandal that exists is in the niggardliness of the average reward received by the British broadcasters. The Governors receive the most generous rewards in relation to what they do.

best thing "on the air" in this type of entertainment. It is to be hoped that the B.B.C. will really take the lesson to heart. When it does discover the right man in any line, let it grapple him and give him enough to live on, thus relieving him of the necessity of worrying about alternative sources of revenue.

Strengthening the Board

The proposal to add to the Governors of the B.B.C. has come up again. There is no doubt a strong case for it. The present Governors are as follow: Lord Clarendon (Chairman, £3,000 a year), Lord Gainford (Vice-Chairman, £1,500 a year), Sir Gordon Nairne, Dr. Rendall, and Mrs. Philip Snowden (£700 a year each).

The Government has always regarded this as a "safe" Board, likely to be more concerned to follow a middle course than to take risks in the interests of art or of anything else. Then, again, the propagation of extremist views, at least those of the "left," is not likely to be encouraged by this group. As long as the Governors concerned themselves only with larger aspects of policy, and left the conduct of the service to Sir John Reith and his competent staff, there was little need of change. But when the Governors began to assume detailed as well as general responsibility, such as, for instance, reading manuscripts to check the judgment of the staff, they laid themselves open to justifiable examination of their qualifications for the executive side of entertainment.

"Pre-War"

Nor have they emerged too well from this examination. There is no one among them who has been even remotely associated with entertainment of any kind. Then, again, they are all "oldish," with pre-war conceptions and standards reminiscent of Methuselah. If they are going to continue to take an active detailed executive part in the broadcasting business, then out of self-protection they should seek forthwith to add to their numbers.

Seven Members

According to the Charter, the Board may have seven members. The most obvious and best qualified addition is Captain Ian Fraser, M.P. The other new member should be Mr. C. B. Cochran. The B.B.C. will never be able to attract Mr. Cochran for an executive job, but he should be persuaded to attend Board meetings now and then just to stir up the Governors to a sense of their responsibility for the lighter side of entertainment.

So there is the solution of the B.B.C. Board difficulty. Lord Gainford would follow on Lord Clarendon as chairman, and he in turn would hand over to Captain Fraser.

Mr. Filson Young's Future

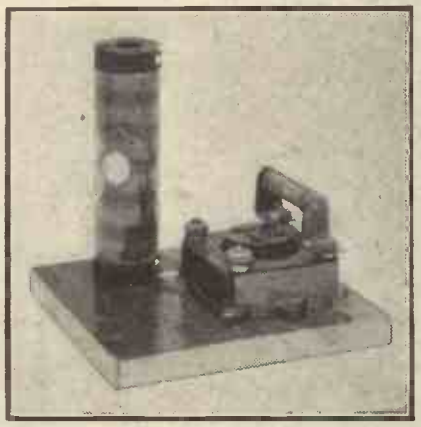
It is rumoured persistently and with the appearance of some substance that Mr. Filson Young is shortly taking over the Programme Department of the B.B.C., vice Captain Eckersley's brother, retiring.

"WIRE-LESS" CONNECTIONS

In many places it is possible to dispense with wires for connecting up components, and this means much greater reliability and efficiency. Novel methods of doing it are explained by the author.

By A. V. D. HORT, B.A.

SHORT connections are always an advantage in a receiver, and any arrangement of components which assists in this direction is commendable. Sometimes it is possible to couple two components directly



Showing a grid leak with clips mounted on the valve holder and an H.F. choke with its bottom tag soldered to the anode tag of the holder.

together so that no wire connections are needed at all.

Every extra joint in the receiver means one more chance of a fault. If you are not an expert with the soldering iron, a reduction in the number of soldered joints to be made will be especially welcome to you.

Obviously you will be asking for trouble if you crowd all the components into too small a space with the laudable intention of keeping the connections short. This way of going to work is rarely appreciated by the different stages of either H.F. or L.F. circuits, and they usually express their disapproval in no uncertain voice when the moment for testing the receiver arrives.

Useful Groupings

There are, however, some parts of the receiver in which crowding does not matter, and, in fact, is all to the good. This applies mainly to small components. Here are a few groupings which you may find useful. The photographs will help you to explain them.

Grid Leak and Valve Holder.—Fit the grid-leak clips under the terminal heads on the valve holder. One clip goes on the grid terminal, and the other on either L.T. plus or L.T. minus, whichever you want. You can make the clips out of two 1-in. long strips of thin, springy brass. Drill a hole at each end of the strip, one hole for the terminal shank and one for the point of the grid leak. This makes the shortest possible connection for the leak between grid and filament.

Grid Condenser and Valve Holder.—This grouping is possible with a fair range of components of different makes. One tag of the condenser is soldered direct to the fixed soldering tag on the grid terminal of the valve holder. If you do this, tin both of the tags first, when a touch with the hot iron will unite them. Alternatively, you can drill a hole in the condenser tag if it is broad enough, so that it will fit on to the terminal of the valve holder.

Soldering Tags Together

Filament Resistor and Valve Holder.—This is applicable mainly to components which have soldering tags close to the baseboard. A resistor of the vertical tubular pattern is shown in the photograph. The tag on its mount is soldered direct to the tag on the appropriate valve-holder terminal.

By-pass Condensers. — Condensers used in shunt with other components, to by-pass H.F. currents, lend themselves particularly well to direct connection. For instance, if you arrange your telephone terminals the correct distance apart, you will be able to solder the tags of the by-pass condenser direct to the shanks of the terminals. This leaves the terminals of the condenser free for securing the connecting leads to the rest of the receiver. If you prefer, you can, of course, put on another pair of tags and solder the leads to these.

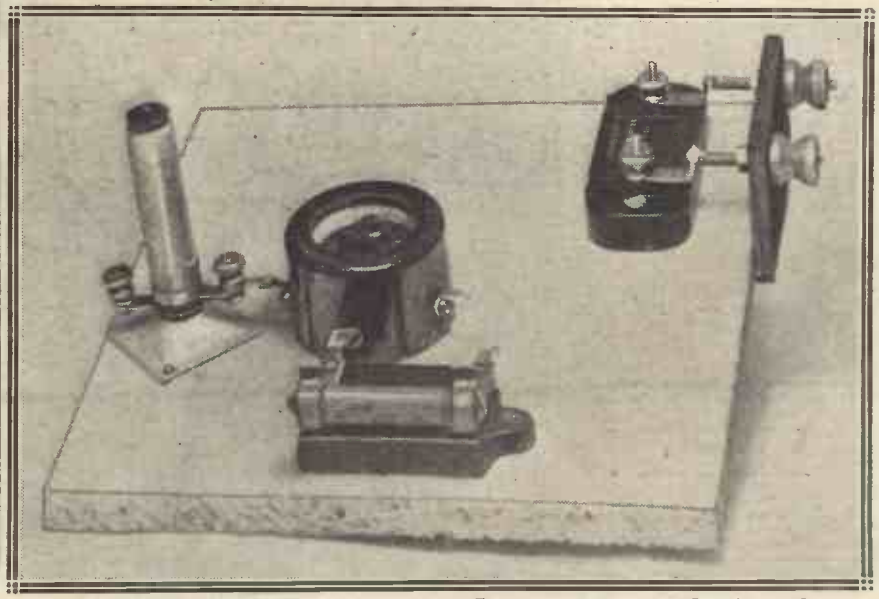
Other Arrangements Possible

Fixing a by-pass condenser close to an L.F. transformer is a bit more tricky. Even so, it is usually simpler than making up and attaching very short connecting wires. If the terminals are suitably spaced you will find it best to solder together the tags on the transformer and condenser terminals. Make sure that they overlap when you solder them. Do not try to make "end-to-end" soldered joints with such thin metal as soldering tags.

If you have a clip-in condenser, fix the clips on the terminals of the transformer.

Enough suggestions have been put forward to indicate the possibilities of this method of grouping components.

No doubt other similar arrangements will occur to you when you are building your next receiver.



Two "direct" connections without wires. Left, a resistance and grid condenser and grid leak soldered direct to valve-holder tags. Right, a telephone shunt condenser with tags soldered to terminal shanks, leaving the condenser terminals free for leads.

Controlling Your Set from the Garden

This article gives full details for the construction of a cheap and useful unit for switching on the set from a distance.

THE best method is to employ a relay which will make and break the L.T. supply close to the set, thus occasioning no drop in voltage. The relay described in this article does this, and has the double advantage of requiring only a double flex connection from the set to the switch, and but a momentary current to actuate the relay.

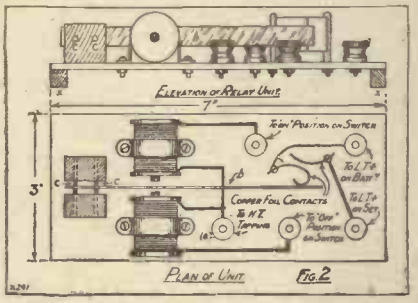


FIG. 2.

As will be seen in Fig. 1, the positive loud-speaker lead is utilised, while a tapping from the H.T. battery is made at the required voltage to work the relay, the double flex leads being used to magnetise each bobbin alternately, and thus complete or break the L.T. circuit at will. A 6-volt dry battery could be used instead of the H.T. battery if the constructor desires, when one terminal of this battery would be connected to the H.T. positive.

Constructional Details

The components required are: 1 piece of ebonite 7 in. by 3 in. by ¼ in., two strips of wood for back of ebonite 3 in. by ¾ in. by ¾ in., 2 electric bell bobbins, 5 terminals, 2 valve legs, 1 piece of clock spring (straightened) 6 in. by ½ in., 2 small pieces of copper foil, 1 piece of wood shaped as in Fig. 4, 2 strips of brass for bobbin clips 3 in. by ½ in., 4 small B.A. bolts and nuts for fixing bobbin clips to panel.

The construction of the relay unit is quite simple, and can be easily followed from the sketches, in which it will be seen that the two bobbins are separated from the connecting pole-piece, care being taken that the two windings are still joined together and connected to the terminal marked "a" in Fig. 2, the two free ends being connected to the "On" and "Off" terminals respectively.

How the Control Works

The steel arm marked "b" is suspended from the block of wood, Fig. 4, by having two small holes drilled through at one end, corresponding with the two small holes in the block as at "c," Fig. 2, through which two small round nails are inserted, the holes in the steel being large enough to allow free lateral movement. It will then be seen that when the arm is attracted to the "On" position, one piece of copper foil is pushed against the second piece, thus completing the L.T. + circuit, and when the other bobbin is magnetised the arm moves sideways, releasing the pressure on the first piece of foil which springs away from the second piece. The use of the

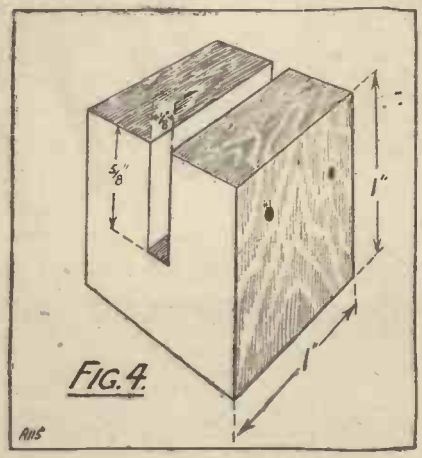
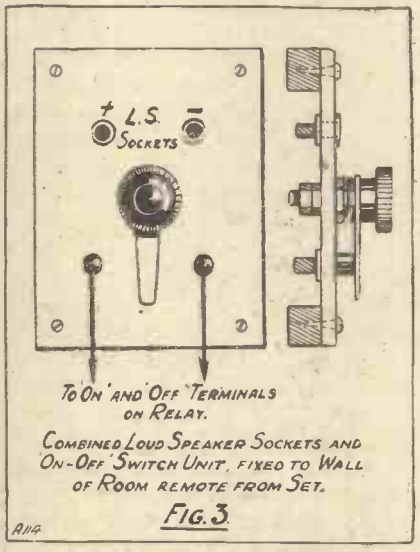


FIG. 4.

two valve legs has been found helpful, as the length and pressure of each piece of foil can be easily adjusted. The ebonite panel can then be mounted on two strips of wood, as at "X" in Fig. 2, to allow for the ends of the terminals projecting through.

The whole of the relay unit will fit comfortably into a cigar-box, and will stand close between the receiving set and the accumulator, small holes being bored in the side of the box to allow the leads to pass through. Any number of rooms can be linked up, the one relay unit only being necessary, but, of course, double flex leads are necessary for each room, and can all be joined to terminals marked "On" and "Off."



COMBINED LOUD SPEAKER SOCKETS AND ON-OFF SWITCH UNIT, FIXED TO WALL OF ROOM REMOTE FROM SET.

FIG. 3.

The Device in Use

The "On" and "Off" switch which is combined with the loud-speaker sockets (Fig. 3) can be easily constructed and fixed to the wall, doorpost, or fireplace of the room or rooms in use; the two sockets being of the Clix socket type, with plug instead of tags at the end of the loud-speaker leads, or a standard plug and socket for loud speakers could be fitted. The switch arm (Fig. 3) should not remain in contact with either of the studs ("On," "Off," Fig. 3) more than a second, otherwise the H.T. battery will soon run down.

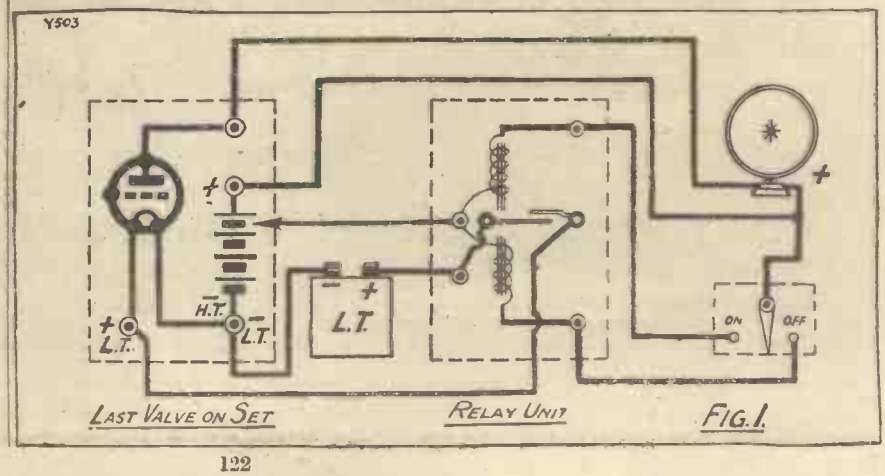


FIG. 1.

HOW TO MAKE A BARREL SWITCH

This low-capacity component is easily constructed and is especially useful for switching out an L.F. stage.

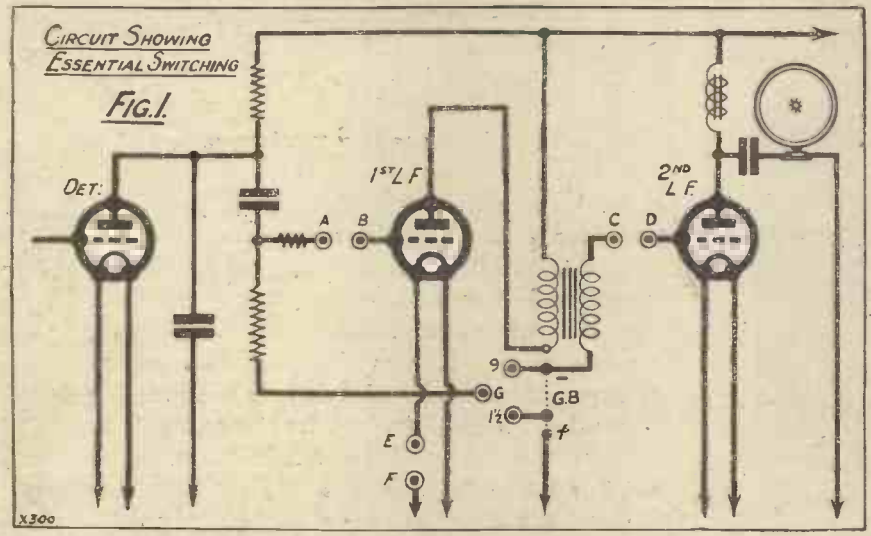
By DONALD STRAKER.

ONE of the most popular multi-valve receivers to-day is that which employs one good H.F. stage, an anode-bend detector, followed by one resistance- and one transformer-coupled L.F. stage. Such a receiver will bring in a great many distant transmissions at good volume, but its very sensitivity unfits it for comfortable use on the local station or 5 X X.

One popular solution is to cut out the first L.F. valve and the transformer, and to couple the detector directly to the output valve by means of the resistance. To avoid the losses and interactions of the usual small switch or jack many constructors make the necessary change of connections with sockets and wander plugs, but the danger in that method is that sooner or later the user will forget to change over the grid-bias plugs, in which case there will be a large diminution in the lives of perfectly good output valves and H.T. batteries.

Costs Only Few Pence

The switch illustrated here has been used by the writer for some time in receivers of the type mentioned with very satisfactory results, and it has the advantage that the contacts can be arranged to suit almost any layout, so that the wiring is short and well spaced. Its construction has been simplified so that it can be made from stock material with simple tools, while its actual cost is only a few pence.



Reference to Fig. 1, which shows the essential contacts in the L.F. stages of such a receiver, will indicate the changes necessary in cutting out the first L.F. valve. In the "all valve" condition, A will be joined to B, C to D, and E to F, while G will be joined to a tapping on the grid-bias battery suitable to the first L.F. valve.

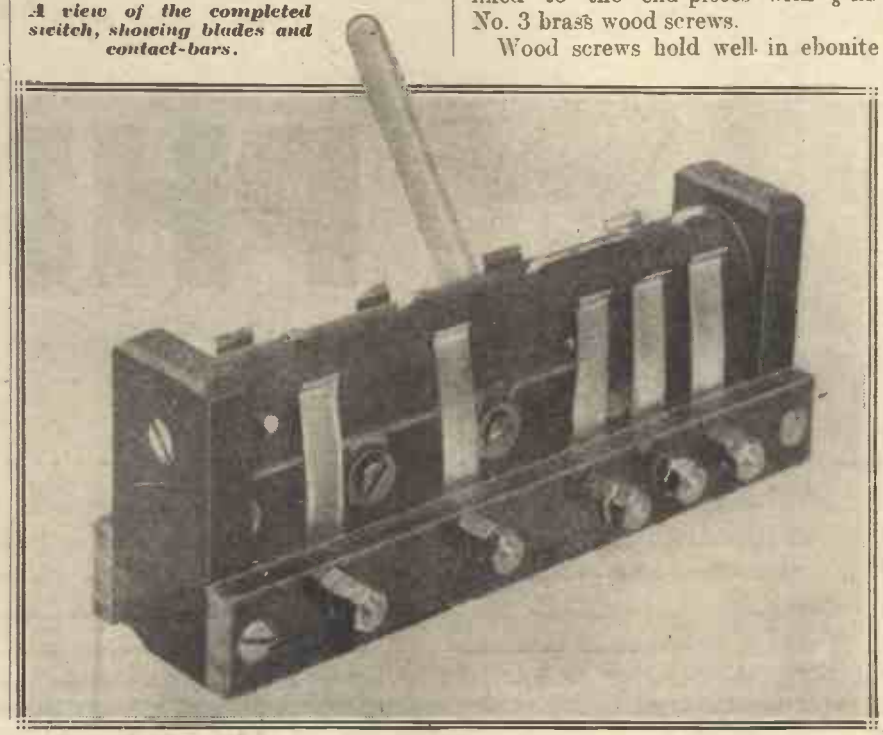
In practice this is usually 1½ volts minus. When the first L.F. valve and transformer are to be cut out the filament circuit is cut at E F, A is joined to D, and as the grid leak at G must now pass bias for the output valve contact must be made between G and 9. It may be noted that the grid-bias terminal of the transformer can be left connected to 9 permanently, as the other end of the secondary is disconnected at C.

The Terminal Bars

Fig. 2 shows the switch in detail, the contacts being lettered to correspond with the diagram in Fig. 1. The two end-pieces are made of ebonite ¼ in. thick, but it is better to use strips of Paxolin 3/16 in. thick for the terminal bars, as that substance is very tough. The bars are fixed to the end-pieces with ⅜-in. No. 3 brass wood screws.

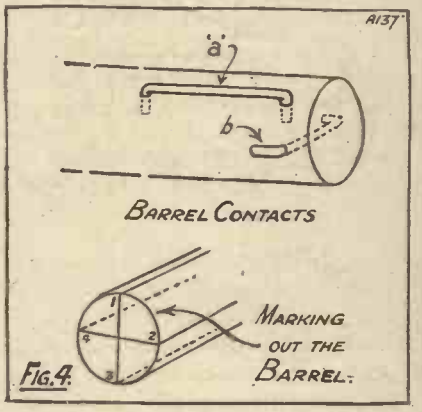
Wood screws hold well in ebonite

A view of the completed switch, showing blades and contact-bars.



How to Make a Barrel Switch—*continued*

provided a suitable drill is used (5/64 in. for No. 3 screws), and the screw is turned backwards and forwards whilst it is being driven. The barrel is a piece of ebonite rod ½ in.



diameter, and the barrel contacts are made from No. 16 tinned-copper wire. Where contact is required between two of the spring contacts alongside each other the wire is bent into a staple, the ends being pressed into holes drilled in the barrel in the correct position (Fig. 4a). For connecting contacts at opposite sides of the switch a hole is drilled right through the barrel, and a piece of wire pushed through and the ends turned down (Fig. 4b).

Brass screws passing through holes in the end-pieces, and tightly screwed into the ends of the barrel, form the axle on which the barrel turns. If it is desired to bring the control knob out through the panel one of these screws should be replaced with a length of 2 B.A. studding, which can be passed through a hole in the panel and fitted with a knob. However, the simple lever shown is quite satisfactory, and it clears the panel of a control which is only used occasionally.

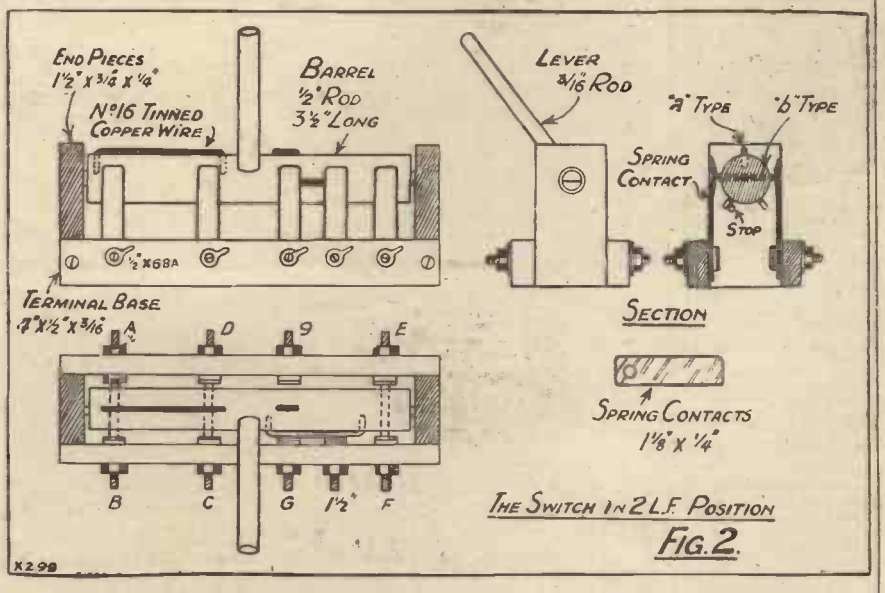
The Spring Contacts

The spring contacts on the terminal bars are cut from springy brass or phosphor-bronze strip. These can be obtained from old flash-lamp batteries or a length of suitable strip purchased from a metal merchant, such as Messrs. Stanton Bros., of Shoe Lane, E.C. Each contact is bent to the section shown in Fig. 2, and fixed to the bar with a ½ in. by 6 B.A. screw and nut.

Soldering tags can be fitted under these nuts, or connections can be made by looping the wiring under a second nut and washer. The length of the contact bars and barrel will depend upon the number of contacts required. Four inches is a useful length, as this gives room to space out the contacts associated with the grids and anodes.

Marking the Barrel

To position the barrel contacts correctly four lines should be scratched along the barrel dividing its surface into four equal segments (Fig. 4).



THE SWITCH IN 2 L.F. POSITION

FIG. 2.

Put the barrel in place and turn it round until line 1 is at the top. The spring contacts will then be immediately opposite lines 2 and 4.

Consider the "1 L.F." position first. For this fit one of the "a" type contacts along line 2, so that A and D will be joined. Then drill a hole right through the barrel from line 2 to line 4, opposite contacts G and 9, and fit one of the "b" type wires there. This will join G and 9. Nothing else is necessary.

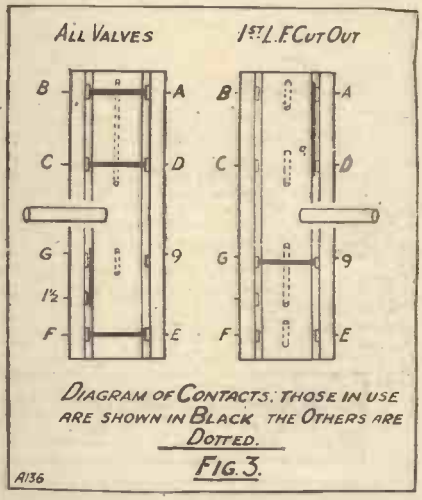


DIAGRAM OF CONTACTS. THOSE IN USE ARE SHOWN IN BLACK. THE OTHERS ARE DOTTED.

FIG. 3.

Then turn the barrel a quarter turn until line 2 is at the top, and proceed with the "2 L.F." position. Fit "b" type contacts between A and B, C and D, E and F, and an "a" type contact along line 1 to join G and 1½. These contacts are shown in diagram in Fig. 3, where the barrel contacts in use are black and those out of use dotted.

A hole should be drilled in the barrel at any convenient position to take the actuating lever. Wooden "dowel-rod," 3/16 in. diameter, is useful here, and most ironmongers stock it. At one end of the barrel two stops are fitted, which bear against a peg in the end-piece to position the barrel correctly at the limits of its movement. These are brass screws with the heads cut off after driving.

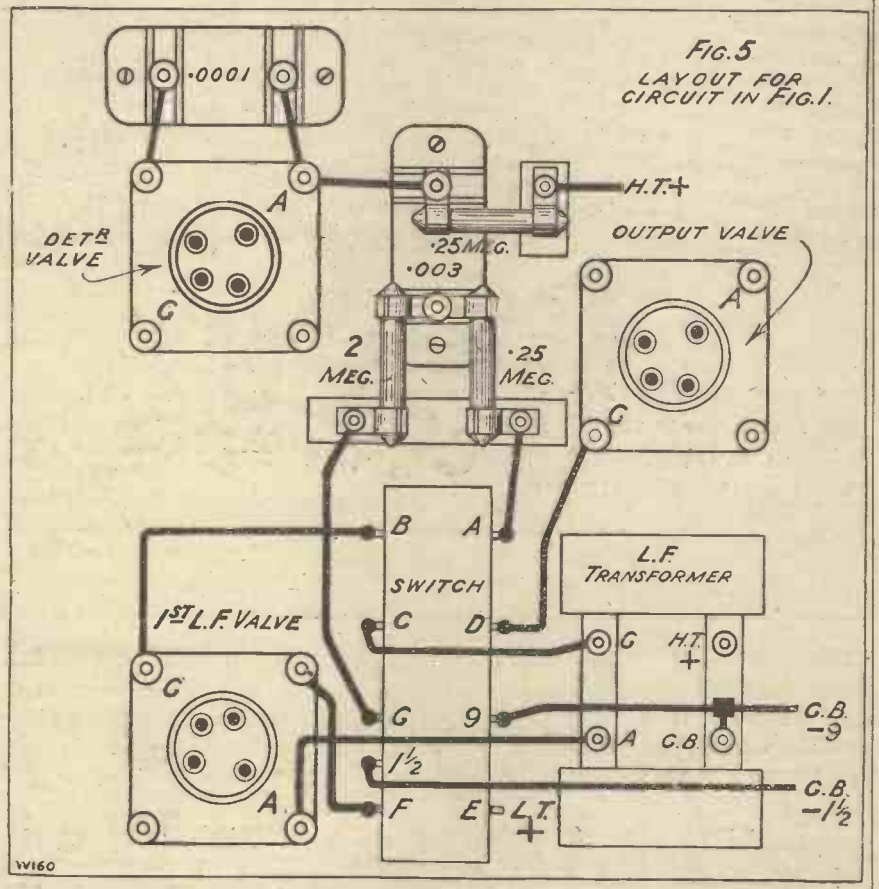
A Good Layout

The brass spring contacts must be bent so that they just clear the ebonite barrel but engage with the projecting wires. This is important, for if allowed to press on the ebonite a bridge of metal dust will eventually form on its surface and produce unwanted couplings. The completed switch is held in position by screws passing up through the baseboard into the ebonite end-pieces.

How to Make a Barrel Switch

—continued

Fig. 5 shows a good layout, using the circuit of Fig. 1, and it should be noted that the use of this switch is not limited to this type of circuit. It is applicable to any circuit with two L.F. stages, whether coupled by resistance, choke, or transformer, or a combination of these.



And it will be seen from the suggested layout shown above that when using the barrel switch all the essential leads can be kept short and direct. This latter, of course, is an essential precaution to take when arranging the layout and wiring, or otherwise the advantages of a low-capacity switch may be lost in the wiring.

LABELLING PLUG-IN COILS

It often happens that plug-in coils get into the hands of the experimenter without any marking so that he does not know just what size of coil he is handling. Again, one may wind up one's own plug-in coils and be uncertain as to the size. A simple way of finding out the approximate size of the coil is to proceed as follows: Take a few known coils, such as 25, 35, 50 and 75, and tune in the local station on your set, noting the exact condenser reading for each coil. You may find, for example, that the local station comes in at 6 degrees on a 50 coil, 20 degrees on a 35, and 50 degrees on a 25 (these are purely imaginary figures). In order that you may be able to tune the local station on several coils it may be necessary to insert a small series condenser in the aerial. Now substitute the unknown coil and again tune in the local station. According to which of the known coils its tuning point most resembles, so you will get an indication of its size. It is, of course, unlikely that you will get exactly the same tuning position for the unknown coil, but if your tuning position is nearer that of the 50 coil than that of the 35, the unknown coil is obviously to be reckoned as in the 50 class.

Incidentally, tests of this kind will show you how different makes with the same number vary quite appreciably in their inductance.

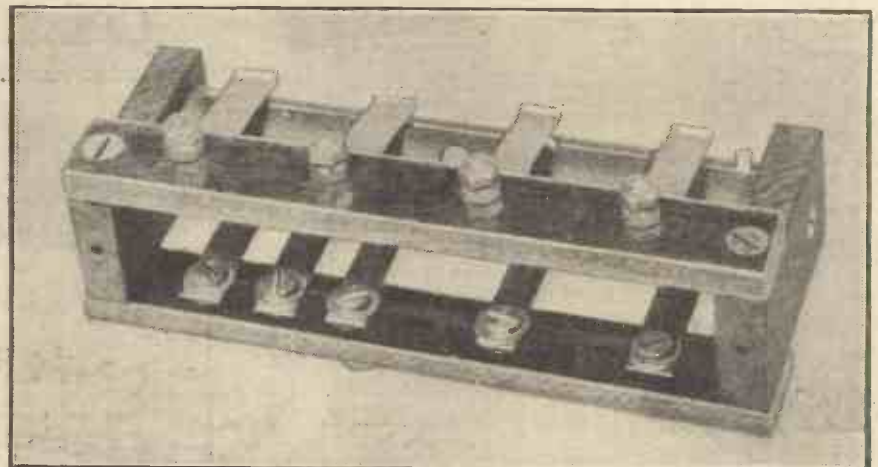
H. P. W.

PRECAUTIONS WITH METAL PANELS

METAL panels for wireless sets are gradually becoming more and more popular, partly because of their mechanical strength and partly because of their appearances. The latter is a strong point in their favour, since they retain their original new appearance and cannot change colour as do some ebonite panels.

When metal panels are substituted for those of the insulating type in sets designed for the latter, care must be taken to see that no short-circuits are occasioned.

Variable condensers which have three fixing screws secured to end-plates connecting with the fixed vanes are unsuitable unless insulating bushes are used for each screw, otherwise the fixed plates would be shorted through the panel to the spindle of the moving plates, thus preventing the condenser working.



This view shows how the spring contacts are fitted to the frame of the barrel switch, and the method of taking connections to the blades.

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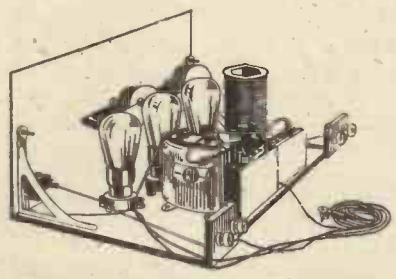

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Ebonite Panel, ·0005 Ormond S.L.F. and S.M. Dial, Igranic 6 ohms, Lissen 2-way, 2 Lotus Valve Holders, ·0003 and series clip, 2 meg. Leak, R.I. and Varley L.F. Transformer, ·0005 Fixed, Strip 4 x 2, 8 marked Terminals, G.B. Clips, 2 Wander Plugs, Square Wire, Screws.

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With Lissen L.F., 37/6.

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2/6 with parts only — For 2/6 extra you can buy 5-ply Base, 16 x 8 Panel (Ebonite), Wood Screws, Connecting Wire. **2/6 THE LOT.**

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(COMPONENTS).

2 Ormond Short Wave Variable Condensers. Igranic 6 ohms. Lissen Potentiometer. 2 Benjamin Valve Holders. Colvern Short Wave Coils on Stand. Lissen H.F. Choke. Igranic L.F. Transformer. 2 Dubilier 2 mfd., Dubilier ·0001, 3 meg. leak, series clip. Blue Print.

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FREE WITH ABOVE — 11 ENGRAVED TERMINALS, 2 Best Quality S.M. DIALS, BASE-BOARD, SCREWS, WIRE and 2 EBONITE STRIPS.

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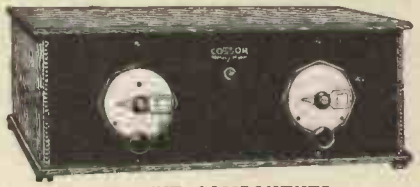

GENUINE COMPONENTS

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(COMPONENT PARTS).

1 200,000 Wire-wound Res. and Holder; 2 Grid Leaks, 2 meg.; 1 Res., ·25 (all Mullard); 2 Holders; R.I.-Varley S.L. Transformer; 2 Mansbridge 2 mfd., one 1 mfd., 2 ·005, and 1 ·0003 (all Mullard); 2 ·0005 J.B. variable; 1 ·00035 do.; 3 Ormond S.M. Dials; 2 Six-pin Bases; Coils for Broadcast wave, ditto Long wave; 4 Valve Holders; 1 Gambrell Neutrovernia; H.F. Choke; 13 Marked Terminals; 5 Plugs; Brackets; L.T. Igranic Switch; 2-9-v. Grid Bias; Panel Rheo., Igranic, 50 ohms; D.P.D.T., Lotus; Wire.

ABOVE PARTS **£8 15 0** Carr. 1/-

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3 ·0005 Log., Cyldon; 1 S.L.F. ·0003; 3 Indigraph Dials; 1 Pye L.F., 4-1; 3 Six-pin Bases; 3 Metal Screens, with Terminals and Strips; Set of Raleigh Broadcast Coils, do. Long wave; 2 J.B. Neutralising; 1 Climax H.F. Choke; 5 Pye V. Holders; 1 Lotus Fil. Jack and Plug; 1 W. & W. D.P.D.T. Switch; R.C.C. Unit (Mullard); 5 meg. Leak and Holder; 3 ·005 and 1 ·0003 fixed; Three 2 mfd.; one 4 mfd. (Mullard); 5 Plugs; 2 Spade, 9 Marked Terminals; Wire.

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Valve Holders, 1/-; Fixed Con., 1/-, 1/6; Leaks, 1/-; Switches, 1/6, 2/6; Latest 2-way Cam Vernier, 4/6; Rheostats, 2/6; B.B., 1/6; Lissenola, 13/6; L.F. Transformers, 8/6; 100-v H.T., 12/11; 60-v., H.T., 7/11; Coils, 60 X, 6/4; 250 X, 9/9; 60-v. H.T., 7/11; 100-v., 12/11; Super 60-v., 13/6; Grid Bias, 1/6; 4-5, 5d.

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Hinged Lid and Baseboard

12/6, 14/6, 16/6

First-class quality. Carriage 2/-.

OUR NEWS BULLETIN

Some of the More Interesting Happenings in the Radio World this Month.

OWING to Press publicity, one of the chief wireless topics of the month has centred about developments in connection with the valve made by the General Electric Co., of America. There is certainly something queer about this valve, even if there is nothing particularly new about its design. Experiments have shown that electrical meters in rooms near the valve, when it is working, are distorted and broken, and anybody going near the valve first has a feeling of warmth, followed by a comfortable glow, and then by quite severe pains in the joints and limbs.

And rodents in a cage nearby the valve become at first terribly excited and then, if exposed too long, die.

Great Power Radiated

This peculiar valve is about 5 in. in diameter and 2 ft. long, and behaves as a self-excited oscillator on a wavelength of 6 metres. It is probably the effect of these very short waves which have had such curious results, but they have not been noticed so persistently before owing to the fact that sufficient power has not been used. But it is said that the valve is remarkable for its heavy output inasmuch as it can radiate from 10-15 kilowatts of H.F. power.

Many Difficulties

Of course, newspaper stories are always a little exaggerated, and as a result of the publicity given to this valve various writers have been suggesting that the transmission of power by radio is now well within sight. As a matter of fact, reputable physicists are still of the opinion that, like television, the difficulties in the way of radio transmission of power are very nearly insuperable, and certainly at the moment there are no signs of any systematic methods being discovered of transmitting power by radio in the sense that one would be able to derive one's electric-light supply, for instance, from a central radio power distribution station.

Uncle Mac's Book

A very entertaining little book has been published by Uncle Mac of the B.B.C. It is entitled "Nonsericks," and is published by Methuen. Uncle Mac is well known for his delightful microphone conversation and his spontaneous sense of humour. I daresay many readers will find it difficult to believe that Uncle Mac is really a spontaneously cheerful young man, for during the war he went through experiences which can only be termed as frightful.

Terrible Experiences

Here is one experience. During the Battle of the Somme he was surprised by German stretcher-bearers, who called upon him to surrender, and then shot him through the eye with an explosive bullet. As he fell, Uncle Mac managed to shoot one of the stretcher-bearers, who, by the way, were carrying ammunition and

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OUR NEWS BULLETIN

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grenades, and then lay for three days and nights in No Man's Land, where he was wounded several other times by stray bullets, and sustained two or three broken ribs and other injuries. Later on he was rescued and spent many months in hospital.

Rare Sense of Humour

On being discharged, he immediately tried to re-enlist in the Air Force, and since that time has undergone something like thirty operations. Just after his book was published he underwent another operation at the hands of a Bavarian doctor. As Uncle Mac jocularly pointed out, when interviewed, it seemed only right and fitting that as he was shot by a Bavarian, he had better be operated on by a Bavarian doctor.

Everyone will wish him a quick recovery and an early return to Savoy Hill, for humour such as his is rare, and the B.B.C. can ill spare him.

"Upside Down"

Amateurs who have found some fun in listening to wireless telephone conversations between Rugby and America will now find it impossible to hear anything intelligible, for engineers have discovered a way to make transatlantic wireless conversations unintelligible to the eavesdropper. According to the Press, this has been done by making the voice frequency band inverted. It is said that this rearrangement of the voice-carrying band by converting the frequencies produces very funny results, and that, for example, a high-pitched whistle is converted into a low-pitched roar and vice versa.

In other words, it seems that people who use the transatlantic telephone, although they will be quite unaware of the change, will speak into the microphone as usual, but before putting them on the air their voice modulations will be turned upside down and then corrected again when received and before being passed to the listener's headphones at the receiving end.

Regional Scheme Held Up

Still there is no sign of the Post Office giving its official sanction to the Regional Scheme. We understand that certain proposals have been put before the Postmaster-General, but the reply has not yet been received, or, if it has, it is vague and unsatisfactory.

The B.B.C. seems to have made up its mind to have the first London Regional Station at Potters Bar, but it is not true to say that any work at all has yet been started on the station, and, as a matter of fact, the site has still to be approved as regards its foundations, etc., by the Post Office people before the B.B.C. can make a first practical move.

The "Shut-In"

America has invented a new name for the listener-in. To wit: "A shut-in." As the Americans say, that is just what a listener-in is—he is a shut-in. Shut in with his wireless set, and he has got to take what's coming to him or not listen at all. It certainly seems a rather apt title, if a little more colloquial than listener-in.

Increased B.B.C. Revenue

It is anticipated that during the next twelve months the B.B.C. will receive from the Post Office £800,000, or nearly £75,000 more than it has received for the current year. Last year the B.B.C's working revenue was £730,000, and it will be remembered that Lord Clarendon, the present Chairman, recently expressed

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OUR NEWS BULLETIN

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the doubt whether the estimated revenue for this year would be sufficient for the proper development of the B.B.C. on progressive lines. Perhaps this odd £75,000 will make a difference. Anyway, with this constantly increasing income the public are certainly entitled to expect more satisfactory programmes from B.B.C. stations.

The B.B.C.'s S.O.S. system has proved so extraordinarily useful, and so many requests have been made to Savoy Hill that these messages should be broadcast in the Dominions and foreign stations, that it is likely at the next meeting of the Union Internationale that a scheme will be discussed for bringing this up-to-date S.O.S. system into full effect.

A "Thermophile" Set

The Marconiphone Model 32 Receiver draws its L.T. supply from the gas mains. This model was one of those exhibited at the Ideal Homes Exhibition and which attracted considerable attention on the Gas Company's stand. Tests which have been carried out by the South Metropolitan Gas Company indicate that the low filament current required by this receiver can be provided by six cubic feet per hour, and that reception is equal to that obtained when accumulators are used.

York Minster

Like all other big buildings, York Minster has its acoustical problems, and as this famous Cathedral attracts large numbers of visitors it has been found that for some time past it has been difficult to find seating accommodation within audible range of the pulpit. As a remedy to this disability a series of tests have been carried out by the Marconiphone Co. culminating in the installation of a permanent public address system. There are several loud-speaker positions, each supplied through a separate output transformer and having its own independent volume control. It is thought that this loud-speaker installation will make ample amends for overflow services which will take place in future.

High-Power S.W. Valves

The General Electric Company point out that in view of the great interest taken in the development of wireless valves for the use of ultra-short wave-lengths, and the inevitable speculation in the public press regarding the possibility of employing wireless for transmission of energy for commercial and domestic purposes other than signalling, it is interesting to note that we, in this country, have for some time past been carrying out experiments in the construction of valves capable of handling tremendous power.

For instance, the Osram valves, capable of dealing with the huge input of thirty kilowatts, are now in actual use in this country. Thirty kilowatts imply a valve capable of dealing with an input up to ten thousand times as great as that of an ordinary broadcasting valve, and it will be obvious that the successful design and manufacture of such valves is a great engineering advance.

Very Low Wave-Lengths

The Research Laboratories responsible for the design of these giant kilowatt valves are aiming at wave-lengths far below those at present in commercial use, and the engineers responsible for the tests have the possibility in mind of employing wireless for transmitting power, although it must be borne in mind

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OUR NEWS BULLETIN

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also that the power necessary for signal work over the longest distances by modern methods of transmission is infinitesimal when compared with that required for lighting or other industrial purposes.

It must not be thought that America is so far ahead in the matter of valve design, for, as a matter of fact, valves for the use on shorter wavelengths and for transmission of greater power are continually in production in this country, and experimentation is going on continuously.

New Talk Features

In a syllabus of Talks and Lectures recently issued by the B.B.C., and covering a period up to July next, there are several new features which may attract the attention of listeners. On Tuesday afternoons a series will be given under the title of "Holidays Abroad." It is said that these talks will be eminently practicable and will not only help listeners to decide where they will spend their holidays, but to deal with how to get there and how to avoid mistakes which ignorance of the ways and customs of foreign countries often provokes.

Holiday Chats

The man who is going to spend his holidays at home will also be the subject of a series of talks by A. B. B. Valentine, who has explored either by foot or by car almost every corner of the British Isles. His six talks began on April 21st, under the title of "Holidays in Britain."

The Baird Patents

The American rights of certain patents of the Baird television system covering transmission and reception have been bought by two American business men who represent a group of American financiers. One of the purchasers, a Mr. Pokress, said they came here, saw and were conquered, but did not get it (Baird's television system) as cheaply as they wanted.

Sir Charles Higham has stated that he liked to see any invention which was British carried forward speedily, and the way to do that was to interest the United States in it. Attempts have been made, of course, to do the same in this country, but thanks to the outspoken and friendly criticisms of scientific experts, we are probably a little more aware of the true facts about television than the Americans.

THE "DIAMOND" THREE

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more so in view of the fact that reaction is being used on the frame to compensate for the difference in resistance between special stranded wire and the ordinary 24 D.C.C.

The frame is now ready for connection to the set. Before we go further we must choose our valves. The first valve, that is to say, the one nearest the front panel, should be of the type specially designed for resistance-capacity-coupling, the second should be of what is generally termed a "high frequency" type, and the third a small power valve.

Connecting Up The Set

A super-power valve will be a slight advantage with loud signals as it will enable the set to handle a bigger volume without distortion; but, on the other hand, the small power valve has a slightly higher magnification factor. Whatever output valve you use be sure that you use the correct grid bias. You will, of course, require a low-tension accumulator, a high-tension battery which should be not less than 100 volts, and preferably 120, and a grid-bias battery.

The middle terminal of the frame is connected to the middle terminal of the terminal strip, and the two outer terminals of the frame to those on each side of the centre terminal on the strip. Connect up your batteries as indicated, leaving for the moment the on-and-off switch at the off position. Carefully set the plates of the reaction condenser so that they are "all out." Also set the tuning condenser at zero.

Tuning-In Stations

Now, with the frame standing behind the cabinet, but far enough away so that you can rotate it through a right angle without touching the cabinet, switch on and slowly turn the tuning dial until you hear your nearest station. Listen very carefully to the loud speaker, for tuning is very sharp, and you may go past it without noticing it before you use the reaction adjustment, particularly if the station is some distance. If, however, you are within five or six miles you will have no difficulty in picking up the station without touching the reaction. It will be necessary to turn the frame to the best angle for reception.

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THE "DIAMOND" THREE

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Once you have found the station slowly turn the knob of the reaction condenser, re-tuning slightly at the same time on the tuning condenser, and you will find a very considerable increase in volume. Go on turning the reaction condenser until the set oscillates, and then turn it back again slightly until you are off the oscillation point. Tuning will be extremely sharp and you will find the reaction condenser will make a tremendous difference to the strength of signals. Indeed, if after rotating the tuning dial from 0 to 100 or 180, as the case may be, and turning the frame, you do not hear your local station with the reaction condenser at zero, increase the reaction setting slightly and search again.

Frame For 5XX

You will soon become accustomed to handling the reaction and the tuning, and once you have found the best setting of the reaction condenser it is quite likely that you will be able to turn from the local station to the alternative, such as 5 G B, without touching the reaction setting.

Using the frame described both 2 L O and 5 G B come in at full loud-speaker strength in the London area, with very sharp tuning and at excellent quality. For 5 X X a special frame will have to be wound having many more turns. For such a frame, instead of using the basket-weaving method already described, it is preferable to mount four pieces of wood at right angles to the ends of the arm, each piece of wood being about 3 in. long. The frame should be then wound as a single-layer square coil with turns touching, thirty-six turns being about the right number with the centre-tap taken as before.

H.T. and Grid Bias

For all ordinary work H.T. positive 1 and 2 can be joined to the same high-tension terminal of your H.T. battery, this being the maximum voltage. A separate terminal is provided, however, for experimenters who like to separate the H.T. tapping of the last valve from that of the second and first; but the set is primarily designed to work with the same H.T. voltage on all three valves. Grid bias negative 1 and grid bias negative 2 should be adjusted according to the valve maker's instructions.

BROADCASTING AND EDUCATION

—continued from page 82

the wave-length bands are so crowded these days that it is highly unlikely whether a spare one could be found purely for the broadcasting of educational matter. The committee suggests that broadcast education can fill many gaps in the existing adult education movement, that it can widen the field from which students are drawn by its power to reach and stimulate a large public, and that it can provide a means of education for those beyond the reach of other agencies.

Separate Wave-Length Required

In short, the report suggests that it can put listeners in touch with the leaders of thought and the chief experts in any subjects. Yes, undoubtedly it can—in a superficial way. Its educational system is bound to be catholic in taste and, although its appeal may be wide and very varied, it must be remembered that education to-day is extremely specialised. It is no good for a potential electrical engineer to take up a course of broadcast lectures on, say, the psychology of laughter or the psychology of dress, or some other alien subject. If it were possible to have various wave-lengths devoted to the purposes of broadcasting lectures on different and specific subjects, then here would be some value, in fact, a very great value, in the B.B.C.'s educational scheme. But the B.B.C.'s educational scheme is rather like a modern and excessively experimental cocktail, inasmuch as it may contain many essential ingredients but so diversified and so mixed up that the result, when absorbed by the listener (as in the case of broadcast education), is simply a concoction, rather heady and of no particular value.

Trite and Trivial

There is a good deal in the report which is very trite and trivial, and, in fact, a repetition of facts well known and which may be regarded as rather stale. For instance, the writer of the report suggests that broadcast programmes require "the greatest freedom of experiment in matter and presentation." Controversial subjects, it is pointed out, should not be cut, and "strict care should be taken in choosing those who are to speak on various subjects," etc., etc.

There is nothing very new in this, nor is there anything new in the suggestion that the technique of broadcast lecturing requires continual experiment and the possession of personality and the ability to convey it to an invisible audience, etc.

Hour Talks?

The committee theoretically suggests that the most satisfactory method of providing an educational service would be to set aside the whole or the main part of one wave-length capable of covering the whole country for a special service of lectures, music, etc. But until this proves practicable, a definite proportion of time in general programmes should be allotted to general talks, and certain periods at appropriate times of the day should be allotted to more formal education.

Under a system of alternative wave-lengths, the latter would require *at least one hour daily from 7.30 p.m., in addition to talks at other times of the day.*

All this undoubtedly points to the fact that in the near future the recommendations of this committee will be adopted either in part or in whole, and in such a way that programme time will be further encroached upon. There is undoubtedly a case for an argument as to whether this policy is justified or not, but in view of the fact that there are so many excellent educational systems in active operation these days there is undoubtedly evidence in support of the argument that the B.B.C. need not add still further to the existing forms of education in this country.

Not Wanted by Listeners

Listeners who are anxious to improve their education are not going to be attracted by a superficial system however impressive and brilliant the various speakers engaged to discuss and to dilate upon various topics and subjects. If, however, there is a definite indication that the majority of listeners in this country want more and more time devoted to educational broadcasts, then the B.B.C. is undoubtedly justified, but from the criticisms we have received and from the general trend of opinion among listeners it would undoubtedly appear that the B.B.C.'s endeavours to enlarge both in time and in scope its educational facilities are not generally welcomed, and that in the main listeners expect from the B.B.C. first-class entertainments interspersed in reasonable degree with talks, debates, etc., of general interest, but not designed specifically for an intensive educational purpose.

INSIDE THE H.T.B.

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should be provided by the number of cells taken in by the tapping. But one frequently sees a 44-cell battery labelled "60 volts."

The total E.M.F. here when the battery is fresh should be 66 volts.

It is quite easy to discover whether a standard capacity battery contains extra cells by measuring its length and breadth. The cells used in these batteries are nearly always ¾ in. in diameter, and they are arranged always in rows of three or four in the oblong battery, and in rows of six in that of nearly square shape; the nominal E.M.F. in both cases being "60 volts."

Arrangement of Cells

The squarish battery is bound to contain 42 cells (7 in. by 6 in.), as a further examination of Fig. 1 will show. The oblong battery, if 6-volt tappings are arranged along either side of its long edges, will have its cells in rows of four. There will thus be either ten rows (40 cells, 60 volts) or eleven rows (44 cells, 66 volts). If an oblong battery is very narrow, and has 4½-volt tappings at opposite sides of the case, then the cells are in rows of three.

Batteries which at first sight may seem rather expensive, are usually worth the extra money owing to their more careful make-up and insulation.

False Economy

There is a dodge on the part of certain foreign makers to which attention should also be called. This is the use of cells much below the standard size. Now the ¾ in. by 2⅛ in. cell is the very smallest that can be used economically in any wireless set. I have before me a cell from a foreign battery which has the same diameter, but whose pot is ¼ in. less in height. The last photograph shows two "skimpy" cells from different makes of battery alongside a standard cell.

Since the diameter is no smaller than that of the standard cell, the length and width of the case of a battery made up with such small cells will not be reduced, and by placing a thick sealing over the cells the depth of the battery can be brought up to normal. The purchaser, therefore, does not realise that he is getting very small cells and probably marvels at the "cheapness" of the battery! Tests show that such a reduction in the size of the cells has an enormous influence upon their useful life.

MORE ABOUT THE "ROADSIDE FOUR"

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taken counting from the point where connection is made to the top left-hand socket. The calibration will be slightly different when this arrangement is used.

Frame-aerial reception of 5 X X requires, of course, a frame separate from that already given. The following particulars of a frame I have wound for this purpose may be of interest. No. 24 D.C.C. wire is used, and a hole is made in the frame former (an additional frame former can be obtained from the cabinet makers at a very small additional charge) as close as possible to one edge.

Long-Wave Winding

Forty turns are then wound on with turns touching, a hole made, and a loop of wire passed through the hole and secured. The winding is now continued for another fifteen turns. If before the fifteenth turn is reached it is found that the former is full, it is only necessary to double back and wind the remainder as a second layer, until the right number of turns is reached. At the fifty-fifth turn take a sharp-pointed tool, open out the underneath windings slightly so that the wood is seen, and then drill a hole through the wood, passing the end of the wire through this and securing it. It will be found a simple and efficient plan to take some strips of electrician's sticky tape and bind the windings to the wooden former at one or two points on each side.

The beginning of the winding is taken to a plug which is plugged into the top right-hand socket. The loop which we have already referred to is bared and connected to another plug, this plug being inserted into the top left-hand socket nearest the hinge, while the fifty-fifth turn is brought out to a third plug and this inserted into the bottom socket. The set is then operated just as before.

5 X X will be brought in very well indeed, but the frame is too small and the set insufficiently sensitive to bring in much else in the way of long-wave stations, although Hilversum and Radio-Paris can be heard on the speaker weakly.

THE "ALL-WAVE" ONE

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The reader will in many cases have his own "pet" winding for short-wave coils, and he will be well advised to adhere to it rather than construct a fresh type. We all have our own preferences, and in most cases there is a fairly solid reason for them.

Series Aerial Condenser

For short-wave work, using these coils, if it is found that the set refuses to oscillate over the whole scale, a very small condenser should be inserted in series with the aerial.

If a ·00005 clip-in type can be procured this should be satisfactory, but in extreme cases a neutralising condenser should be connected between the actual aerial terminal and the lead-in. The clips may then either be shorted out or a fairly large condenser inserted therein.

In general, a ·0003 grid condenser and a 2-megohm leak will be found satisfactory for broadcast work, but for the short-wave section it will often be preferable to use a ·0001 condenser and as high a leak as is procurable. Five or even 7 megohms give a very nice reaction control as a rule, but the value is, of course, largely dependent on the type of valve in use.

I have always found the 6-volt type of valve to give results slightly superior to those given by other types when short-wave work is concerned. For ordinary broadcast reception there is probably nothing to choose between them.

Suitable Valve

For use in this set a valve with an impedance of about 30,000 and a "mu" of 20 is recommended. Such valves as the D.E.5b, P.M.5X, or even D.E.L.610, etc., all give excellent results with about 50 volts H.T. If a small power valve is used probably not more than 30 volts will be required.

If the reader is pleased with results it is quite a sound scheme to add a note-magnifier to the set, but for really distant short-wave reception I prefer the single valve. An amplifier, unless it is very carefully designed, will often amplify the "mush" to a greater extent than the signals.

SHORT-WAVE WINDINGS

50-100 metres	Grid 14 turns	Aerial 5 turns	Reaction 10 turns
32-60 metres	Grid 8 turns	Aerial 2 turns	Reaction 6 turns
24-35 metres	Grid 4 turns	Aerial 1 turn	Reaction 4 turns
18-27 metres	Grid 3 turns	Aerial 1 turn	Reaction 3 turns

HOW TO DO YOUR OWN FRENCH POLISHING

—continued from page 100

coats of polish, and allow to stand, as before, for a day or two. Glass-paper down between the coats as may be necessary, in order to preserve a perfectly flat surface, using a spot or two of linseed oil to prevent sticking. When dry, if the grain is completely filled, then the bodying is complete.

The Final Process

Having obtained a good body, not a brilliant surface, the final finishing process can be started. Before dealing in detail with this latter process it is well to remember that in the foregoing process a foundation is being laid, and it is essential for good final results to use care in papering down, as little pressure as possible on the rubber, and to prevent the rubber sticking to the surface use just a spot of linseed oil. When applying the polish it is as well to keep just a little linseed oil on the palm of the other hand, and dab it from time to time with the rubber. Again, do not under any circumstances dip the rubber into the polish. Always open the linen cover and pour the polish on to the cotton wool, and never soak the wool superfluously.

"Spiriting Up"

If the surface of a piece of work after application of polish shows milky, then this is an indication that too much linseed oil has been used. Probably the rubber has been over-supplied, or maybe in papering.

The final or polishing stage may now be commenced. The process of producing the brilliant surface is called "spiriting up."

Procure a new rubber made in the same way as described previously. Pour on to the cotton wool a little methylated spirit, sufficient only to secure a slightly damp surface on the linen wrapper. The amount of spirit applied is vital and only very small amounts as indicated must be used. Now work the rubber over the surface of the bodied wood, using only light pressure and working first in the curved path as indicated previously, and then working much more rapidly; use the rubber up and down the grain, and continue to polish until the desired brilliancy is secured.

When polishing small mouldings and quirks an arrangement for holding as shown in Fig. 4 should be used.

WITHIN THE VACUUM

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would let me have their comments, is that the filament voltage, magnification factor and impedance of each valve should be stated, together with the present H., L., R.C., etc., sign used by some firms to denote whether the valve is suitable for H.F., L.F., resistance coupling, etc.

Of course, the impedance and magnification factor would tell the technician all that he would require to know about a valve to decide for what purpose it was suitable, but for the average man to be able to tell at a glance, and for list classification purposes, I would suggest the employment of the letter symbols.

Incidentally the magnification factor and impedance figures could be arranged in such a way as to show at a glance the efficiency factor (or mutual conductance) of each valve—possibly a bad recommendation for the scheme from some manufacturers' points of view.

Easily Done

This could be done as follows. The mutual conductance is $\frac{M}{I}$ (mag. factor divided by impedance) and for convenience sake is usually expressed as a fraction or so of unity. Thus a valve with a magnification factor of 10 and impedance of 20,000 would have a mutual conductance of $\frac{10}{20}=\frac{1}{2}$; the thousands figures of the impedance being neglected.

Also, I suggest that as most valves are dull emitters having filament consumptions of less than 0·25 amp., we need not state the filament consumption in the main nomenclature—this current could be given on the valve box with other data. And, to simplify matters, the magnification factor, which is always only approximate, could be stated in round figures.

For instance, a valve suitable for H.F., requiring 2 volts, and having a magnification factor of 10 with an impedance of 30,000 ohms, would be designated as 2H.10/30, while one having characteristics of 6 volts, L.F. magnification of 13 and impedance of 15,000, would be 6L.13/15.

Super-power valves with low impedances would have to be stated as follow. A valve of 6 volts, S.P., with 2,500 ohms impedance and a magnification factor of 3, would be 6S.P.3/2·5, and so on.

HOW TO BUILD A POWERFUL A.C. MAINS UNIT

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terminals of the set to the output side. Join up also the high-tension negative, high-tension positive 1, 2, and 3.

Now, the voltage on H.T. positive 3 is very high, and designed for use with such valves as the L.S.5A, which will stand high voltages on its plate. The ordinary super-power valve is rated at 150 volts maximum by the makers. With the load taken by a super-power valve the voltage is still too great for such valves on the full tapping, therefore if a valve rated at 150 volts maximum is used, ignore H.T.+3 and use H.T.+2 in the first tapping nearest to maximum. This will give us about 150 volts with the load of a super-power valve and one or two other valves in the set. Before switching on be careful to set the grid bias at the correct figure for 150 volts.

Adjusting the G.B.

Be very careful when making adjustments always to switch off the high-tension before readjusting the grid bias. Make sure before you switch on the high-tension that the grid bias is approximately in the correct position, being too much rather than too little. Remember, too, that as you adjust the various voltages the overall voltage on the other tappings will vary slightly. If you intend to use this set at its maximum capabilities, I would recommend an L.S.5A (Marconi or Osram) as your output valve, with the maximum voltage of the eliminator on it. With the load taken by a single L.S.5A, with correct grid bias, the voltage on H.T. positive 3 will be approximately 220 volts. With two in "push-pull" the voltage will be approximately 170 volts.

Get your adjustment on the output valve first of all, and then connect up H.T. positives 2 and 1 to the correct terminals on the set, and adjust these voltages. Again, I must repeat, do not make any adjustments on tappings or the grid bias without first switching the unit off, or you may get a severe shock.

A very excellent use of this power unit is to drive the "Super-Quality Amplifier," using two L.S.5A valves push-pull in the last stage. You will then be able to get marvellous quality of reproduction, particularly if you use a good moving-coil loud speaker.

BATTERY VERSUS ELIMINATOR

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rectification involved, D.C. units are considerably cheaper to buy or to make than the A.C. type.

At the same time, they are usually not so satisfactory in use. The reason is two-fold. In the first place such units are directly coupled with the power-supply network through the potentiometer resistance. It follows that any sudden alterations in the load across the dynamo at the power house, such as may be caused by a more or less distant neighbour on the same supply service switching his lights on or off, or working one of the new ultra-violet ray or "home sunlight" installations, or running a small motor for a carpet sweeper or sewing-machine, is going to cause voltage fluctuations which the ordinary filter circuit is not designed to deal with. Such "noises" will, therefore, get through the receiving set into the loud speaker.

Source of Noise

In the second place, the principal source of "noise" in a D.C. supply service, apart from those just mentioned, is due to commutator ripple. If this were an absolutely constant factor, a filter circuit could be designed to cut it out efficiently. Unfortunately, however, this is very seldom the case. Commutator noise depends upon the condition and setting of the brushes of the main dynamo, and these will vary from time to time according to the degree of supervision given to them by the engineers in charge.

It is hardly necessary to point out that the supply of steady plate and filament current to the users of wireless valve sets is not the foremost consideration of the big electric supply services. They have other and bigger interests at stake, and whilst no doubt they try their best to keep sparking at the brushes down to a minimum, there is in practice sufficient variation to give rise occasionally to some trouble in the listener's set.

It must be borne in mind that it is only in the case where high-frequency amplification is involved that this kind of noise becomes troublesome. As previously stated no difficulty need be experienced from this cause where mains units are fitted to a detector valve followed by L.F. amplification.

A.C. Units

Alternating-current eliminators necessarily involve the use of rectifying devices, either of the thermionic valve or other type, in order to convert the fluctuating supply into a unidirectional current for application to the plate.

For this reason they are somewhat expensive to install. On the other hand they possess the advantage of being coupled through a step-down transformer to the main supply network, and are thus cut off or isolated from any fluctuations caused by outside customers on the same supply service.

In addition, the chief source of "noise" in an alternative-current power-line is not due to commutator ripple, but to the fundamental frequency or periodicity of the supply, whether this be 25, 50, 60 or any other number of cycles per second.

Filter Circuit Design

Whatever the periodicity of the mains may be, it is, within close limits, a steady and uniform effect, and the design of modern filter circuits is sufficiently advanced to be able to eliminate completely any definite and sustained frequency of this kind.

WHAT'S NEW

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Ediswan "Lo-Ten" Accumulator

Although the word "Ediswan" immediately suggests "valves" to every reader of this journal, it must not be forgotten that the Ediswan Company makes a number of other wireless components and accessories, notably accumulators, which they have now marketed for many years. We recently received from the Ediswan Company, for test and report, three 2-volt "Lo-ten" cells in glass containers, and having now subjected these to tests extending over two or three months, we are able to report favourably upon them.

The Ediswan "Lo-ten" accumulator is notable for its specially prepared positive plates, the grids being made in such a manner that it is extremely difficult to dislodge the paste even when one subjects the plates to drastic treatment of a kind which cannot possibly occur in practice. The particular cells which we have tested (type XC442) have an actual capacity of twenty ampere hours, and after considerable use at various discharge rates (some considerably above those recommended by the makers) not only is there no trace of shedding of the positive material, but a careful examination of the surface of each positive plate indicates that this is as smooth as when new, there being no bulges, projections, or pittings which so often show on plates after extended use at fairly heavy discharge rates, and which result sooner or later in the shedding of active material with consequent loss of capacity.

The "Lo-ten" accumulator, which is of British make throughout, is a good specimen of a glass cell accumulator and can be thoroughly recommended.

N/R

Your duty towards your neighbour!

ONE H.F. STAGE

There is a large Public who are content with reception from the local Station and Daventry, whose requirements can be met by the ordinary 3 Valve re-acted Detector Set of which there are so many varieties advertised with fanciful names. To get more than this inevitably means "oscillation" with consequent howling and annoyance to your neighbours.

The B.B.C. definitely state that one H.F. stage is essential at the following ranges, if loud speaker reproduction is to be anything but "indifferent":—

100-150 miles from Daventry.	5XX.	4 Valves.	1 H.F. stage.
50-100 ,, ,, ,,	5GB.	,,	1 H.F. stage.
Over 15 ,, ,, Main Station.		,,	1 H.F. stage.

These figures obviously allow for that factor of safety which is so necessary if consistently pleasing reception is to be obtained under all conditions.

One neutrodyned stage of H.F. will give that additional sensitivity necessary for more distant reception, with radiation reduced to a minimum.

The Met-Vick 4 Valve A.N.P. Constructor's Set is the ideal solution. With the additional H.F. stage, there is no need to force the set. Using A.N.P. coils the set is stabilised, screening is unnecessary and high voltage factor Valves can be used. Additional selectivity is provided by a Tuned loose coupled aerial circuit, brought into action when required. Delightful to operate and cheap to build, the parts with two sets of coils costing only £9.

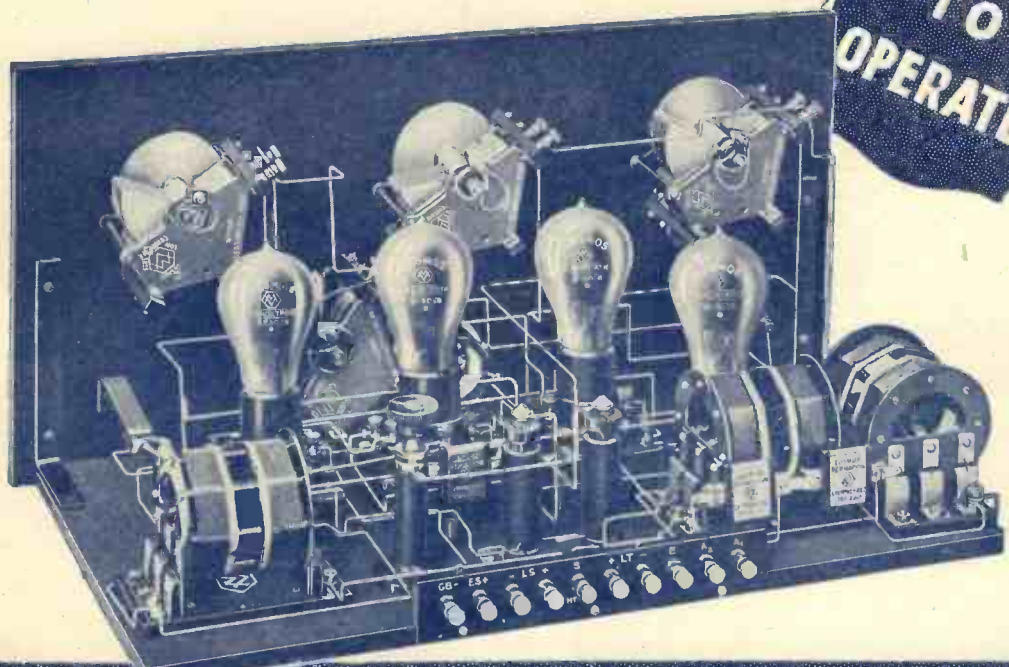
The Met-Vick A.N.P. 4 is pre-eminently the 4 Valve Set of the Day.

If unable to obtain instruction book from your dealer, write for Publication No. 7117/5 or 7117/4 (the A.C. Valve Model) free on request.

CHEAP TO BUILD

EASY TO OPERATE

MET-VICK



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