RADIO PRESS ENVELOPE No. 2

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HOW TO MAKE A FAMILY FOUR-VALVE RECEIVER

FOR USE WITH TELEPHONES OR LOUD SPEAKER

By PERCY W. HARRIS

Assistant Editor of "WIRELESS WEEKLY" and of "MODERN WIRELESS."

This handsome Four-Valve Receiver has every convenience for both skilled and unskilled operation. It can be used as a one, two, three, or four-valve instrument, and is sensitive enough to receive American broadcasting when conditions are favourable. All the B.B.C. Stations, Radiola, Eiffel Tower, etc., are easily heard, frequently in sufficient strength to operate a loud speaker.

EVERY POSSIBLE DETAIL EXPLAINED

This Envelope contains:

Two full sized blue prints, 12 pages of working instructions, 4 pages of working drawings, 3 sheets of photographs printed on special art paper, list of components required, hints on their selection, full instructions on soldering and wiring, etc., etc.

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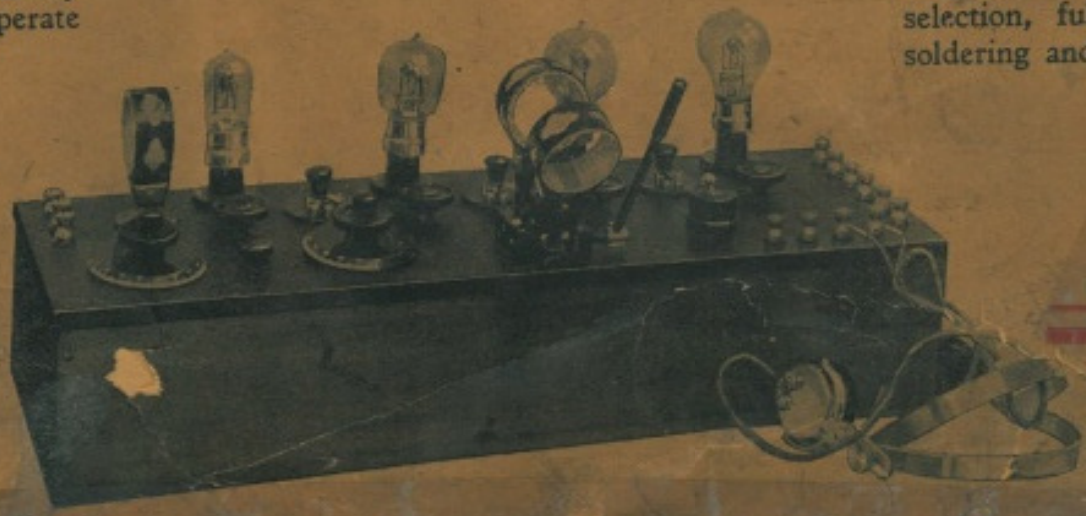

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NO WORKSHOP IS REQUIRED TO BUILD THIS SET.

Published by Radio Press

THE FOUR VALVE FAMILY SET - HOW TO MAKE AND USE IT.

- By -

PERCY W. HARRIS, Assistant Editor of ''MODERN WIRELESS'' and ''WIRELESS WEEKLY.'' Author of ''THE A.B.C. of WIRELESS,'' ''CRYSTAL RECEIVERS FOR BROADCAST RECEPTION,'' ''YOUR BROADCAST RECEIVER AND HOW TO WORK IT,'' ''PRACTICAL WIRELESS SETS FOR ALL,'' ''TWELVE TESTED WIRELESS SETS,'' Etc., Etc.

This receiver has been designed to fill the urgent need for what may be called a good all-round ''family'' wireless set, capable, when properly adjusted and in reasonable conditions of receiving all the broadcasting stations in this country with comfort and frequently on a loud speaker. In addition it fills the need for a set which, so far as the local broadcasting station is concerned, can be operated safely and successfully by the most unskilled member of the family without the slightest risk of causing interference to one's neighbours. Amongst its special advantages are the following:-

1. It can be used as a one, two, three or four valve set.

2. A loud-speaker and two pairs of telephones can be kept permanently connected so that when necessary a turn of a knob will change from 'phones to loud-speaker or vice-versa.

3. The first valve, acting as a high-frequency amplifier, is so connected as to get the utmost efficiency from it, using for this purpose the well-known tuned-anode method.

4. Reaction is used in the most efficient manner.

5. Critical adjustment is possible owing to the fitting of vernier adjustments to both tuning condensers, and by the added refinement of potentiometer control.

6. The turn of a switch will cut out the high-frequency valve entirely, leaving all the tuning on one dial only (of great advantage in unskilled operation).

7. The high-frequency valve can be cut in or out by a switch ir respective of whether one is listening on the detector valve or the detector followed by one or two stages of note magnification.

8. The switching methods have been so designed as to be of the utmost simplicity and efficiency with no appreciable loss through their introduction (this cannot be said of many designs in which switches are introduced).

9. The aerial tuning condenser can be placed in series or in parallel by a very simple arrangement which obviates the necessity of a complicated switch.

10. Without in any way detracting from the appearance of the set the usual expensive ebonite panel is dispensed with, thus effecting a considerable saving.

11. All of the components can be purchased from any reputable wireless dealer at a cost (excluding of course, valves, loud-speaker, telephones and batteries) of not more than £8 0s. 0d. at the outside.

12. The set is quite sensitive enough to give good results in the telephones when using an indoor aerial and it should give loud speaker results in this way from at least one broadcasting station.

13. The constructional work has been reduced to the simplest possible form sc that it can be handled by the veriest tyro.

Before commencing work on this instrument the reader is recommended to read carefully the whole of these instructions and to study the drawings, diagrams and photographs in every detail. Although an endeavour has been made to present every part of the apparatus in the clearest possible light there is always the possibility of a false step being taken if the reader has not acquainted himself thoroughly first of all with the practical details. The best way to start is to take the large blue print showing the wiring diagram and trace out on it each wire, endeavouring to understand as one goes the purpose of this particular wire by consulting the other illustrations and charts. Of course, this is not absolutely essential and many readers will perhaps prefer to start work right away, but the method just outlined will help the beginner to an intelligent appreciation of the various parts and their function.

The components required are not very numerous and are detailed below. You will find many firms willing to supply complete sets of parts or if you are experienced in the building of home sets you may perhaps prefer to pick and choose your parts among the various makes. So long as the components are of good quality, either method will be quite satisfactory.

1. 1 box measuring 2 ft. by 8 in. by 4 in.
2. 1 top panel 2 ft. by 8 in. by not more than ¼ in.
3. 13 terminals with ebonite bushes for wood mounting.
4. 4 valve sockets for wood mounting.
5. 1 single coil-holder.
6. 1 2-coil holder.
7. 2 variable condensers, each of 0.0005 μF fitted with single plate vernier.
8. 4 filament resistances for panel mounting.
9. 2 3-point single pole switches mounted on ebonite.
10. 1 2-point single pole switch mounted on ebonite.
11. 1 miniature tumbler switch.
12. 1 potentiometer.
13. 1 fixed condenser, 0.0003 μF.
14. 1 grid leak, 2 megohms with clips.
15. 2 fixed condensers, 0.002 μF.
16. 1 fixed condenser, 1 μF.
17. 2 intervalve transformers.
18. A quantity of No. 22 tinned copper wire.
19. Quantity of Systoflex or other insulating tubing.

NOTES ON COMPONENTS.

1. The box can be made of any kind of wood, but it is preferably made of some good wood such as Mahogany, which can be finished to have a good appearance. Where economy is a first consideration it can be made of deal, sand papered and treated with varnish stain.

2. The top panel can very conveniently be made of 3-ply wood, although ¼ in. fretwood will do quite well. Good well seasoned wood is recommended here or warping will take place.

4. The valve sockets on my own set were made by Messrs. Fullers and although more expensive than some are of high grade ebonite, well finished. The ordinary A type flanged sockets will do here, but my own experience is that unless these are bought from a reputable dealer, they may be made of very inferior material. Several makers sell special sockets for wood mounting and these can be recommended.

5. There are several excellent makes of single coil-holder for wood board mounting; that used on the set was made by the Bowyer-Lowe Co., of Letchworth.

6. Any good 2-coil holder will do here. That shown was obtained from Messrs. McMichael, Ltd.

7. It is not absolutely essential that these condensers should be fitted with single plate vernier adjustment, but there is no question that the vernier movement is helpful, particularly to the inexperienced, in getting a good setting and fine adjustment. Be careful that your condensers are not smaller than 0.0005 μF for unless this value is used you will not be able to get the full range of wavelength with plug-in coils. Those shown in the set were obtained from Messrs. McMichael.

8. Any good filament resistances will do here. Those shown are known as the ''W & M''; they are of good average quality. It is not necessary to have vernier adjustment on these filament resistances, although on the high frequency valve, it may sometimes be found a slight advantage. Vernier adjustments are not so important on British valves as they are on American. Dutch valves if used in this set as detector valves may possibly benefit by vernier adjustment. (see later notes on the use of valves).

9 and 10. The switches shown were obtained from the Bowyer-Lowe Co., of Letchworth. They have the advantage that they are ready mounted on ebonite and are fitted into a wood panel merely by cutting a circular hole with a fretsaw. However, there is nothing to prevent the reader buying the ordinary switch arms and studs and mounting them on small pieces of ebonite to occupy about the same space as that shown.

11. Any ''on'' and ''off'' switch will do, but it will be found neat and convenient to use one of the small ebonite tumbler switches which are obtainable from any motor accessory dealers. This form of switch is used on the dashboards of motor cars for switching headlights on and off.

12. The potentiometer shown is of the T.C.B. variety; any well made potentiometer will do here, provided it will fit in the space given.

13 and 15. These condensers are best of a recognised make such as Dubilier, Mullard, etc. Avoid at all costs the unnamed fixed condensers sold by ''back-street'' wireless dealers. You may save a shilling or so, but the risk is not worth it. The particular fixed condensers shown are of an unusual type and were used because they happened to be at hand when the set was built. They do not possess any advantages over those named.

17. There are so many good intervalve transformers on the market now that the reader has a very wide choice. Intervalve transformers can be obtained for prices ranging from 10s. 6d. to 30s.; the cheapest of all are dear at any time and the most expensive are usually worth the money. A good average price is £1 1s. 0d., for which figure a number of excellent makes can be obtained. There is no need to use identical transformers here and different makes will work quite well together. Those actually used in the model set were a Peto-Scott and an Igranic. A strong warning must be issued here against buying unnamed transformers,--the market is flooded with these atrocities, which look quite well from the outside but are composed of rubbish within. It stands to reason that a maker of a good transformer is not only willing but anxious to attach his name to it. Buy a well-known make such as those advertised in ''MODERN WIRELESS'' and ''WIRELESS WEEKLY.''

NOTES ON ACCESSORIES.

The following accessories will be required with this set:--

1. 4 valves.
2. 1 accumulator.
3. 1 high-tension battery.
4. 1 or more pairs of telephones.
5. 1 loud-speaker.

With regard to 1, the reader has a large choice. Very likely he already has several valves and these can be used in the set now being built. Any good valves will do provided they will all work effectively on the same high-tension voltage. Dull emitter valves can be used just as well on this set as on any other, but the following points should be noted:--(a) If the old types of dull emitter are used (D.E.R., A.R.D.E., or Mullard L.T.), a 2-volt accumulator will be needed. Do not try to run a 4-valve set with the above-mentioned dull emitters from dry cells. The load will be far too great for any dry cells, no matter what their size unless you get them so big as to be extravagantly expensive. With the above-mentioned valves the ordinary filament resistance will suit quite well. (b) This set will work quite well with the Wecovalve Pea-nut type, but here again it is not recommended that the reader should attempt to run these valves off dry cells. A 2-volt accumulator should be used with the special filament resistances supplied by the Western Electric Co., Radio Communication Co., or the Mullard Radio Valve Co., for use with these valves. (c) If it is desired to run this set off dry cells the reader is recommended to use the new dull emitter valves, using 0.06 of an ampere. These are obtainable from the British Thomson Houston Co. (B.T.H. valves), the Marconi Osram Valve Co. (DE3 valves), the Edison Swan Electric Co. (A.R.06 valves) or the Mullard Co. When these are used the special filament resistances supplied for these valves should be fitted.

2. The accumulator required should be a 6-volt if used with bright emitter valves or a 2-volt if used with the older type of dull emitter or the Pea-nut. If used with bright emitter valves the ampere hour capacity (actual not intermittent) should be not less than 40 ampere hours. A 60 actual is a better proposition. If all of the valves are used all the time, a 40 ampere hour accumulator should run this set for about 17 hours continuously with the ordinary bright emitters and a 60 actual ampere hour cell should run it for 25 hours in the same condition. Of course when using less than 4 valves the current will be economised. It is easy to find how long the accumulator will last in given circumstances by taking the number of valves used and the current consumption of each valve (this can be found from the Makers' list), multiplying the current consumption by the number of valves used and dividing this figure into the ampere hour capacity of the accumulator. If a 4-volt accumulator is used with the new .06 ampere valves a 20 ampere hour accumulator of this voltage will run the set, using four of the new valves, for 80 hours at least. I would recommend you to use accumulators even with the new valves if you have facilities for charging them. To summarise, the following are the minimum sizes of accumulators recommended for use in this set. For use with bright emitters a 6-volt 60 ampere hour actual; for the old type of dull emitter (D.E.R., A.R.D.E., etc.) a 2-volt 40 amp. actual; for use with Pea-nut valves, a 2-volt 30 amp. hour actual; for use with the new .06 ampere valve, a 4-volt 20 ampere hour actual. If the cells are bigger, so much the better.

3. The high-tension battery should be of a well-known make, such as Siemens, Ever-Ready, etc., 60 volts being a suitable value. Most makers make several sizes of battery for the same voltage, the larger sizes having larger unit cells in them. I would recommend the largest you can afford in this way. Be sure to buy the battery from a dealer who does a good trade or you may buy a high-tension battery which has been in stock for a long time and has seriously deteriorated.

4. The telephones should be of the high resistance variety. Of course you need only have one pair, but terminals are provided for two pairs and you can if you desire use several more pairs than this. If you want to use more pairs of telephones than there are terminals for them, connect the telephones in series.

5. A loud-speaker is not necessary with this set, but will be found a very great convenience. There are numerous makes of loud-speakers of high grade on the market. The reader is not recommended to buy a small pattern if he can afford the larger, as although these former are good value for money the quality is not comparable with that given by the larger models. It is quite a mistake to think that the larger models are only suitable for large halls. They do not give much greater volume than the smaller size (if given the same signal strength to start with), but they give far better general reproduction. I cannot recommend the loud-speaker arrangement which is merely a horn, on to which a pair of telephones can be clamped. I have yet to find a device of this kind which gives such good results as the properly built loud-speakers, with their self-contained mechanism.

BEGINNING WORK.

I would recommend the reader to commence work by making or obtaining the box. Do not leave the construction of the box until the last, for you will find it of great convenience in supporting the panel when wiring it. Without the box you will find it difficult to support the panel firmly when soldering up the connections.

For some reason or other many beginners seem to avoid cabinet work, although it is by no means difficult to make a box of this kind. The size has been made expressly to suit the sizes of wood that can be bought ready planed. For the box you will need the following (all $\frac{3}{8}$ in. wood):--

1 length of planed wood, 2 ft. by 8 in.
1 2 ft. length of same width sawn down the middle so as to make 2 pieces each 2 ft. long by 4 in. wide.
2 pieces of the measurements given in the diagram to form end pieces.

If you are making the box yourself, you will find it convenient to buy a length of 8-inch wide wood, $\frac{3}{8}$ in. thick and 5 ft. 6 in. long. From this you will be able to cut the strips described above. If you rule the crosslines on the wood at right-angles to the edge and saw carefully, you will find that no further planing is necessary and the parts of the box can be screwed together with ordinary wood screws without recourse to glue. When the box has been assembled in this fashion rub it all over very thoroughly with sand or emery paper. If you do this carefully you will obtain quite a good finish, and the wood can then be treated in any manner desired. If the box is of plain deal, a coat of the popular floor varnish stain will give quite a good appearance. If the box is made of better wood such as mahogany it can be finished in several ways; two of which I can personally recommend. The first of these two methods is recommended to the beginner who has no experience in treating wood. It consists of painting the wood first of all with a water stain (Stevens, the ink people, sell very good water stain in bottles--walnut or mahogany may be chosen). This stain is painted on with a soft brush and will sink evenly in the wood without showing streaks. When the wood is quite dry, apply one or two coats of clear spirit varnish (you can obtain both the stains and the clear varnish from Hobbies, Ltd.). This will give a very fine appearance closely resembling French polish. The second finish is French polishing. If the builder is experienced in French polishing he will know what to do in finishing off the wood by this second method. It cannot be explained in a short article. If the reader so desires, the top panel can, of course, be of ebonite, and the set will have a very handsome appearance if the panel is so made, but there will be no loss of efficiency and considerable saving

will be effected if the top panel is of wood. The set being described is made in this way. The wood should not be thicker than ¼ of an inch or you will not be able to mount the various components on it. When the panel has been cut to size, it should be carefully finished on the top and at the edges with two or three grades of sand or emery paper and when this is done a single coat should be given of ebony floor stain or other suitable black paint or stain. Black enamel is not recommended in this connection, for it will sink in the wood unevenly, and will easily mark when the reader is mounting his set. The ebony floor stain has proved in the writer's hands to be the most satisfactory substance to use for treating these wooden panels. It can be obtained in bulk from any oilshop, or in bottles as one of the proprietary brands of floor stain.

You are now ready to start the mounting of the component parts, all of which are carried on this top panel. When the stain is quite dry, lay the panel face downwards upon a sheet of paper to avoid damaging its surface, and mark out with a lead pencil on the under or non-stained part of the panel the positions of the various parts as shown in the blue prints and diagrams. You need not worry about lead pencil marks here, for in all case holes will be cut out in the wood to allow for the insulating ebonite, so that there will be no continuous line between one component and another. Be sure that you mount the component parts in their proper places, and that you allow adequate space for the thickness of the sides of the box. This means that you should rule all round the panel a line which will show the limit to which your components can come. Thus, if the wood of the size of the box is ⅜ in. thick the line should be at least ⅜ in. from the edge of the panel. This will avoid any components coming into contact with the side of the box. When this same edge has been marked out around the panel, you should lay out the component parts to see whether they will fit in spaces shown in the diagram. With some makes of condenser and some components it may be necessary slightly to alter the positions of the centres of the holes, but in general it will be found that the reader can follow the plan in detail without difficulty. A brace and bit will be found useful for cutting the smaller holes, whilst for the larger apertures a fret saw is recommended. For some reason or other the fret saw is very little used by wireless constructors, although it is the most valuable instrument. If you use the ebonite bushes made by the Bowyer-Lowe Co., ⅜ holes will be necessary. Other makes of bushes may require different size of holes. Before starting to drill any holes it is well to make an impression in the wood where the centre of the drill is to come, otherwise there will be a tendency for the drill point to wander, and when the hole is cut the terminals and other parts will not be strictly in line. This naturally spoils the symmetry of the apparatus, and should be guarded against.

When cutting the holes for the spindles of the condensers and the filament rheostats, be sure to make the holes of ample size, to avoid any possibility of rubbing. Most variable condensers are mounted on a panel by metal screws which run into a threaded hole in the top plate. In this case it will be necessary to drill clearance holes in the wooden panel in the exact position where the screws should come, so that the metal screws can be passed through the panel and then into the top plate. Unless a drilling template is provided with the condenser the reader is recommended to make the template himself. It is quite easily done by cutting a piece of paper the same size as the top plate of the condenser, and pressing it over the top, so that marks will show exactly where the holes in the top plate occur. The paper template can then be transferred to the top of the panel, arranged in position, and marks made in the wood where the holes should come. Usually 4 B.A. screws are used, and a clearance drill for 4 B.A. screws should be obtained.

If a T.C.B. potentiometer is used a drilling template will be provided with it. The Igranic potentiometer is similarly provided with a paper template. The mounting of the filament resistances should be quite easy, and should not require the drilling of holes in the top of the panel.

After a central hole has been made for the spindle, wood screws of sufficient length to pass through the ebonite former and about ⅛ in. into the wood behind will make the necessary attachment.

When fitting the valve sockets it will be found necessary in most cases to cut four holes each exactly an inch in diameter. If these holes are cut carefully it will be possible to stand the flange type of valve socket immediately above the hole so that the projecting pins on the under side of the socket will not make contact with any portion of the wood. The flange type of socket can be fitted either on top of the hole or secured on the under side of the panel, so that the barrel of the socket can be pushed up from the under side. The wood screws can then be passed through the flange on the under side of the panel.

It will be noticed in the photograph that the particular valve sockets have a projecting clip which makes contact with the metal part of the valve mount. It is sometimes claimed that this is an advantage, but the writer has not found any special advantage from their use in this set.

A very convenient tool for use when making up instruments on wood board mounts is an ''expanding bit.'' This is made to fit into an ordinary brace, and can be adjusted to cut holes of any diameter between ½ in. and 1½ in.; larger sizes may also be procured. If the reader contemplates making other apparatus besides the present set he is strongly recommended to purchase one of these tools, which is cheaper than a complete set of bits to cover the same range of holes.

For attaching the transformers (which should be well spaced) the fixed condensers and the large Mansbridge type condenser short wood screws of a length sufficient to obtain a good hold, but not long enough to pass right through the panel, should be used. Before the small tumbler switch is screwed in place, two holes should be cut in the panel to allow of the wires from this switch to pass through. A couple of wood screws will then suffice to hold the switch in place, and it will be easy to pass the connecting wires through from the underside, so that they can be locked in the terminals. If it is not convenient to obtain such a switch (although any dealer in motor accessories will provide it for 2s. 6d.), any ordinary 'on' and 'off' switch can be used equally successfully, although the appearance may not be quite so neat as that shown.

A point which may give a little difficulty to the beginner is the method of mounting the grid leak. The Dubilier Co. sell their .0003 μF condenser, complete with clips, in which the grid leaks can be placed, but the use of these clips in this way is only possible when the leak is to be connected directly across the condenser, as is the case with some circuits. In this case, however, the leak must not be across the condenser, or it would enable the high-tension supply from the first valve to reach the grid of the second, to the detriment of the working of the instrument. The leak in this case must be connected between the filament and the positive lead of the valve, which means in effect that only one side of the lead must be connected to the clip. The simplest way of joining up the lead is to do as shown in the photographs. Place one end of the lead under one clip and solder a short length of fairly heavy wire to the other end, so that it can be connected directly to the positive leg of the valve. A note of warning is necessary here. When soldering the wire to the grid leak, use a hot iron and only let the iron rest on the leak for just one moment to cause the solder to melt. If this is not done rapidly you may injure the leak. An alternative method is to obtain a pair of clips for holding grid leaks, and to mount these on a separate strip of ebonite alongside the grid condenser.

WIRING UP.

When all of the components have been secured in place we are ready to start the operation of wiring up. The first step is to take a

smooth file and to rub the ends of all terminals and other points where a soldered connection has to be made. Unless you carefully remove the lacquer in this way the solder will not adhere well and you may get an unsatisfactory joint and loss of signals. A slight touch of the file so that a bright surface is exposed is all that is necessary. After filing all points, carefully remove the brass filings with a camel hair brush.

The next operation is to ''tin'' all points which are to be soldered with a good hot soldering iron. In case some readers may not be adept in the use of a soldering iron, the following is the procedure :--

Take the soldering iron, which should be of generous proportions, as the small irons do not retain their heat long enough, and place it in a clean flame (such as that obtainable from a gas cooker or ring) until a small greenish flame starts to play round the iron. Remove the iron from the flame, rub quickly with a smooth file until a bright surface of copper is exposed, and dip into a good soldering paste such as Fluxite; then with a piece of solder rub the bright portion until an even bright coating of solder covers the tip of the iron. If the iron is of the correct temperature it should cause the fluxite to hiss and smoke when it is quickly touched on it. With a drop of solder adhering to the end of the bolt it should be held for about 5 seconds on each point that has to be soldered and, if the iron is of the correct temperature, a small drop of solder would adhere to each point. The iron will probably not retain its heat long enough to tin all the points at one round, so it should be returned to the flame in such a way that the tinned end is not in the flame itself but projects just beyond. Be very careful not to overheat the bit or the solder will be burnt off, and the bolt will need to be retinned. It is advisable to keep close at hand an old rag with which the point of the bolt can be quickly wiped each time it is removed from the flame. Coating the end of the bit with solder is facilitated if a little of this substance is placed in an old tin lid together with some fluxite; the hot iron can then be dipped into this tin lid just before it is applied to the points which are to be soldered.

When all the points have been suitably tinned, we can start wiring up. It is not absolutely necessary to follow any special order in so doing, but it is well to progress logically from one end of the set to the other, marking off on the wiring diagram each wire as it is put in place. In this way a glance at the diagram will always show how many more connections we have to make. Perhaps the best way to start is to take a reel of wire, unwind about a foot, and then, with the hot soldering bolt in the right hand, and the wire in the left, touch the end of the wire so that a small amount of solder adheres. Now quickly bring together the end of the wire and the point to which it is to be attached; if the iron is of the right temperature the beads will fuse, and a firm and sound electrical joint will be made. Now stretch the wire across to the point to which it is to be taken and cut off a length about ½ in. longer than this distance. Next take a length of insulating tubing, measure how much is required between the two points, cut off this length, slip it over the soldered wire, and with the hot soldering iron make the next connection. Frequently it will be found that one wire can be made to run to several points. When this is the case, roughly measure the length of wire required for a continuous run and cut it off; then, as before, cut the necessary lengths of insulating tubing and slip them over one at a time, soldering each connection as you proceed. It is not necessary to solder the wires to those points which have screw terminals, such as transformer connections. Soldered connections are strongly advised on the valve socket pins.

Some 2-coilholders require flexible connections to be made to the moving coil and in this case special steps must be taken. A good flexible wire for use in such holders is that used for electric lighting. i.e., the usual double flex. wire, rubber covered. A short length of this should be cut, the two parts untwisted and the silk or cotton covering removed. The wire will then be found to be rubber covered and will be sufficiently

flexible for the purpose. Strands are bared at each end of each section of wire and joined up as shown. In order that the wiring under the panel may not be loose, the two flexible wires are clamped against the underside of the panel by a piece of wood secured through its centre by a wood screw. On the other side of this piece of wood the wires going to the other parts of the set are soldered.

It is of paramount importance in a job such as this to do your soldering cleanly, and to avoid the excessive use of fluxite or other flux. The merest trace is all that is necessary when soldering to brass, and if any excess is used it will melt, run down the shank of the terminal, and form a thin semi-conducting surface on the ebonite surface, thus effectively removing the insulating qualities of this material. Judging from some panels I have seen, some amateurs use a great excess of this material. They will not get any better results by so doing and in nine cases out of ten will lose in efficiency of the set through leakage.

Be particularly careful when soldering up to join the correct wires to the I.P., O.P., I.S. and O.S. terminals of the transformers. The arrangement of terminals varies with each make, so that the markings should be carefully noted. In some transformers, for example, I.P. is opposite O.P.; in others it is opposite I.S. Remember always that O.S. goes to grid and I.S. to filament, whilst O.P. goes to plate and I.P. to positive high-tension.

TESTING THE SET.

As soon as the wiring is complete you will naturally wish to try the set. To do this proceed systematically, or you may possibly burn out your valves if you have made a wrong connection. First of all, turn all the filament resistances to the ''off'' position and place the tumbler switch at the ''on'' position. Next insert valves in the socket; thirdly, connect up the accumulator to the low-tension terminals, leaving for the moment the high-tension battery disconnected. Now turn on the filament resistances one by one and see if the valves light. If they do, you can now connect up the high tension battery as shown. If all is well so far, connect the aerial and earth to the set with the condenser in the parallel position, i.e., with the strap connecting the lower two terminals and the aerial on the upper terminal and the earth on the lowest. Place the switch so that only the detector valve is in use and switch off the filaments of the valves not in use. Insert the necessary coils. Now if broadcasting is proceeding from your local station you should be able to hear it at a certain position on the left hand tuning condenser (the right-hand tuning condenser and the reaction on the anode coil will not be in circuit, so you need not trouble to adjust them). If you find that signals are clearly audible, switch on one note magnifying valve with the selector switch and switch on the FOURTH VALVE (this is the one in circuit when one note-magnifying valve is being used). You should immediately get a great increase in signal strength, and if this is the case turn the switch to the point for two note-magnifying valves and light the third filament. Again there should be a very great increase in signal strength, probably quite sufficient if you are within 10 or 20 miles of a broadcasting station to operate a loud-speaker. If you have a loud-speaker it should be connected to the loud-speaker terminals, and as soon as the strength is too great for the telephones you can turn the switch from telephones to loud-speaker. If the wiring has been properly done the turning of this switch should disconnect the telephones and connect the loud-speaker at once. The filaments should only be turned on sufficient to give good signals, for it will be found that if they are brightened unduly you will not get any better results, and you may get howling. In addition, the life of the valves will be considerably shortened.

When a detector, one note magnifier and two note magnifiers have been found to be in order, as well as the 'phones and loud-speaker switch. you may now experiment with switching on the high-frequency valve and

lighting this particular valve. When this valve is on you will need to tune also on the second condenser and of course the reaction can now be used on the anode coil. First of all open out the reaction coil at right-angles to the fixed or anode coil, and turn the potentiometer until the slider is on the end nearest the positive wire (you will see which position this is by examining the diagram). Try the best position on both condensers for signals (you can leave the first condenser set about as before and tune on the second), and then, when signals are well tuned in, gradually raise the reaction coil until it comes closer to the fixed or anode coil. This bringing up of the reaction coil should greatly increase signals strength until a point is reached until you hear a slight ''plop,'' which indicates that the set is oscillating. The best telephony will be found at the point immediately before this plop is heard, but if the broadcasting station is within 12 miles it should not be necessary to use reaction to increase signal strength. If you find after the set has been tuned on both aerial and anode condensers that there is no increase but rather a diminution in strength by bringing up the moving coil, try reversing the connections which go to the moving coil. This will probably put matters right. When you have succeeded in tuning in satisfactorily and in using the reaction coil, you should try varying the position of the slider upon the potentiometer. You will find that when this slider is over at the negative end it is very much easier to make the set oscillate, but on the other hand it is not so easy to tune, and signals will not usually be of the same quality. You will generally find it best to leave the slider of the potentiometer permanently on the positive side, this connection having been made permanent in the ''ALL CONCERT'' receiver, which contains no potentiometer. This greatly reduces the risk of radiation from the aerial when the set is in the oscillating condition.

For very short waves you will need to place the aerial tuning condenser in series. This is done as shown in the diagram by connecting the aerial to the middle terminal and the earth still to the bottom terminal, opening the link which connects the two bottom terminals.

TUNING AND COILS TO USE.

If you wish to hear all broadcasting programmes, both British and Continental, with this set, you will need the following numbers of coil. The numbers given are those of the Igranic Co., but similar numbers of other makes of coil will suit.

25, 35, 50, 75, 100, 150, 200, 250, 300, 400.

Any good make of plug-in coil will do here. For British broadcasting a set of Concert coils made by any of the leading makers is an advantage in place of numbers 25, 35 and 50. At the time of writing this article, the British broadcasting stations are about to have their wavelengths changed, and therefore the figures given below may be inaccurate at the time of publication. They will, however, be found a good general guide.

	AERIAL COIL.	AERIAL TUNING CONDENSER.	ANODE COIL.	ANODE CONDENSER.	REACTION COIL.
LONDON.	35	90	50	80	75
CARDIFF.....	35	64	50	72	75
MANCHESTER....	35	100	50	86	75
BOURNEMOUTH...	35	134	50	98	75
NEWCASTLE.....	35	172	50	114	75
GLASGOW.....	35	180	50	134	75
ABERDEEN.....	50	76	75	48	50
BIRMINGHAM....	50	10	75	22	50
RADIOLA.....	200	28	300	64	250
EIFFEL TOWER..	300	40	400	30	250

The transmissions of the Ecole Superieure de Postes et Telegraphes will come in at a position intermediate between Glasgow and Birmingham.

Koenigswusterhausen, the German Broadcasting station, will be found about 20° above the Eiffel Tower adjustment. The Dutch concerts from the Hague will be found on 100 coil for aerial, 150 in the anode and say 75 in the reaction. American broadcasting can be heard quite easily on this set when conditions are favourable. The adjustments for most of these stations will correspond either with London or Bournemouth wavelengths or somewhere intermediate.

HOW TO PICK UP TELEPHONY.

The simplest way to pick up weak telephony is first of all to make the set oscillate (you will not be radiating with this set if you keep the potentiometer slider on the positive side when oscillating), and then to vary both tuning condensers until a high pitch whistle is heard. Further adjustment of these condensers will bring the whistle down in tone until neutral point is reached, after which the note will rise again on the other side. You should stop at the neutral point on both condensers, and then loosen the reaction coupling until the best telephony is heard. This will be found at a point just before the oscillation starts.

LISTENING TO MORSE FROM SHIPS AND SHORE STATIONS.

When no telephony is available and the reader desires to test and adjust the set, it is a good plan to listen to the ship working, which is carried on at all hours of the day and night on the 600 metre adjustment. A 50 or a 75 coil is the aerial and a 100 coil in the anode with say 150 in reaction will enable the reader to find the adjustments for ship working. It will usually be quite sufficient to use two valves (the high-frequency and the detector) for this, and if more than one magnifier is used signals will be far too powerful for the headphones.

USE OF THE SET WITH INDOOR AND FRAME AERIALS.

A very satisfactory indoor aerial is made by running a wire, such as an ordinary double cotton covered bell wire, round three sides of a room supported on dresser hooks on the picture rail. The earth connection should be made to the set in the usual way, and the lead from this indoor aerial taken from the aerial terminal of the set. The condenser should be used in parallel in this case. Although there will be a diminution in strength of signal, compared with the outside aerial connection, yet such an arrangement should often be quite good enough for loud-speaker reception from the nearest broadcasting station. As far as telephones are concerned, when using only one note magnifier following the detector and high-frequency valve, you should be able to hear several broadcasting stations in this way.

To use the set with a frame aerial, connect the ends of the frame to the aerial and earth terminals with the connections made for a parallel condenser. No coil must be used in the coil socket when using a frame as the whole of the inductance should best be in the frame itself. Tuning will now be conducted by varying the aerial tuning condenser and the anode condenser as before, the frame being swung round on a vertical axis until the best signals are heard. Best reception will be found when the frame is in the plane joining the receiving station and the transmitting station. The set can in many cases also be used very satisfactorily with a Ducon adaptor made to plug into the electric light socket.

USE OF SINGLE PLATE VERNIER ADJUSTMENT OF CONDENSERS.

The vernier adjustments on the condensers are only used when it is necessary to make a very fine adjustment, such as when picking up telephony on the carrier wave, as explained above. It is not absolutely essential in this set, and can be dispensed with by those readers who do not find it convenient to buy a condenser fitted with a single plate vernier.

RESULTS WITH THE SET.

Immediately after the set described in this article was completed it was tested on both indoor and outdoor aerials. On the latter it was found possible to listen to all of the broadcasting stations in this country at loud-speaker strength in a good sized room. Radiola and the Eiffel Tower, as well as Koenigswusterhausen, were also heard quite clearly on the loud-speaker. The set is thus a good universal set for general reception of broadcasting, and can be confidently recommended.

SUGGESTIONS FOR USE OF SWITCHES.

If the owner of the set desires to leave it so that it can be manipulated easily by unskilled persons, it is suggested that switches be set to cut off the high-frequency valve. All tuning will then be conducted on the aerial tuning condenser, which only needs to be turned until the best signals are obtained either in telephones or loud-speaker. The filament resistances should be adjusted to the best point once and for all, and should then be controlled by the ''on'' and ''off'' switch. If the young folks in the family are fond of the bed-time stories when father is away, the set can be arranged and tuned on the previous evening's broadcasting, and then switched off with the tumbler switch. The next afternoon when bed-time stories commence, the set can be brought into immediate operation by pulling over the tumbler switch. In many cases reception in the telephones will be all that is required, and in that case of course the necessary number of valves can be switched on, tuned and switched off again with the tumbler switch, ready for the next person who desires to use the set. When the local broadcasting station is not more than 10 miles away, it will be found that just as good signals are obtained with the high-frequency valve turned off. With indoor aerials and frames, however, the high-frequency valve is necessary, even at this distance.

USE OF THE TELEPHONE-LOUD-SPEAKER SWITCH FOR COMPARING TWO LOUD-SPEAKERS.

It is frequently interesting to be able to compare the merits of two different loud-speakers. If one loud-speaker is connected to the telephone terminals, and the other to the proper loud-speaker terminals, and broadcasting is tuned in, one can change immediately from one loud-speaker to the other by moving the switch from one position to the other. This saves a great deal of bother in fixing up special switches or connecting and disconnecting different loud-speakers when making tests. Similarly, two different types of telephones can be compared.

Percy W. Harris.

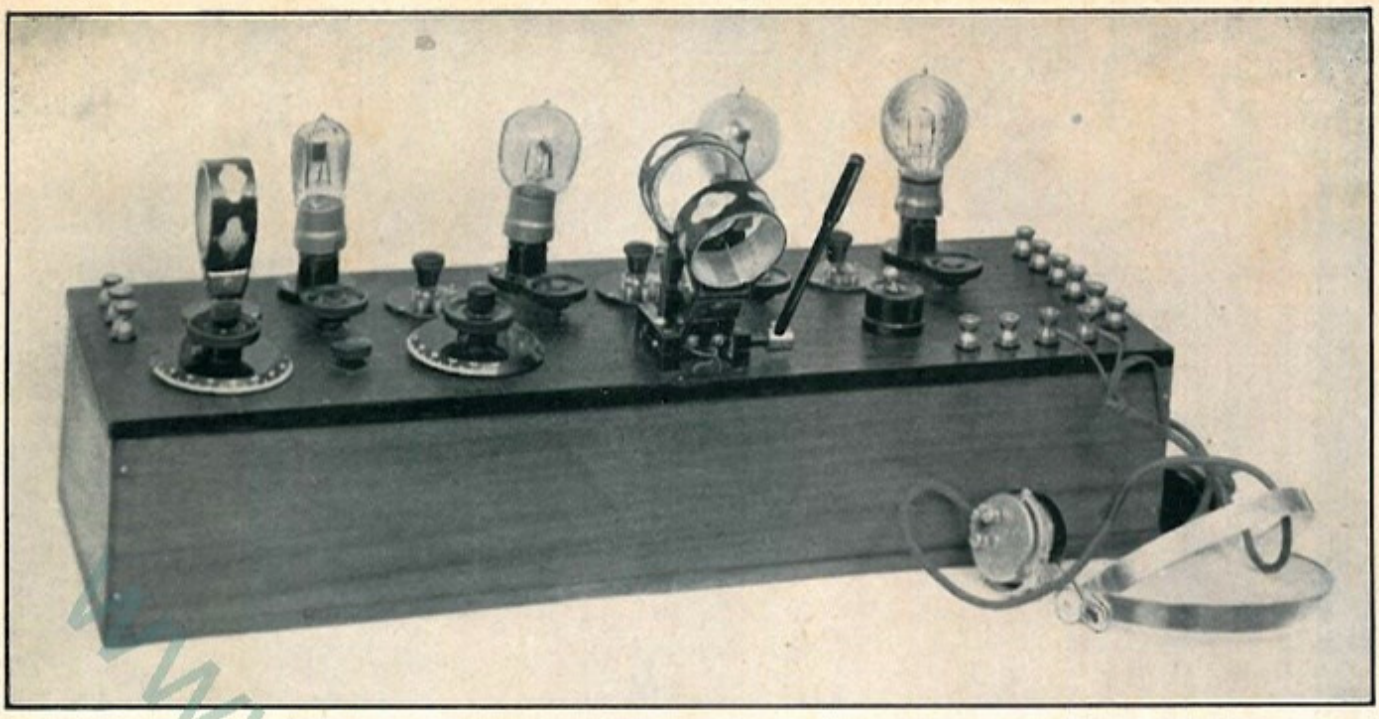
IMPORTANT NOTICE.

The author of this Envelope will be very pleased to hear of the results obtained by those who build the Family set, and to help by supplying any desired addresses of dealers in the necessary parts.

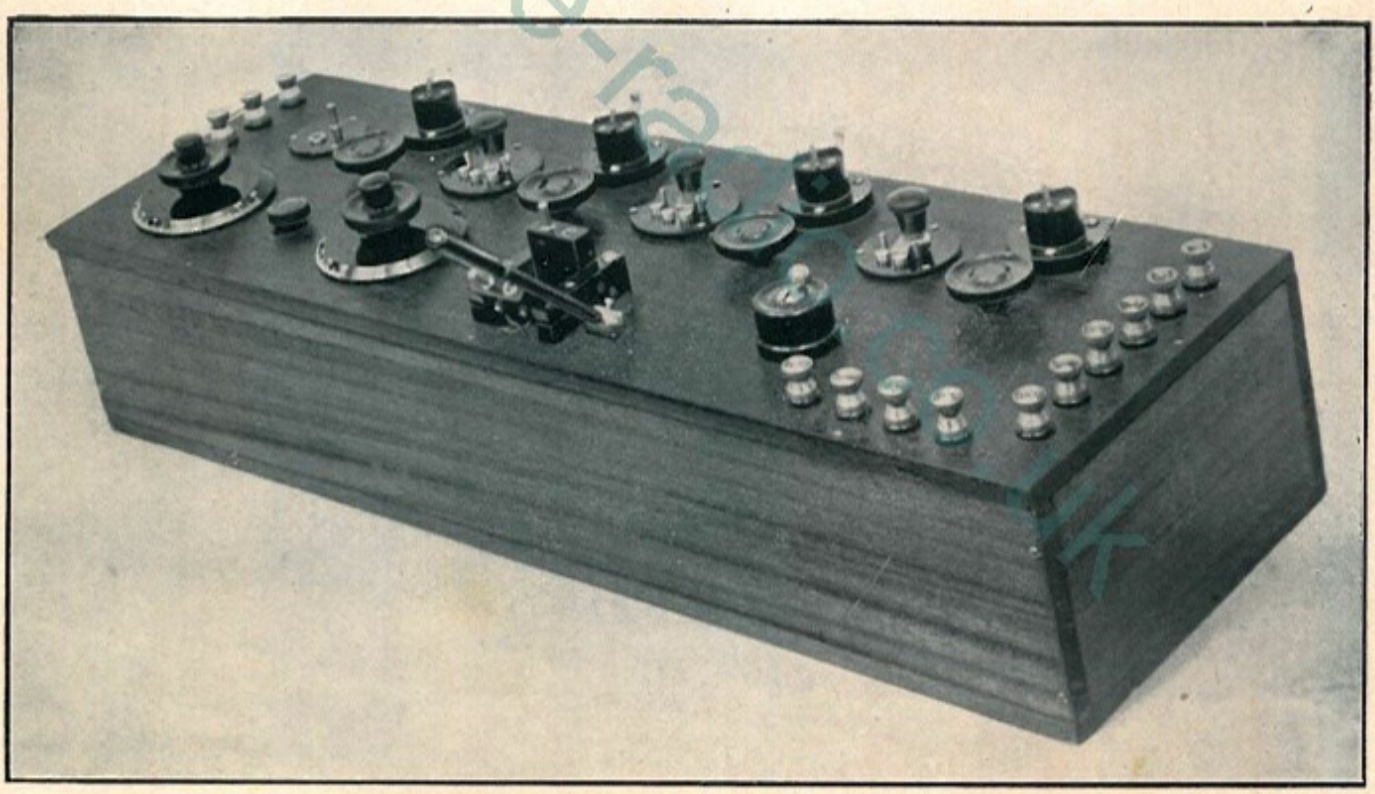
In any case of difficulty, the proper course for the constructor to take is to apply for assistance to :

Radio Press Service Department, Ltd.,
Bush House,
Strand,
London, W.C.2

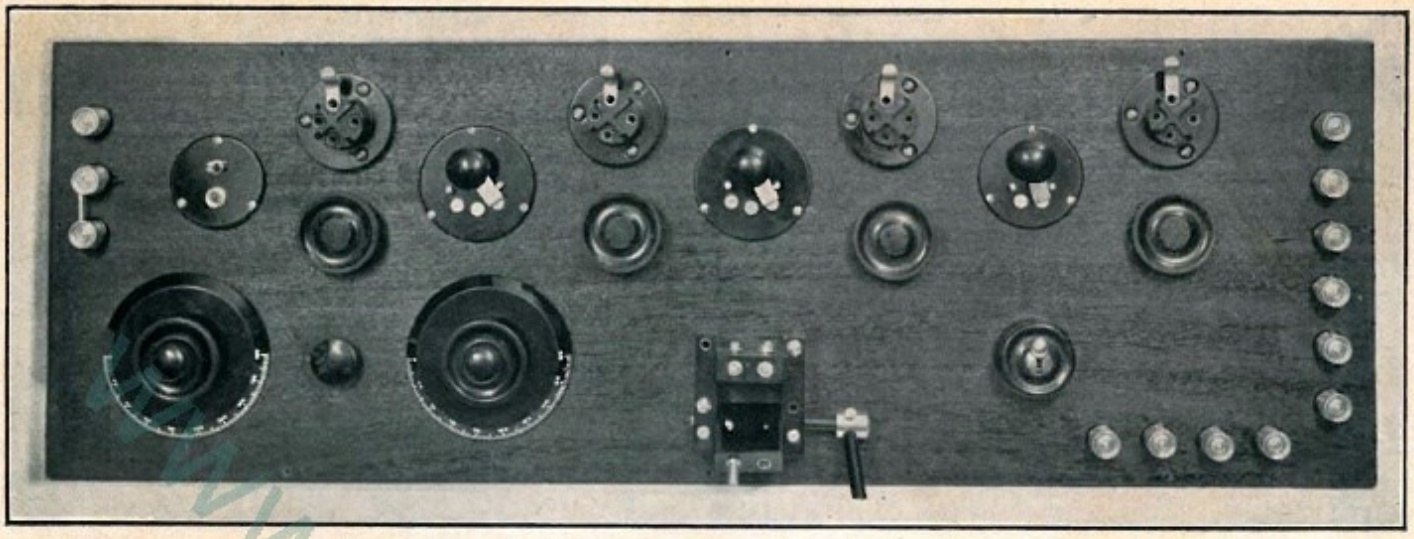
Please give the fullest possible description of all the parts and accessories used, valves, batteries, aerial and earth, symptoms observed, and so on. If your difficulty proves to have been due to any error or lack of necessary information in this envelope, advice will of course be given without charge, but in all other cases the usual fee of 2/6 must be enclosed, with a stamped addressed envelope.



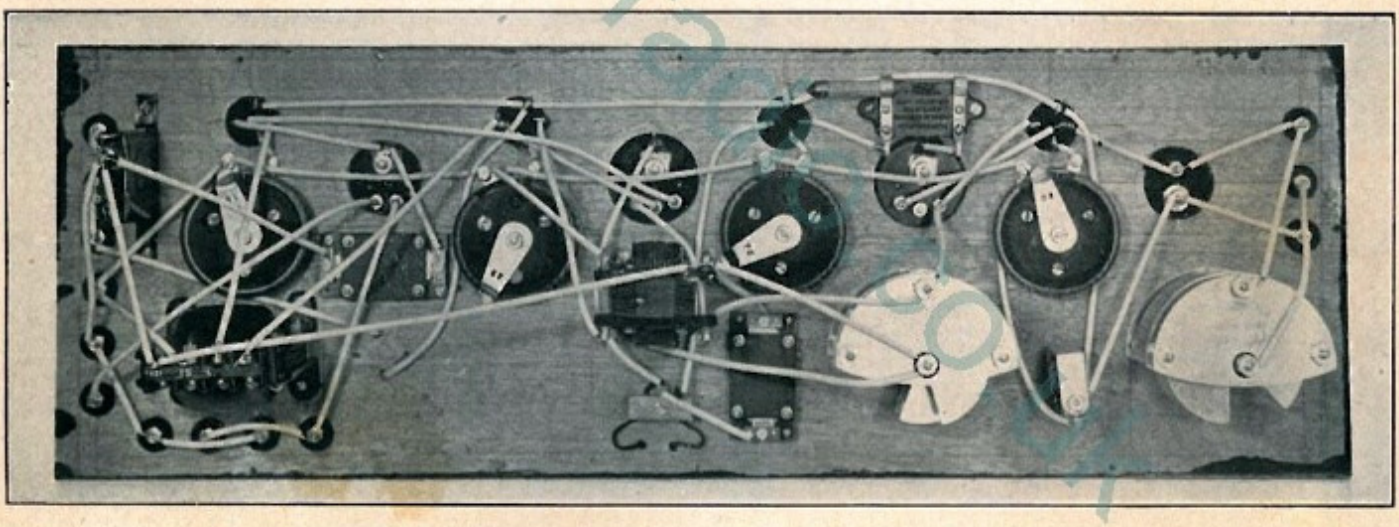
The finished set with valves and coils in place. Notice how the black finished wooden top gives the effect of an expensive ebonite panel. The three terminals on the left are for aerial and earth connection. If you want to use the aerial tuning condenser in **series**, connect the aerial to the **middle** terminal and the earth to the bottom, leaving the linking wire **open**. For parallel connection (best for general work) join the lower two terminals with a wire, connect aerial to the **top** terminal and the earth to the **bottom.**



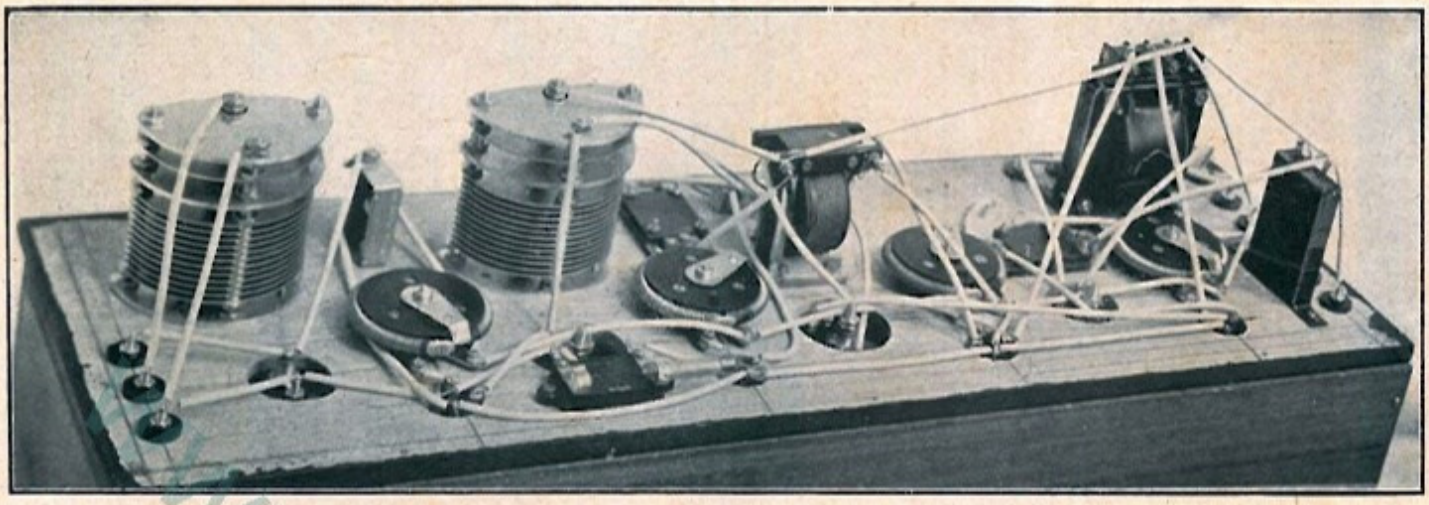
A "close up" with valves and coils removed, showing tuning controls and switches. The batteries and loud speaker are attached to the right hand terminals and telephones (one or two pairs) to the front terminals. The tumbler switch turns all the filaments on and off. Adjustment of each filament can be carried out with the separate resistances.



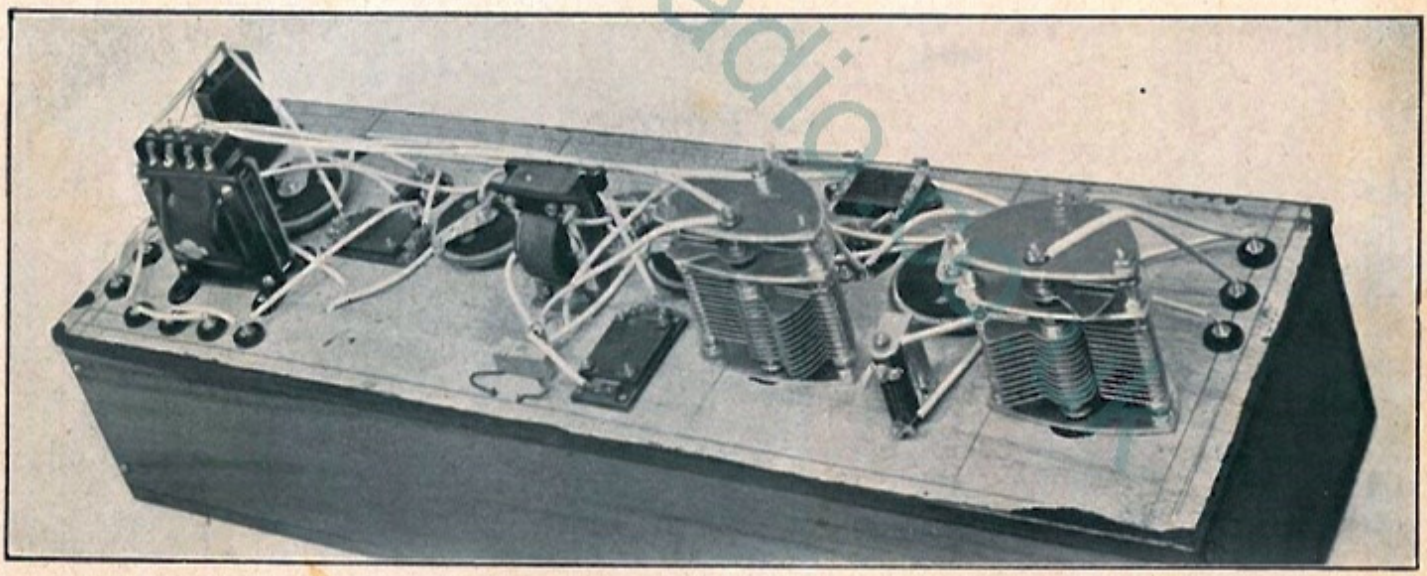
Plan view of top of panel. The connections beneath this panel can be seen in the photograph below. Note that the **right** hand end appears on the **left** in the photograph below.



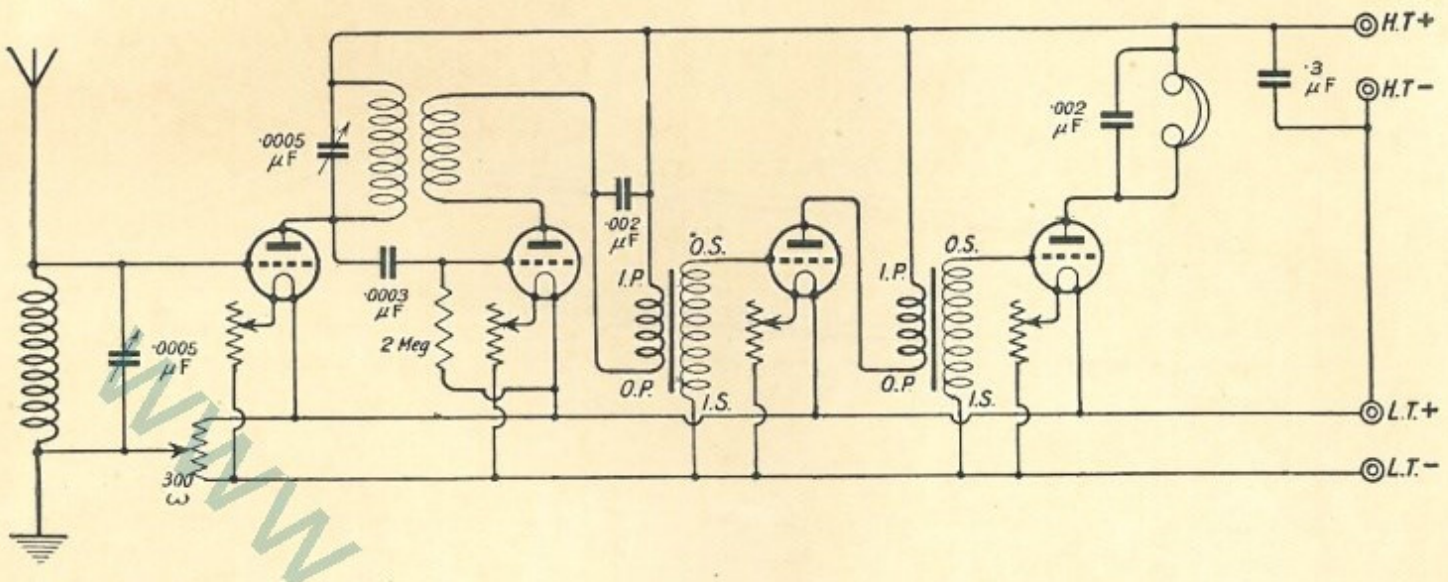
Plan view of the underside of panel, showing general layout and disposition of parts. Notice the circular holes cut to allow the switch terminals, etc., to clear the wood. The ebonite bushes of the other terminals can also be seen.



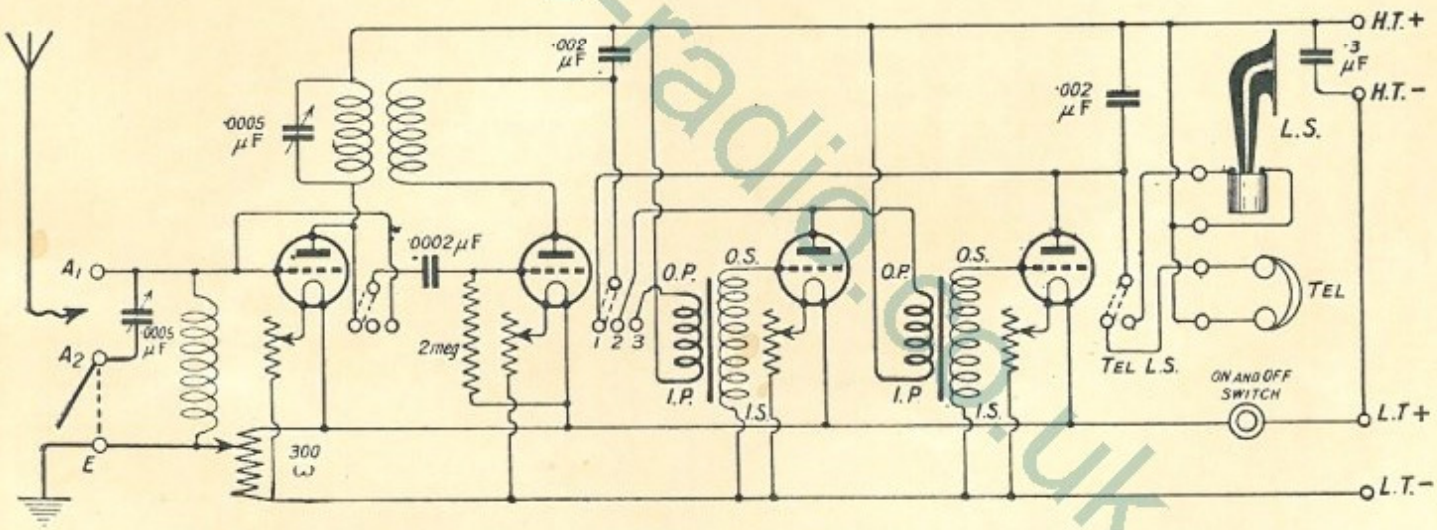
This photograph and the corresponding picture taken from the other side will show the home constructor how to arrange his parts to correspond with the diagram. Notice that the wiring is kept very short. This has a very important bearing on the efficiency of the set.



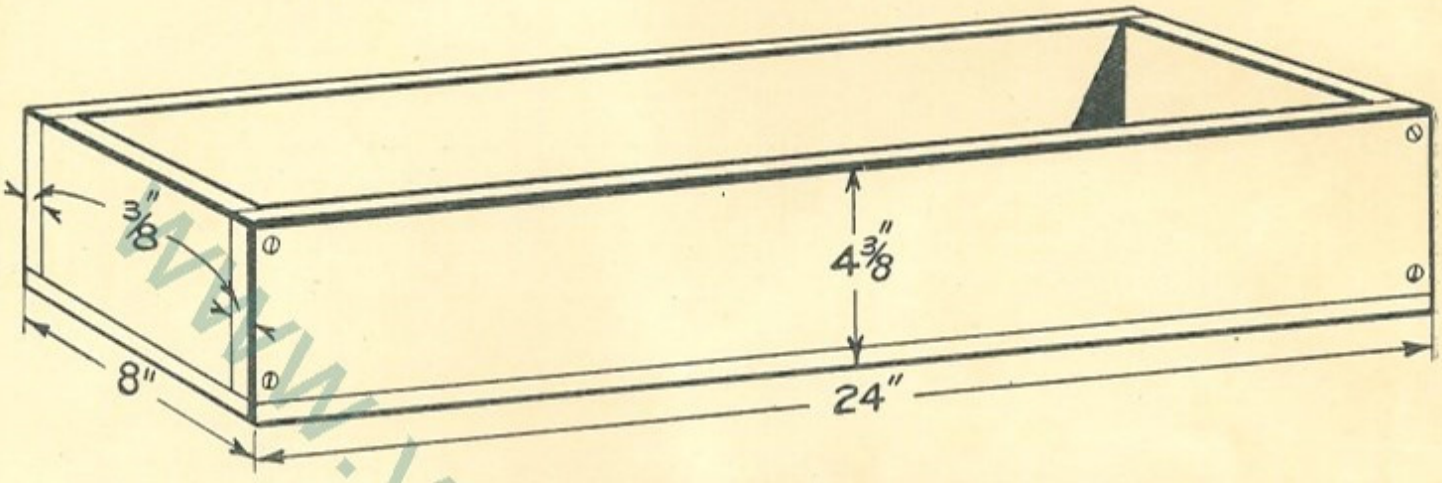
In this photograph the flexible leads from the moving coil holder are clearly shown, as well as the potentiometer connections (three wires).



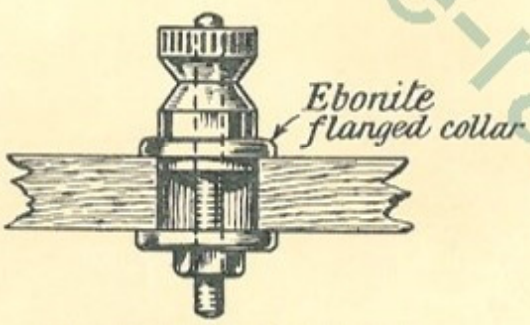
Elementary circuit diagram showing principle of instrument, switches being omitted for simplicity.



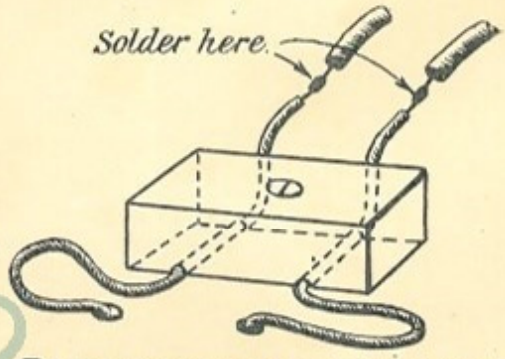
Full circuit diagram with switches in place. Three terminals are used for series and parallel arrangement of aerial condenser. For parallel adjustment connect aerial lead to A_1, and connect A_2 and E together. The earth connection is permanently connected to E. For series, connect aerial to A_2, opening the connection between A_2 and E.



DIMENSIONS OF BOX



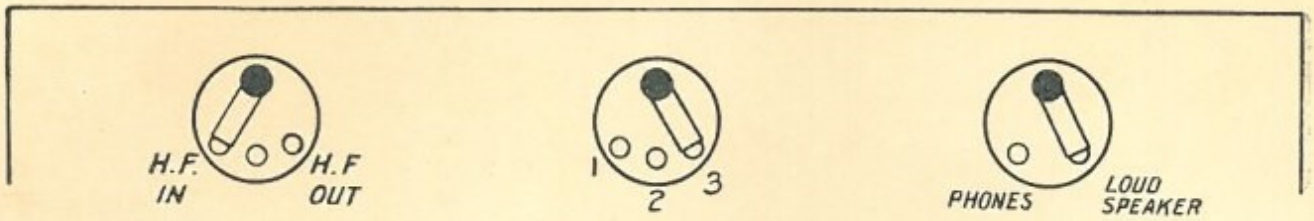
METHOD OF FITTING TERMINALS.



BLOCK TO HOLD FLEXIBLE LEADS FROM MOVING COIL.

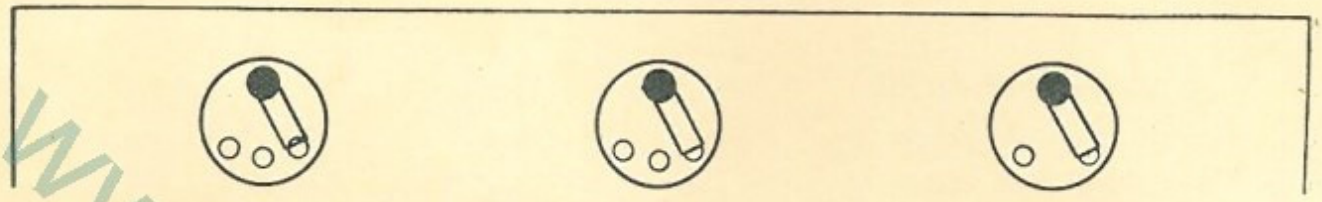
A few useful constructional details. The method of fitting the terminals effectively insulates them, for the metal is kept well away from the wood everywhere. If special flanged collars are unobtainable, small squares of ebonite above and below the panel will serve.

a



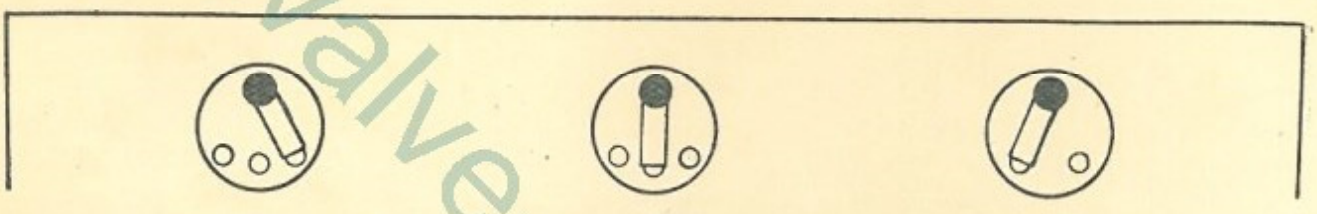
ALL VALVES IN WITH LOUD SPEAKER.

b



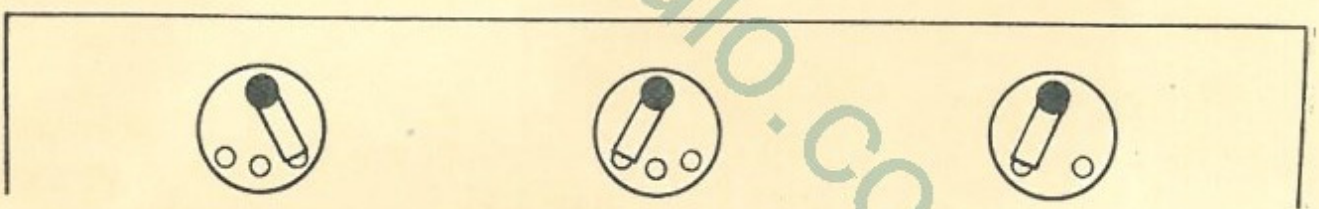
DETECTOR & TWO NOTE MAGNIFYING VALVES ON LOUD SPEAKER
(H.F. VALVE CUT OUT & FILAMENT SWITCHED OFF.)

c



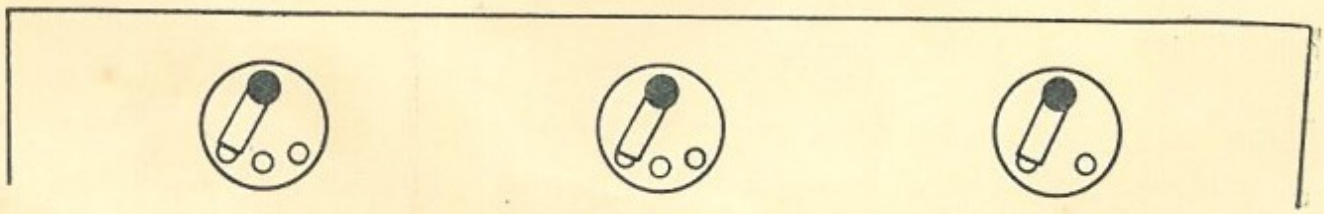
DETECTOR & ONE NOTE MAGNIFIER ON TELEPHONES (FIRST & THIRD VALVE FILAMENTS TO BE SWITCHED OFF) H.F & ONE VALVE CUT OUT

d



DETECTOR ONLY IN USE ON PHONES. H.F. & BOTH NOTE MAGNIFIERS CUT OUT. ALL BUT DETECTOR VALVES TO BE SWITCHED OFF

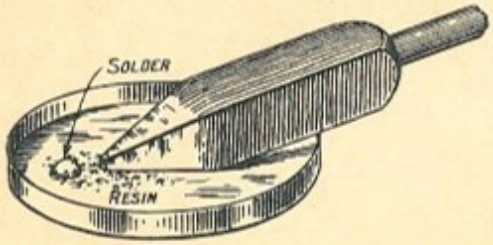
e



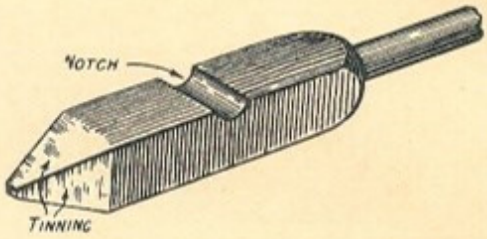
H.F. & DETECTOR ONLY ON PHONES. NOTE MAGNIFYING VALVES CUT OUT & FILAMENTS SWITCHED OFF

SOME SWITCHING ARRANGEMENTS.

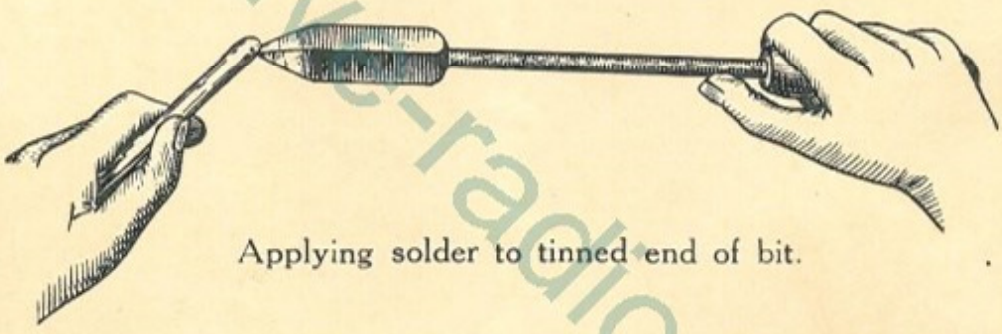
A SOLDERING GUIDE.



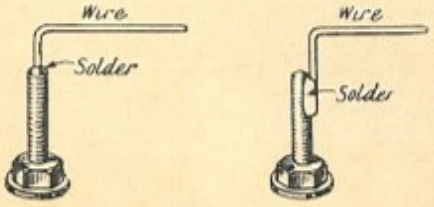
Tinning the end of the soldering bit by rubbing it in flux and solder, having previously filed the end.



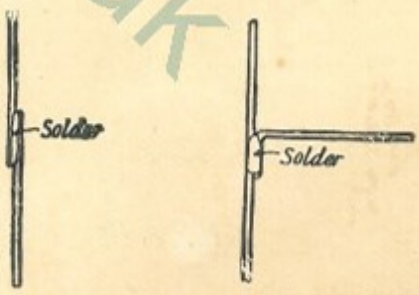
A useful notch can be filed in the bit. When this contains molten solder it is most useful for tinning the ends of wires.



Applying solder to tinned end of bit.



Two methods of soldering a wire to a terminal shank.



How to join two wires.