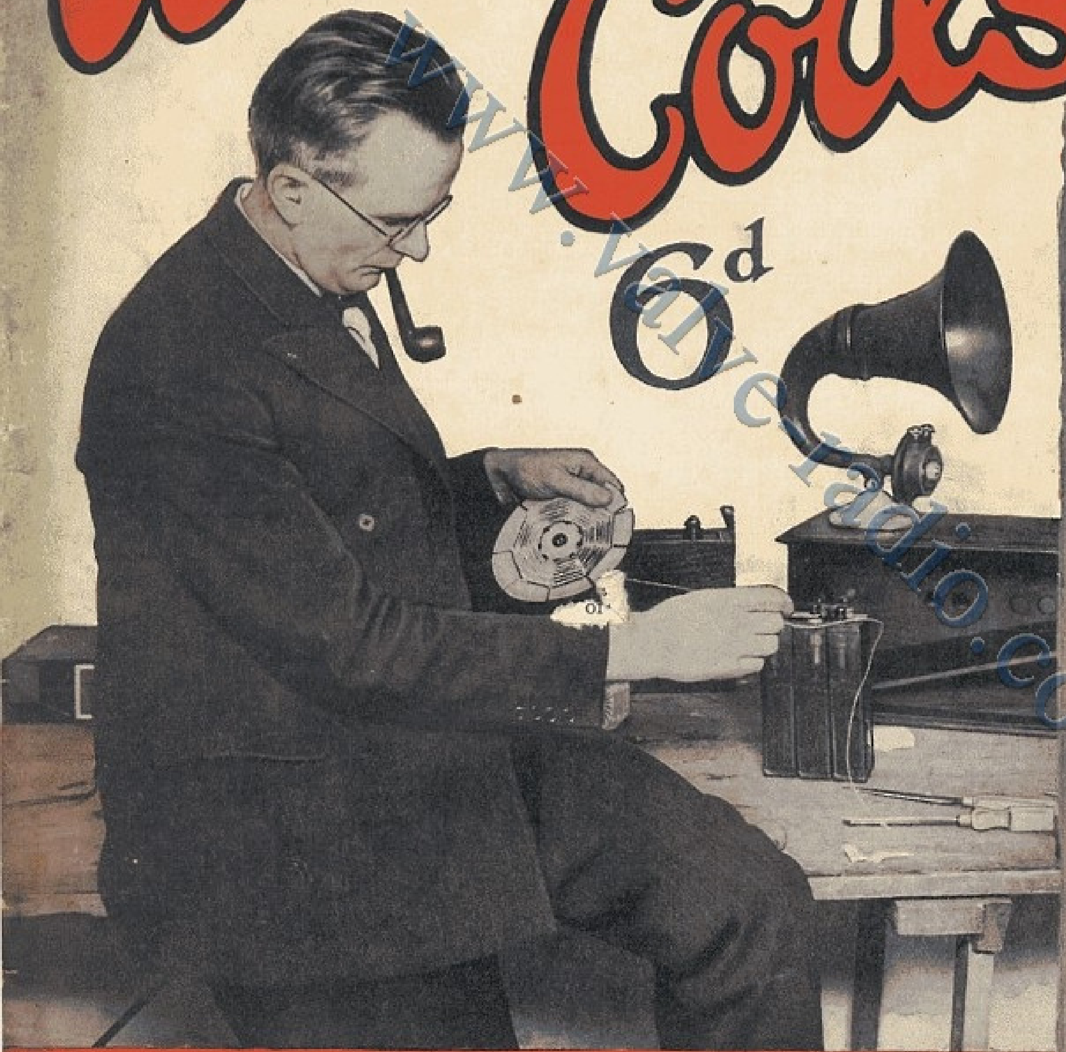
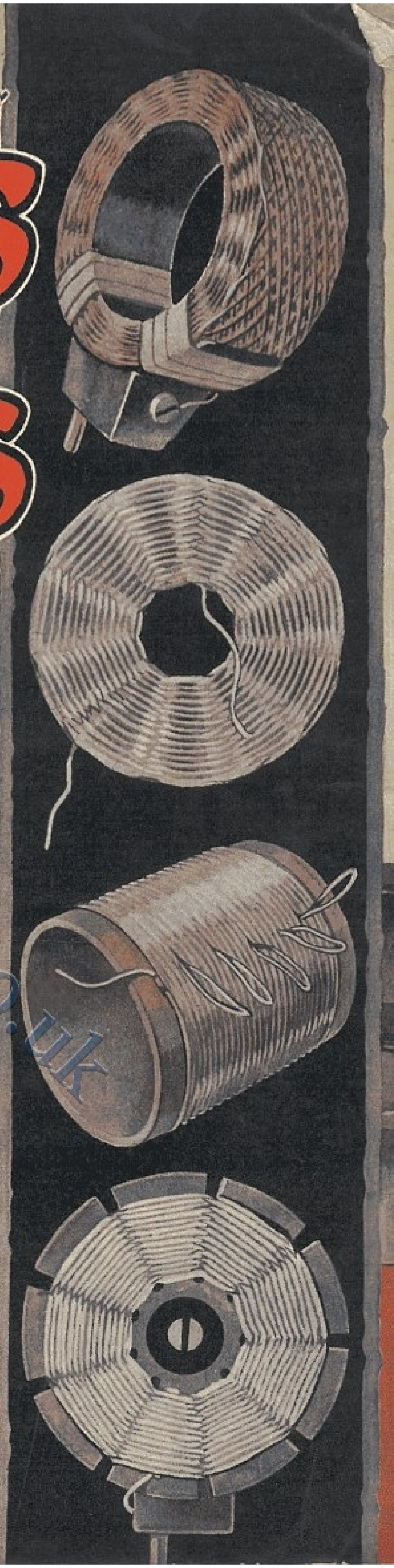
"BESTWAY" The Guide for the Wireless Constructor

No 172

HOW TO MAKE Wireless Coils

6d

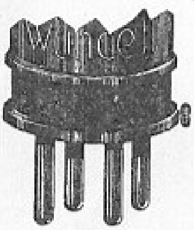




Contents

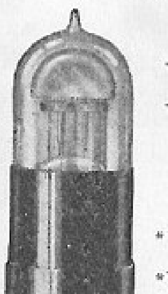
ECONOMY —real and false

Wuncell exclusive advantages featured:
No. 1



THE man with a multi-valve Set using bright emitters can replace his valves one by one as they become useless by Wuncells W.R.1 and W.R.2. These are the only dull emitters on the market that can be used with a 2-volt, 4-volt or 6-volt accumulator without any alteration to the Set.

Every W.R. type of Wuncell has incorporated in its base a special resistance which can be short-circuited when not required by the screw shown above. When *all* the bright valves have been replaced by Wuncells these resistances can be short-circuited and the accumulator altered to give 2 volts with a greatly increased capacity. Full instructions for this simple alteration are supplied with every Wuncell valve:

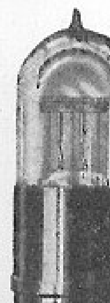


Prices:

W.1 For Detector or L.F. Amplifier
W.2 (With red top) for long distance reception
18/- each

*W.R.1 Corresponding to W.1
*W.R.2 Corresponding to W.2
20/- each

** Fitted with internal resistance as above.*



THE point is just this: Can you afford *not* to use Wuncell Dull Emitters.

Or, let us put it in another way. You own, perhaps, a 3-valve Set. Now the average bright emitter valve consumes about .7 of an ampere every hour. Three of them, therefore, will consume 2.1 amps. every hour you are using them. If your accumulator is rated at 6 volts 30 amp. hours (that is a good average size) you will get about 15 hours' use from it on a charge.

The cost for this may be anything up to 2/-. Eight shillings for a month's broadcasting—practically £5 per year. Not much when compared with the pleasure you obtain, but still quite an appreciable item in the family exchequer.

* * * * * *

Now let us see what you would be paying if you used Wuncells. First of all you would re-connect your accumulator to give 2 volts only by connecting all the cells in parallel instead of series. This will triple its capacity and give you 2 volts 90 amp. hours, but the charging cost won't be any higher.

Wuncell Valves function best at 1.8 volts and consume .3 of an amp. per hour—your 3-valve Set, therefore, will consume .9 amp. per hour, and your accumulator will last six weeks on one charge.

In other words, you get 5 weeks' broadcasting for nothing every time you get your accumulator charged if you are using Wuncells. And they will save their cost in a couple of months or so.

* * * * * *

That is not all. The filament of a bright valve is naturally incandescent. It glows at a white heat and becomes brittle. No matter how careful you are, sooner or later the filament breaks and your valve is useless . . .

But see the Wuncell working. You'll have to look pretty hard before you will realise that the filament is glowing. In daylight it is almost invisible. In fact, it is the nearest approach to the cold valve yet produced.

Isn't it obvious that such a low temperature must mean an exceptionally long life? And to make the Wuncell even stronger, we have inserted a centre support to the filament. No wonder *Amateur Wireless* reported that its filament "is practically unbreakable."

* * * * * *

So you'll readily admit that not only do you save quite a considerable amount in running costs, but you get a valve that is likely to last at least three times as long as the ordinary bright emitter. Surely this is real economy.

Cossor Wuncell Valves

THE ONLY DULL-EMITTER VALVES SOLD IN SEALED BOXES

Advertisement of A. C. Cossor Ltd., Highbury Grove, N. 5   Gilbert Ad. 2359

"BESTWAY" No. 172 WIRELESS COILS

PRINCIPAL CONTENTS

THIS "Best Way" Wireless Book is devoted to one of the most important aspects of the amateur constructer's hobby—the making of various types of inductance coils to function in wireless receivers. Coil tables are appended to the text, and the various operations are well illustrated, forming a comprehensive guide to the making of tuning coils, which should prove of considerable value.

OUR companion wireless book, now on sale price 6d. (No. 173), entitled "How to Make Special Sets," is one which every wireless constructer should possess. Detailed instructions are given with lavish photographic and diagrammatic illustrations.

THE "Best Way" Wireless Books—Nos. 161 and 162—have already established themselves as first-class and really reliable guides to wireless constructers. This book, together with our companion book, "How to Make Special Sets," makes a total of four books for the constructer who wants the best and only the best. Other books will follow in due course—but in the meanwhile make sure you have copies of the four already published.

THE EDITOR-IN-CHIEF.

CHAPTER 1
Introduction
Coils and How to Make Them

Practical wireless reception depends largely upon the efficiency of the coils used in the set.

Amongst the many types of coils which can be purchased or made there are bewildering differences. Coils vary not only in name, shape, size, and method of construction, but in efficiency, and in their suitability for a given receiver.

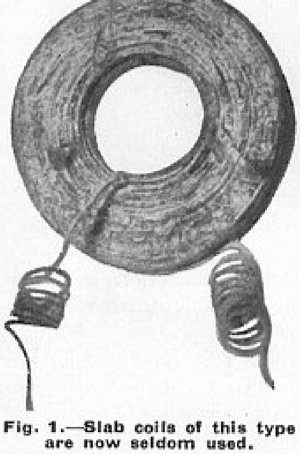


Fig. 1.—Slab coils of this type are now seldom used.

Before describing the construction of the various types it is therefore necessary to say a few words about tuning coils in general.

The first remarkable thing about tuning coils is that they are one of the few wireless components that can be constructed at home in a really successful manner.

This fact is not as widely recognised as it should be, but it remains true that the home-made coil has two distinct advantages over its commercial rival. In the first place, the time occupied in its construction is generally not a consideration. The home constructer can afford to spend hours in making coils, which if constructed commercially would have to be produced in as many minutes.

The other great advantage of home-construction is the fact that coils can be made specially for a particular set, or to suit the particular circumstances in which they will be used. As the cost is quite low different coils can be made and compared, the form of winding and number of turns being altered experimentally until maximum results are obtained.

Various Types of Coils

Many and varied are the claims made for one way or the other of winding coils, but it is impossible to reduce comparison between them to a uniform basis of efficiency. Coil construction is largely a matter of compromise, and each of the different methods of winding secures some particular advantage, but only with a corresponding disadvantage in some other respect.

For instance, cylindrical or "solenoid" coils are very easily wound upon a tube, and their efficiency is very high. But they are extremely bulky, and are not readily interchangeable, so that despite their advantages they are not very popular.

Flat "pancake" coils, which include the basket and spider-web type, are also easily made. But their shape makes them unwieldy in the larger sizes, and their method of construction renders them rather fragile. Nevertheless, they are extremely effective, and thoroughly deserve their present popularity.

The commonest coils of all are the duolateral types. These are modifications of a honeycomb-like structure, in which great efficiency is successfully combined with compactness. Because of their robust construction and handy size these coils are readily interchangeable, but they are not as easy to make as some of the other types.

In order that the home-constructer will be able to weigh the different advantages and disadvantages of the various methods it is necessary to consider briefly what are the requirements which a good coil should fulfil. Such considerations as size, mechanical strength, and interchangeability can be judged by the inexperienced, and, of course, a coil may be selected upon these

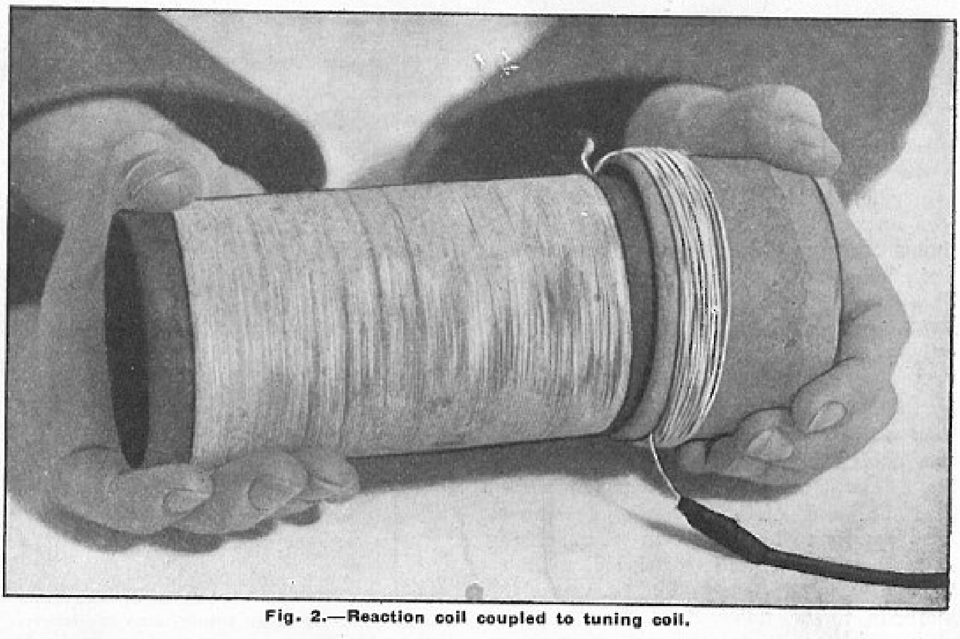
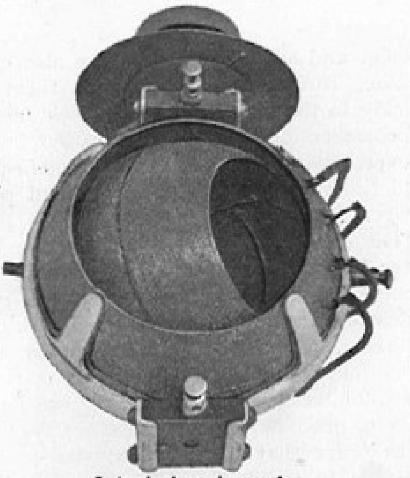


Fig. 2.—Reaction coil coupled to tuning coil.

grounds alone. But those who wish to secure electrical as well as mechanical efficiency should bear in mind the following considerations also.

All tuning coils possess, in varying degree, the three electrical properties called inductance, self-capacity, and resistance. Only the first of these is desirable, but self-capacity and resistance always appear as well, even in the best coils. The advantage of a coil with high inductance value is that less wire can be used for tuning to a given wave-length. Less wire means a lighter coil, and it also means less resistance (for the longer a wire is, the greater is its resistance).

Unfortunately, as soon as we commence to coil wire so as to increase its inductance (and thereby reduce its resistance) we also increase its self-capacity. Adjacent turns of the wire, separated by the thin insulation of its covering, act like the plates of a condenser, separated by air. For various reasons (which need not be entered into here) this capacity-effect is undesirable. There are several ways of minimising it, such as by spacing wires apart, or by making turns cross each other at right angles only.



A typical variocoupler.

Do not forget that the self-capacity of a coil is increased by dipping it in wax. This is often done to strengthen the coil mechanically, but the adjacent turns can act as a condenser more easily through wax than they can through air, so the condenser-effect is increased by such a procedure, and coils should not be impregnated with wax more than is necessary to keep out dampness.

The Reader's Choice

When it is desired to utilise two coils in conjunction, the cylindrical type is not, as a rule, the most satisfactory, as can be seen on page 3, where the reaction coil is shown as a bank-wound coil slidable on the main inductance. In such cases it is easier to use basket or plug-in coils.

Other considerations are those of the relative difficulty of making the coils and their mountings, but this must be decided by the individual constructer after studying the various points set out in the pages of this book. The following illustrations are almost without exception so photographed that the hands of the worker are shown as they appear to his own eyes when looking at his own hands, and this should assist to remove any lingering doubts as to the methods to be followed.

CHAPTER 2
Basket Coils

This name has been given to a form of tuning coil in which the winding resembles the weaving of a basket, as shown below in Fig. 2. Basket coils occupy very little space, as they are quite thin, and are seldom more than 3½ inches to 4 inches in diameter. They are also very efficient when wound with wire of appropriate gauge, and when the turns are properly spaced. They are adaptable to all classes of wireless receiving sets, but are particularly suited to many forms of compact crystal sets, and also for portable sets where weight and space have to be considered.

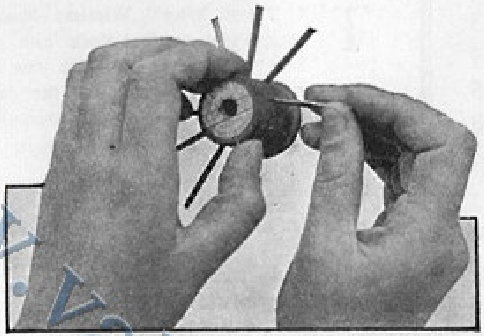


Fig. 1.—Arranging the spokes in the former.

A basket coil is wound on a former, which is similar in appearance to the spokes of a wheel without a rim, the wire being wound around the spokes in a particular manner.

The wave-length value will be determined largely by the gauge and total number of turns of wire wound on the former, and also by the arrangement of the turns themselves. It is also affected by the closeness of winding, and by the means adopted for waxing and finishing or mounting the coils. The most usually adopted sizes are here given, but the best way to be certain of the inductance value, or wave-length range, is to test the coil against another coil of known value.

A Wave-length Guide

The following can, however, be taken as reasonable figures for well-made coils 1 in. in diameter, when tuned by a ·001 variable condenser shunted across the coil; that is to say, when the two ends of the coil windings are connected to the terminals of the condenser, and those terminals connected respectively to aerial and to earth.

Using No. 24 D.C.C. wire, the probable maximum and minimum wave-lengths that

Fig. 2.—Winding the wire on the former.

may be expected to be tuned when used with an average aerial are as shown below:—

25 turns, 150 to 275 metres.
35 turns, 180 to 360 metres.
50 turns, 275 to 470 metres.
75 turns, 400 to 860 metres.
100 turns, 600 to 1,100 metres.

Formers for making basket coils can be purchased quite cheaply, or the formers themselves can be made at home by the handyman if the following directions are carried out.

First determine the probable number of turns to be wound, and then select a suitable size for the hub, or boss, of the former. This should generally be about ¾ in. to 1¼ in. in diameter for coils intended for use on the B.B.C. wave-length range, and a small cotton reel will be found to be well adapted to the purpose. Any suitable sized piece of hard wood, or a piece of brass rod, will serve equally well; but whatever is used, one end of the former boss must be of equal diameter to the centre part, otherwise the coil when wound cannot be withdrawn.

The Winding Process

The next step is to divide the boss into an uneven number of equal spaces—say, 11 or 13, for example—and to drill holes radially into the boss, being careful to keep all the holes on a central line drawn around the centre part of the hub. Stiff pins of brass or steel wire must now be prepared and fitted to the holes in the boss (Fig. 1) to act as the spokes of the former.

They must fit accurately, neither too slack nor too tight. In the first case the pins will move about while the winding is in progress, and in the second case it will be difficult to withdraw the spokes when the winding is completed. The former is only needed while the winding is in progress, and consequently one former may be used

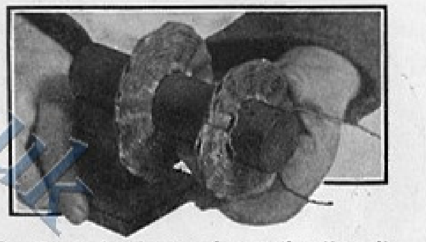


Fig. 3.—A simple way of mounting the coils

repeatedly for the construction of other basket coils of the same or different wave-length range.

There is no golden rule for the winding, but a very good plan is to support the former on a steel peg driven into the edge of the work-bench in a slanting direction. The former is then free to revolve as the winding proceeds, and both hands of the operator are free to attend to the arrangement of the wire. If preferred, the former can be held in the left hand while the wire is manipulated with the right.

To begin the winding, fasten an end of the wire to one of the spokes of the former (calling this No. 1), and allow at least 4 in. surplus for the subsequent connections. Twist this end as much out of the way as possible and guide the wire to the front of the next spoke, keeping the wire as tight against the hub as possible. Then turn the wire between this spoke and the one next to that and pass it behind the latter. This will be the third spoke from the beginning, and the wire has to bend round the outside of this spoke and then pass between the third and fourth spokes. This plan is then repeated with the remaining spokes until the starting-point is reached.

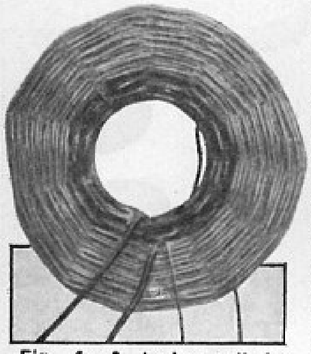


Fig. 4.—A tuning coil for aperiodic coupling.

This constitutes one turn of the winding. Continue in this way (Fig. 2) until sufficient turns have been wound, and then fasten the end of the wire to the main part of the winding. One good way to do this is to cut off the wire about 6 in. beyond the finishing point and pass it down by the side of the spoke at which the winding was commenced.

On inspecting the windings it will be seen that the wire is interlaced, and that any particular turn which passes behind a spoke will come in front of that spoke on the next turn. This is one of the reasons for the comparatively low self-capacity of basket coils; the windings are well spaced and do not come directly one above the other, as they would do if wound on a former with an even number of spokes.

Two-spoke Winding

When a basket coil has been wound by passing the wire round alternate spokes, as described above, it is called a simple-or single-basket winding. A variation of this method, which makes the coil rather more compact, and is decidedly better for rather large coils such as 75 turns and over is the "two-spoke" or double basket winding. In this instance the coil is made upon an exactly similar former, having the usual odd number of spokes, but the actual method of winding is slightly different. Instead of the wire crossing the edge of the former from the front to the back between every spoke and the next, it is made to pass two spokes at the front of the former before it crosses to the back. Here it passes behind two spokes before emerging again at the front of the former, and so on.

Having now constructed the coil, it will be apparent that if the spokes were withdrawn the coil would collapse, as it is not a self-supporting form of winding. Consequently it is necessary to support and strengthen it by immersion in wax, or by sewing the turns together with thin silk or cotton. This can readily be done by loosening the spokes sufficiently to permit the withdrawal of the hub, but leaving the spokes in their place between the windings. Withdraw a spoke or two at a time and pass a needle and cotton through the space previously occupied by the spoke. One turn of the silk or cotton will be sufficient if it be drawn tight.

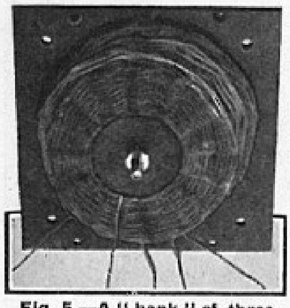


Fig. 5.—A "bank" of three basket coils.

When all is completed, fasten the end of the cotton to the starting-point, and take one or two turns around the finishing end of the winding which has already been passed through a spoke-hole. This will help to keep the wire in place and make the winding secure. Before finally withdrawing the spokes the coil can be stiffened by impregnating it with wax, but this will detract from its tuning efficiency.

Molten paraffin wax can be used for impregnation, the coil being immersed long enough for the wax to penetrate to all parts of the winding. This can be done by melting some paraffin wax in an old iron saucepan over a slow fire, such as a gas-ring, with the gas turned well down. Be careful to keep the wax under observation during the whole of this time as, should it boil over, it will almost certainly ignite and cause a blaze.

Methods of Mounting

As soon as the wax is melted immerse the coil in it, holding the coil by means of the two ends of the windings, which may be temporarily twisted together. Withdraw the coil and hold it above the saucepan until it ceases to drip, then place it aside to dry hard.

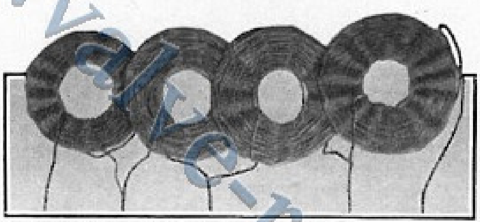


Fig. 6.—Several basket coils connected in series, showing leads for tapping.

There are many ways of mounting basket coils, the choice being determined by the purpose or location of the coil, and the amount of space at disposal within the cabinet.

Should the set be of the simplest character the coils can be mounted by resting them on a block of ebonite or of impregnated hardwood and securing it with a brass wood screw passed through a disk of celluloid or thin ebonite. This disk ought to be a little larger in diameter than the bore of the coil (that is, the diameter of the hole through the centre).

The ends of the windings are then taken to terminals or soldered to lugs on the components to which they are to be attached. If the coils are to be interchangeable, as they will be if the set is to be used for the reception of signals from long wave-length stations as well as from local broadcasting stations, then it will be preferable to arrange the coils with a plug-in type of mount and to provide a suitable socket on the panel.

When the coils form part of a compact set—as, for instance, a portable set—it will be found advantageous to mount them direct to the panel with holding-strips of ebonite, which are attached to the panel with brass screws. Reaction coils and those used in two circuit tuners will have to be mounted on an adjustable mounting, the simplest being a pair of strips of thin ebonite attached at one end to the panel by a brass screw and a spring washer.

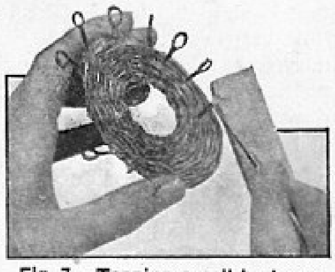


Fig. 7.—Tapping a coil by loops at every tenth turn.

The coil is clipped between the other ends and secured by a screw passed through both and tightened with a small nut. This screw should come just below the lower edge of the coil when it is in place. The second coil is then mounted permanently to the panel, in such a position that the movable coil can be swung through an arc and thus approach to or be removed from the fixed coil. The moving coil thus swings in a plane parallel to the panel and to the fixed coil.

For experimental purposes the simple coil mount shown in Fig. 3 can quickly be made up from a block of wood and a short piece of broom-handle nailed to the top. The coils are simply slipped over the projecting part and can be variably coupled by adjusting the distance between them by sliding them on the rod.

Joining Coils in Series

Another application of basket coils is for aperiodic coupled aerial tuning coils. (Fig. 4.) In this case the aerial primary is composed of 10 turns of 20 gauge wire wound as described previously, the ends of this winding ultimately connecting to aerial and earth. Over this winding is wound the secondary with the required number of turns and generally of thinner wire.

Yet another method of arranging two windings on one coil for aperiodic coupling is to wind from the two reels simultaneously. When enough turns for the small coil have been put on, continue winding the large coil in the ordinary way, thus leaving the small coil interwoven with the other upon the former.

Basket coils need not be employed singly, but may be wired in series to obtain a greater wave-length range than would be practicable from a single coil. (Fig. 5.) To connect them in the proper order, the inner end of the winding of the first coil is joined to the outer end of the second. Join the inner end of the second to the outer end of the third, and so on.

A somewhat similar arrangement can be followed with several basket coils connected in series (Fig. 6) and tapped at convenient points, the coils being laid out flat prior

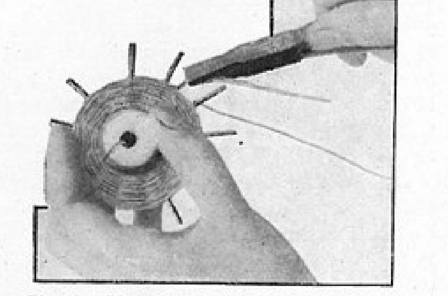


Fig. 8.—Making a tapping connection on a basket coil.

to "banking" them. The taps are taken from between each coil, thus allowing one or more to be in circuit; but when more tapping points are needed, they have to be arranged during the process of winding. One way is to take a long tap at every 10th turn (Fig. 7) by simply bending a loop in the wire and twisting the ends with a small pair of pliers, after which the winding continues.

For Fine Tuning

For fine tuning a coil may be tapped at adjacent turns, but these tapping points should not come opposite to one another, or they will make contact between adjacent turns. For instance, if tappings are being taken from the 8th and 9th turns of a coil, and the tapping on the 8th turn happens to come opposite to No. 1 spoke, it would be advisable to take the tapping on the 9th turn opposite No. 2 spoke, and so on.

CHAPTER 3
How to Wind Cylindrical Coils (Part 1)

The first essential in winding a cylindrical coil is to fix the beginning securely, so that it is unable to become loose and thereby affect the general tightness of the winding. A very simple way is to drill two small holes about ⅜ in. apart and parallel to the side of the coil at the point where it is desired to commence the winding. The beginning of the wire is pushed through the hole nearest the direction of winding, from the outside. The short end of the wire is looped round and returned through the second hole to the outside of the tube. The loop is formed with the right hand and the wire pulled through with the thumb and first finger of the left hand. (Fig. 1.)

The bends may then be pressed against the inside and outside of the tube in order to make them nearly at right angles. A pull of some pressure should then be made on

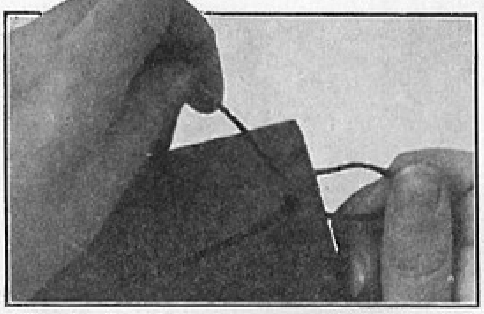


Fig. 1.—Forming a loop on a cylindrical coil.

the main length of wire to make certain that there is no possibility of the wire slipping out of position. This method may be used with either a cardboard or ebonite former. Another effective method of securing the beginning of the wire is suitable where the winding of the coil is required to start close against the edge of the former or tube.

In this case a hole of about three times the diameter of the wire is drilled a short distance from the edge of the tube. The wire is then pushed through from the outside of the tube, bent round, and pushed through again from the same side to form a series of two or three loops. A coil started in this way will have the free end of the wire projecting at the inside of the tube.

Another method is to employ a small screw of the round or cheese-head variety, drilled and bolted into the position where it is desired to start the winding, so that the head of the screw is on the outside of the tube. The extreme end of the wire is freed from insulation and twisted under the screw head so that it passes round in the same direction as the screw follows when it is tightened up. In this method the connecting wire may be soldered into the slot of the screw head after the coil has been mounted in position. A variation of this method can be employed for making tappings from a coil.

Coil-winding by Hand

To wind the coil by hand, the tube is held so that the starting-point is on the right of the operator. The tube is then gripped firmly with the left hand as close as possible

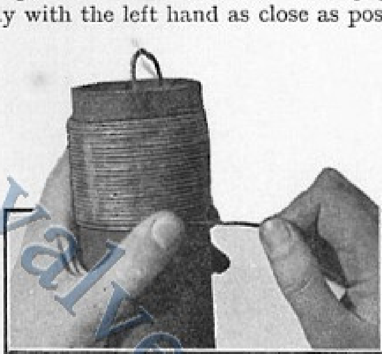


Fig. 1a.—How a hand-wound coil should be held.

to where the winding is taking place. When in this position the near side of the tube is turned away from the operator by twisting the left wrist. During this operation the wire is fed by an even pressure between the thumb and forefinger of the right hand so that the wire passes along the ball of the thumb. (Fig. 1a.) Leverage can be obtained to secure sufficient pressure by pressing the back of the first and second fingers on to the tube.

After a number of turns have been made in this way the winding is stopped so that the turns laid may be pressed closely against each other. The thumb of the left hand is pressed against the last turn to keep it from becoming slack while the edge of a piece of wood, such as the end of a rule, is pressed against this turn so as to force the windings closely together. (Fig. 2.) The winding is continued as before, and the end is made fast by the method adopted for securing the beginning.

Lathe Winding

Winding a cylindrical coil may usually be carried out more quickly if a lathe is available. One end of the tube is gripped in the jaws of a self-centring chuck. The other end is centred in the tailstock by means of an end plate centred and turned up to fit the end of the tube.

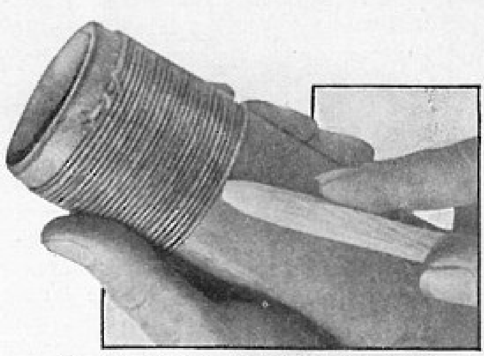


Fig. 2.—Method of keeping the turns close together.

The lathe is set to run at a comparatively slow speed and in an opposite direction to that employed for ordinary turning purposes.

The beginning of the wire being secured, the wire is held fairly stiffly at right angles to the tube. When a little practice has been obtained, the hand may be drawn slightly sideways in the direction of the headstock during winding, so that the turns may be laid more closely together. If the angle is decreased too much the wire will commence to wind over itself, while if it is held too far in the opposite direction, a space between adjacent turns will be formed.

A Useful Tip

While winding coils in the lathe, it is advisable to wear an old kid glove to prevent the fingers being chafed or heated by the passage of the wire. It is necessary to allow the reel of wire to rotate at a suitable tension on a spindle secured somewhere behind the operator. If a kink or bad place in the wire is met the risk of damage to the fingers through their being

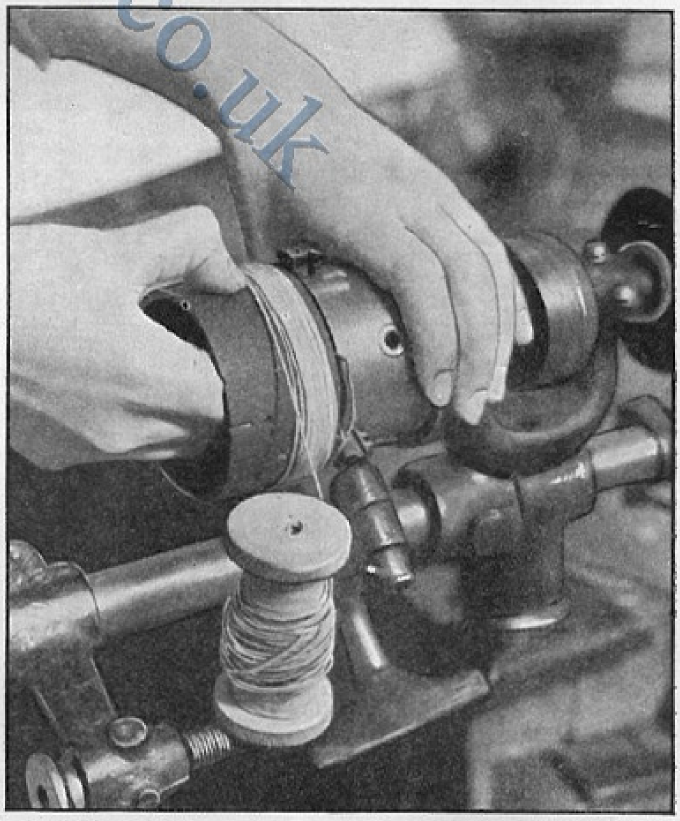


Fig. 3.—Method of winding a coil by hand when using a mandrel.

caught between the wire and tube is reduced, as the hand is then used only for guiding the wire into position.

In winding upon a thin tube, which is likely to become distorted in shape by the chuck

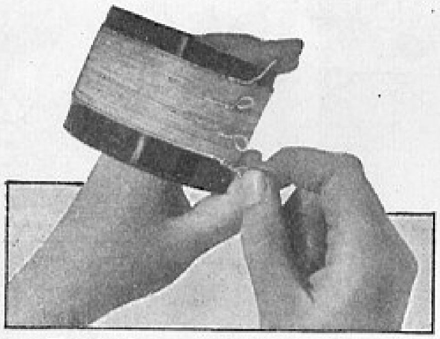


Fig. 4.—Twisting the loop tappings.

jaws, it is necessary to place a piece of wood, either circular or triangular in shape, to resist the pressure of the chuck jaws.

The winding of a coil in a small lathe may best be performed by rotating the mandrel by hand. The method is particularly applicable to small coils. (Fig. 3.)

Where means are required for varying the amount of inductance in use, a simple slider may be employed. Part of the insulation

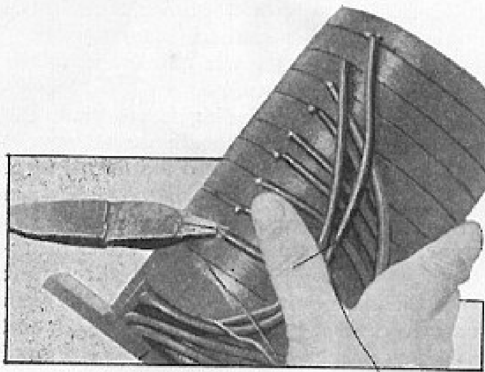


Fig. 5.—Showing tappings to screws on a cylindrical coil.

is removed from the coil, so that the slide may move along and make contact with any desired turn. The disadvantage of this method is that the contact with the slider becomes faulty after a time, but a tapped coil is found to be more durable. In this case short lengths of wire are independently joined to make good electrical connection with the coil at any desired points between its beginning and end. By connecting the tapping points progressively to a suitable switch the amount of inductance included in the circuit may be varied.

Making Loop Tappings

One good method of making tappings on a cylindrical coil is to twist a loop in the wire at the point where the tap is required, after which the winding is continued, and when finished the insulation is removed from the loops forming the taps. (Fig. 4.) Subsequently, a connecting wire is soldered or twisted securely to make good electrical contact to each tap.

Another plan is to scrape away the insulation from one turn of the coil for a length of ½ inch and to solder a wire to it, but if a connecting wire makes contact with two adjacent turns, it will result in the short circuiting of one complete turn and care must, therefore, be taken to avoid this. Also a large loop of wire may be left at the tapping point, so that the loop may be connected directly to the switch which selects the required amount of inductance.

Still another method of tapping is by screwing a small round-headed screw into the former where the tapping is required. The next turn is then laid along the slot of the screw after the insulation has been removed from this part of the wire. A small space should be arranged between each

section of the coil. Connecting wires from a stud switch are soldered to the tapping points at the same time as the tapping point of the wire is soldered to the screw head. (Fig. 5.)

It is often found convenient to carry connecting wires through the inside of the tube. To do this, comparatively long loops are made at the tapping points, the loops being threaded through a small hole in the former, and pulled through to the interior

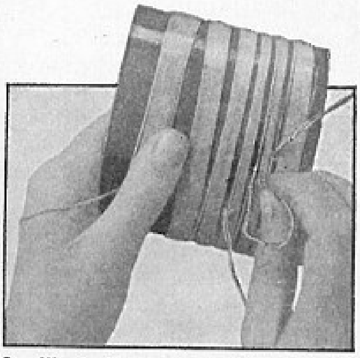


Fig. 6.—Illustrating method of spacing sections of the coil windings.

of the coil. (Fig. 6.) This coil also illustrates the spacing of the different sections of the coil, the method often being an advantage in reducing "dead-end" effects.

How Turns are Spaced

For very short-wave tuning space-winding may be applied to single-layer cylindrical coils, a length of fine cord or string being wound at the same time as the wire in order to separate adjacent turns. (Fig. 7.) The winding is carried out in exactly the same manner as ordinary winding, except that the wire and string are wound together. The latter should be of a thickness equal to that of the wire used, and when completed the string can be unwound.

Cardboard or ebonite tubes are generally employed for the formers upon which cylindrical coils are wound. When cardboard is used it should be *thinly* coated with shellac varnish as a protection against damp, but ebonite needs no such coating, and is therefore to be preferred.

Cylindrical—or "solenoid"—coils, as they are sometimes called, are generally very efficient, the chief obstacle to their general use being the fact that they are invariably bulky.

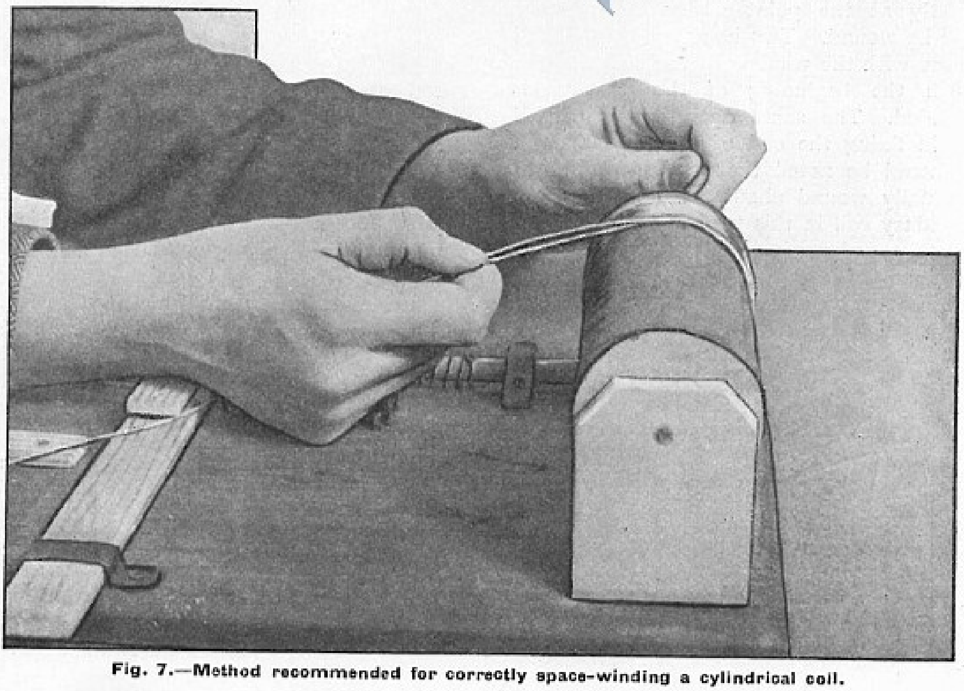


Fig. 7.—Method recommended for correctly space-winding a cylindrical coil.

CHAPTER 4
How to Wind Cylindrical Coils (Part 2)

The use of aperiodic aerial coupling has been referred to under the heading "Basket Coils." This form of coupling may, however, be applied to coils wound upon cylinders. The secondary coil, the number of turns of which are arranged according to the wave-lengths on which it is desired to receive, is first wound on the coil former in the manner described for the single layer inductance.

In the centre of this coil and over the turns already in place a smaller coil is wound, which serves as a primary circuit. Where the secondary coil is arranged to receive on the ordinary British broadcasting wave-lengths, from 8 to 15 turns on the primary coil will be found sufficient. An advantage may be gained if the primary coil is wound with a slightly thicker gauge of wire than

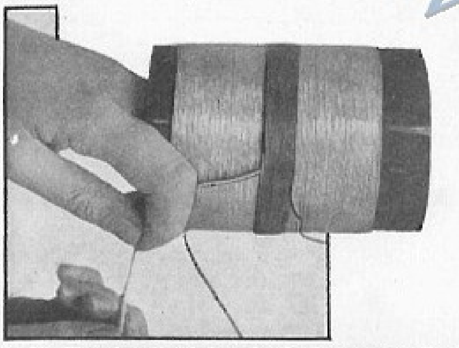


Fig. 1.—Showing the fixing, beginning, and ending of primary winding of the coil.

the secondary coil, No. 22 S.W.G., D.C.C. being found suitable by experiment for the primary and No. 24 S.W.G., D.C.C. for the secondary coil. No other form of insulation is normally required between the two coils, other than that on the wire itself.

The Primary Winding

The method of fixing the beginning and end of the primary winding in the coil (Fig. 1) is to separate the secondary wires slightly at the point where the primary is to be wound. Two holes are then drilled in line with the winding of the coil, through which the beginning of the primary is threaded. The same operation is carried out in fixing the end of the primary coil. It should be noted that the aperiodic coil is usually wound about the middle of the secondary coil in this type of inductance.

A type of tuning coil suitable for the reception of low wave-lengths, by which is meant wave-lengths up to 250 or 300 metres, is illustrated in Fig. 2.

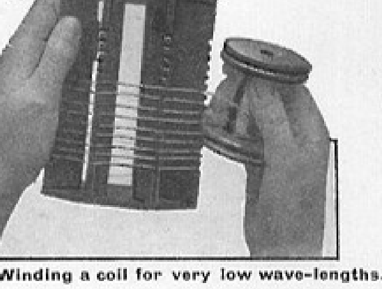


Fig. 2.—Winding a coil for very low wave-lengths.

The former on which the inductance is wound consists of a number of strips of ebonite firmly fixed into end plates of the same material. The ebonite former may have any number of supporting strips desired. In the inductance illustrated, eight strips of $\frac{3}{16}$ in. ebonite $5\frac{1}{2}$ in. long and 1 in. wide are fixed into two octagonal end plates. Suitable slots are cut in the latter, extending from the corners towards the centre. The outside edges of the strip are nicked with a saw at $\frac{1}{4}$ in. intervals to form grooves into which the wire may be wound.

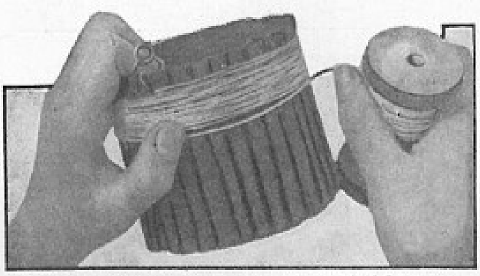


Fig. 3.—Making a coil on a corrugated former.

A thick-gauge wire is employed, No. 16 S.W.G. being selected in this case, but No. 7-22 stranded aerial wire in the uninsulated variety will also be found to be satisfactory. The beginning of the wire is twisted to form a loop in a small hole drilled at one end of the former, when the wiring may be proceeded with. The end of the coil is fastened in the same way as the beginning, both being brought to terminals conveniently placed.

If a variable inductance is required, a spring clip, which may be made from a split valve pin set in an ebonite handle, may be attached to the wire in the place desired for any particular wave-length. If this method is employed, one end of the coil is left unconnected. Contact with the other terminal is made by a flexible lead which connects to the spring clip.

Another way of winding a coil to decrease

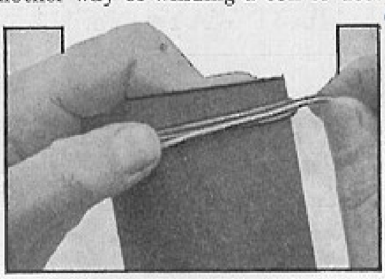


Fig. 4.—Showing position of the third turn of the wire in double-bank winding.

the undesirable effects of self-capacity is to wind the coil over a tube covered with corrugated cardboard. The cardboard is wound once round the tube so that the corrugations are in line with the length of the tube. (Fig. 3.)

One simple form of multilayer coil, which is quite effective for high wave-lengths, is known as "bank-" or "lap-winding." This is a method of winding cylindrical coils in which one or more coils of wire are wound on the top of the bottom layer.

It is not satisfactory to wind one complete layer and to wind the second and subsequent layers backwards and forwards over the previous layer. The bank-wound coil is, therefore, wound at the start to its full height and the winding continued progressively to a finish.

After the beginning of the wire is made secure, two turns are laid together on the tube. These turns should be wound as tightly as possible, for trouble may be

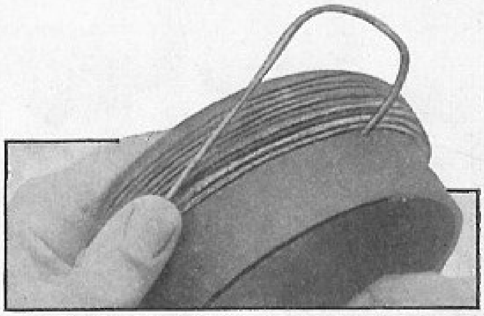


Fig. 5.—Illustrating triple bank winding.

experienced if they are allowed to separate. The third turn is then wound at a lesser pressure on the top of the other two turns already laid. The wire will be found to rest in the trough between the two original turns. The winding at this stage is illustrated in Fig. 4, where the third turn, forming the first turn of the second layer, is being laid in position. The fourth turn is brought down again and wound as tightly as possible on the tube itself, so that the turn is adjacent to the second turn wound.

Double-bank Coils

The fifth turn forms the second turn of the second layer of wire and, therefore, rests between the turns Nos. 2 and 4 and to the side of the third turn.

If double-bank winding is required, the next and sixth turn is again wound on the tube in the same manner as the fourth turn. The next turn goes to make the third turn of the second layer. Subsequent turns are wound in the same manner. (Some assistance may be gathered from the fact that with the exception of the first turn, the even numbered turns lie in the tube itself, the odd numbers forming the second layer.)

Triple bank winding is carried out in the same way until the sixth turn is reached. This turn, instead of returning to the tube is wound between the third and fifth turn. A pyramidal section is thus produced, each three subsequent turns being wound up the side of the slope. (Fig. 5.)

Apart from tuning coils, it is sometimes desired to wind a coil with a minimum of inductance—viz.: non-inductive winding. Two reels of the wire are required and, after removing the insulation, the ends are soldered together.

A small hole is then drilled at one end of the bobbin on which the wire is to be wound and the soldered end pushed in and wedged securely with a peg of wood. The two turns of wire are then wound side by side (Fig. 6), the ends being connected to terminals, soldering tags, or other means as required.

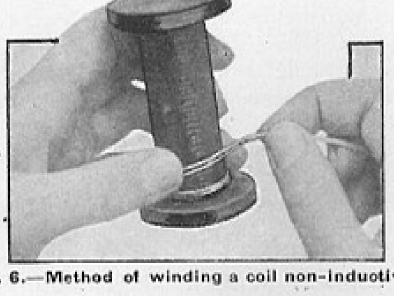


Fig. 6.—Method of winding a coil non-inductively.

CHAPTER 5
The Correct Uses of Coils

The degree of efficiency obtained in a wireless set is probably governed more by the type and suitability of its tuning coil or coils than by any other single component, except perhaps the detector or amplifying valves if these are employed. Put in another way, the success of a radio receiver depends on its coils, for if these are even "poor" the set is bound to be a failure, as *all* sets have to have coils of some sort.

It is therefore advisable, to say the least of it, that all owners or potential owners of receivers should think a little about the coils they intend to use *before* they make their decision as to the type and size of receiver they are going to make. The need for this will immediately become apparent when it is understood that variometers, for instance, are useless as tuning units in a receiver if the owner of that set wishes to listen to Chelmsford, Radio Paris, Eiffel Tower, or, in fact, any station whose wave-length is above 1,000 metres.

Variometers' Restricted Use

True, provision may be made for "loading" the variometers, that is for adding plug-in or other coils to increase the wave-length, but this is theoretically and *practically* very inefficient and *should never be* done. If you want Chelmsford (1,600 metres), for instance, and also London, and other stations, use plug-in or tapped cylindrical coils so that you can vary the wave-length, either by changing the coils or adding or taking away more turns to vary the wave-length. This is both economical and efficient and is undoubtedly the best way.

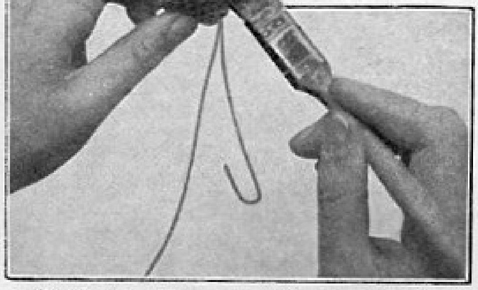
For one series of wave-lengths, and *those* below 1,000 metres, a variometer is quite good, but in the writer's opinion not *better* than a coil and condenser, and as the latter method has the advantage of being variable over a range of wave-lengths between 100 and 30,000 metres merely by plugging-in various coils, or switching in more turns (equivalent to the same thing if done properly) it is an easy matter to choose whether you will have coils or variometer.

Having chosen instead of a variometer, coils and a variable condenser for tuning, or a tapped coil with no condenser, we must next discuss these two methods. Again, for short ranges of wave-lengths from, say, 200—4,000 metres, the tapped coil, properly constructed, *can* be very efficient, but for amateur construction and ease in fitting to the set you cannot beat the plug-in coil and it has the merit of being equally, sometimes more, efficient when carefully made and selected.

Space Considerations

Before picking upon any one type of coil the constructer must consider (1) the space available in his set, (2) the wave-length range he wishes to cover. Let us take these points in turn.

(1) The space available will decide to a certain degree the type of coil to be used, for, though it is bad practice to cramp the set anywhere, yet it is not desirable to have gigantic coils all over the place if smaller ones will do *just as well*. Wave-length range for wave-length range, coils can be classified as follows, the largest being first and then decreasing in size in order:



Varnishing a home-made honeycomb coil.

Basket and spider coils, lattice coils, Burndept and Lissen coils (about the same), honeycomb or duolateral coils. Cylindrical or solenoid coils and variometers being left out of the question as it has been decided that the plug-in coil is the best for general purposes.

Of these coils, the cheapest are basket or spider, and as they are very efficient and easy to make these are best for general purposes *until we consider No. 2.*

(2) Upon this depends the *size* of the coils so that the constructer would do well to consider this point closely before choosing his coils. Telephony broadcasting is carried out between wave-lengths of 200—4,000 metres (disregarding the ultra short-wave work) and all the programmes that are any good are to be found between 200—3,000 metres.

How the coils should look when complete and "plugged-in" a set.

Now as many sets employ secondary coils, or tuned anode coils, it will be realised that a coil reaching 3,000 metres will have a great number of turns of wire in it. Those who study the "Best Way" Valve Books will notice that, as a rule, the secondary, and the anode coils are both larger than the coil used in the aerial unless the aerial condenser is in SERIES.

This is because they have to make up in size and number of turns that wave-length (about 130 metres) that is contained in the aerial itself.

Thus, for instance, an aerial coil of 50 turns, plus *aerial itself*, will give, say, 450 metres max. with a *parallel* condenser while the anode coil will need 75 turns and the secondary will need 75 turns also with *parallel* condensers. A series aerial condenser decreases that 130 metres due to the aerial, and also some of the wave-length of the coil (in effect, at any rate, even if this is not a truly theoretical exposition) and so a larger coil has then to be used to make up for the reduction, and in this case a 75 turn coil must take the place of the 50 before used. The advantages of a *series* condenser cannot be gone into in this book.

A Useful Summary

All this will make clear that 3,000 metres needs a coil of some size, having, as a matter of fact, about 300—400 turns (see coil chart at end of book), and if this is wound basket or spider fashion you will have a coil of about 6 in. in diameter and this will not be practicable for the average set. Up to 1,000 metres the basket or spider coil or even the cylindrical tapped coil, will be O K, but above this it is advisable to use either lattice (Burndept), duolateral, or other type of coil taking up less room.

There is one other important point to be considered, and that is whether the coils are to be used for a set needing good coupling between the coils, such as a loose coupled crystal set or a Unidyne H.T.-less receiver. In these cases the basket or spider coils excel, followed closely by Lissen coils and then by lattice and honeycomb or other duolateral inductances.

Summarising the foregoing we can tabulate the coils, etc., fairly easily as follows:

Wave-length range.	*Type of coil.*
For 200-500 metres.	Variometers and cylindrical coils suitable. Basket and spider coils, and the other types in this book, are equally good.
500—1,000 metres.	Variometers not advised. Cylindrical too bulky. Basket and spider-web good. Duolateral and Lattice good and more compact.
1,000 metres upwards.	Variometers and cylindrical useless. Basket and spider coils too large. Lattice, honeycomb or duolateral coils best.

CHAPTER 6
Making Spider-web Coils for Tuning

Spider-web coils differ from basket coils because the former used is part of the coil and is not removed from it. It is therefore necessary to take a fresh former for each coil required. Fortunately, the construction of the former is a comparatively simple operation and, being made from a disk of cardboard, is inexpensive.

A circle 4 in. in diameter is marked and

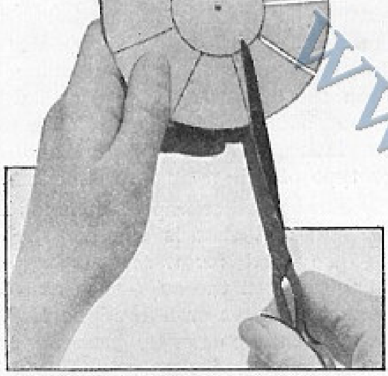


Fig. 1.—Cutting the slots in the former.

cut out with a pair of sharp scissors from a sheet of stout cardboard. Nine slots are required radiating from the circumference of the disk to meet a circle of $\frac{7}{8}$ in. radius which is marked with the same centre as the disk. Probably the easiest method of spacing out the circumference into nine equal parts is by trial and error, or by marking off in degrees with a protractor.

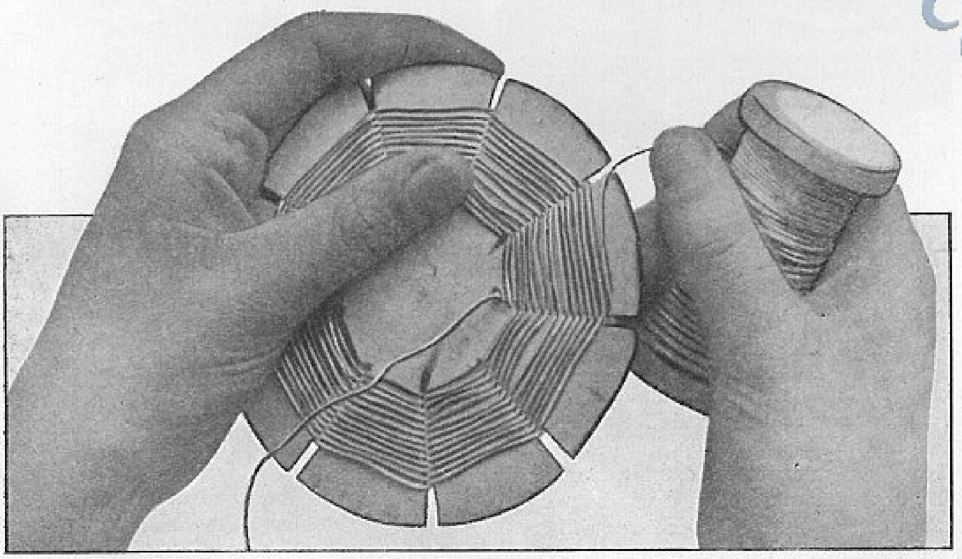
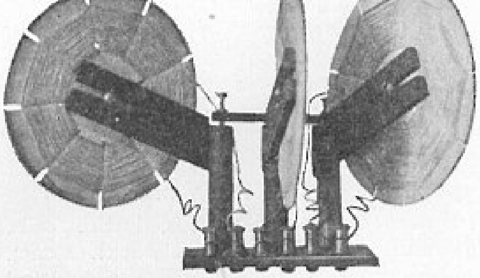


Fig. 2.—Showing the method of securing beginning of the coil of wire.

For nine lines the angle from the centre of the disk will be 40 degrees. On either side of these lines, other lines parallel to and $\frac{1}{16}$ in. from them should be drawn from the circumference to meet the inner circle. A slot is cut along these two outer lines (Fig. 1) and the centre piece removed, thus allowing the wire to be wound without seriously buckling the former.

For low wave-length British broadcasting a fairly thick gauge wire may be used, No. 22 gauge D.C.C. being very suitable. If a neat appearance to the coil is to be obtained, it is essential that new wire free from kinks or dents should be used. One method of securing this is to hold one end of the wire firmly in the left hand and to pass thumb and first finger of the right hand along the wire for a convenient length. When this length of straightened wire has been wound, the process may be repeated until the winding is complete.



Spider-web coils mounted in the holder described in this issue.

In winding, one end of the wire is placed at the bottom of any one slot and, after being brought through to the other side of the disk, is threaded through the next slot. The same process is repeated for the next slot, and so on until one round has been made.

Securing the Ends

After the first winding has passed through every slot the wire between any two adjacent slots is on the opposite side to that occupied in the first turn. The winding is continued in this way, taking care to keep the wire straight between adjacent slots. A neat method of securing the beginning and end of the wire is to pass it through a small hole drilled through the former. (Fig. 2.)

When a number of turns have been put on it is often difficult to count them. An easy method of performing this operation is shown in Fig. 3. A pin or other sharp pointed object is held across the wires and at a fairly acute angle to it. Starting from the centre, the pin is drawn slowly and evenly to the outer end of the coil, the slight jar of its rise and fall forming an accurate method of counting. The other side of the coil should then be counted, the total giving the complete number of turns.

Tuning Without a Condenser

By connecting two coils made in this way in series with each other, it is possible to obtain fine tuning on the principles of the variometer.

If the two coils are joined together in series—the inside of the first coil being connected to the outside of the second—the total wave-length of the arrangement will depend upon how the coils are placed relative to one another. If they are kept widely apart, the value of one coil is merely added to that of the other coil. If they are brought close together a third factor—due to interaction between the coils—makes its appearance.

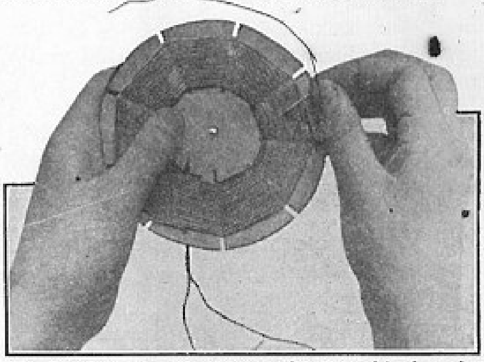


Fig. 3.—Counting the turns with the aid of a pin.

This third factor (called "mutual inductance") may either increase or decrease the total wave-length, according to whether the coils are connected in conjunction or in opposition. But in either case this factor will *alter* the wave-length, and the amount of the alteration will vary with the distance between the coils.

Mounting the Coils

Therefore we have only to connect the coils in series and couple them in a movable coil-holder in order to make a simple tuner, which dispenses with a variable condenser. Any convenient form of mounting may be employed, but it must enable the coils to be placed very closely side by side in the one position, and quite widely apart in the opposite position.

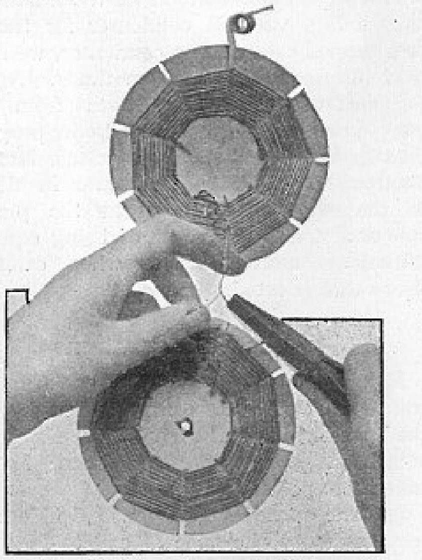


Fig. 4.—Joining spider-web coils in series.

CHAPTER 7
Honeycomb Coils—How to Make Them

(Readers are requested to note that these coils are subject to letters patent, and cannot be constructed without permission of the patentees. See advertisement in this book.)

The reason why certain types of coils have become known as honeycomb coils is best explained by reference to Fig. 4, which shows very plainly the cellular appearance of the windings of a coil of this kind. The coil illustrated there is not a true honeycomb coil, but is an improved form of it, known as the duolateral coil. (The old-fashioned true honeycomb coils are now very seldom seen, but in their case the resemblance to a honeycomb is even more strikingly shown than in the type illustrated.)

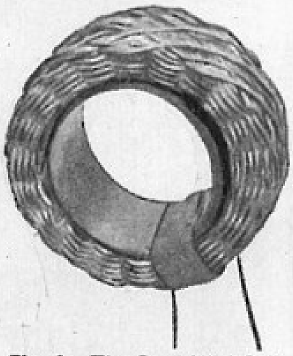


Fig. 1.—The Completed Coil.

Honeycomb or duolateral coils are admirably adapted for use as interchangeable coils of the plug-in variety. Being sound and robust constructionally, they will stand a lot of handling without deterioration, and in receivers where coils are being frequently interchanged in order to tune-in upon different wave-lengths this is an important advantage.

The original honeycomb type of coil had the great disadvantage of possessing a rather high degree of self-capacity. By a simple alteration in the method of winding, the manufacturers altered the construction in such a way that, although the coil remained almost unaltered in appearance, its self-capacity was greatly reduced, and its efficiency correspondingly increased. The chief disadvantage of all such coils from the home-constructer's point of view is that at first they are difficult to make.

After a little practice this becomes no longer a disadvantage, and a complete set of coils covering all the broadcasting wave-lengths can be turned out at home without much difficulty.

Special Former Required

The wooden or metal former upon which the coils are made can be purchased for a shilling or two, or it may be made upon a lathe. As shown in Figs. 2 and 4, it consists of a wooden handle which is easily grasped in the left hand, surmounted by a cylindrical boss of hardwood, from which the two rows of spokes project. The boss generally measures about $1\frac{1}{8}$ in. across, and in the types now on the market provision is made for several rows of spokes round the circumference. Brass pins can be plugged into these holes, and the former used for making several types of coils, including the popular basket type.

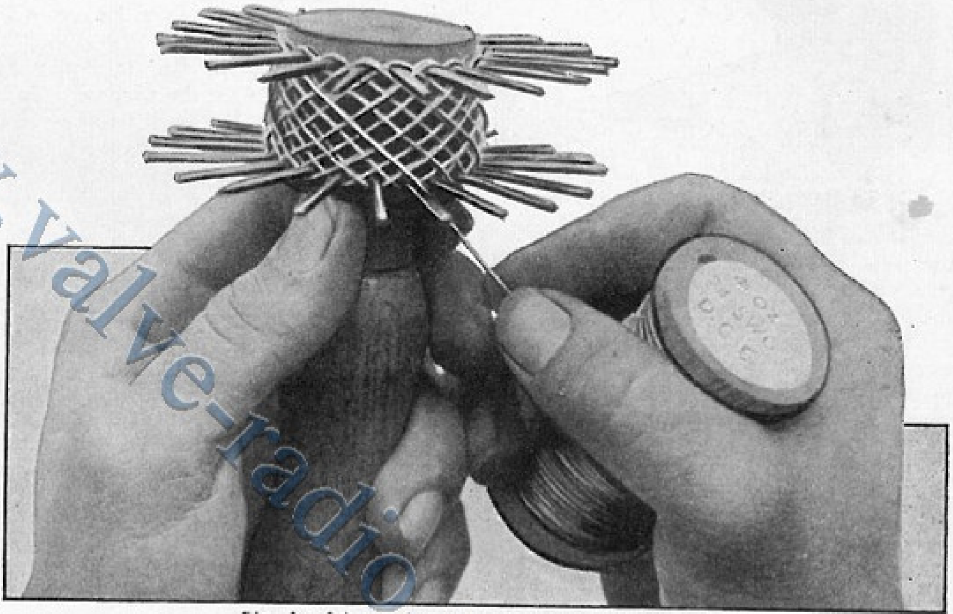


Fig. 4.—Advanced stage in the wiring of the coil.

To make the duolateral coil illustrated on this page forty spokes were used. The first twenty are spaced equally round one set of holes, and the other twenty form the second row of spokes, there being a space of about one inch between the rows. It is important to notice that the two sets of spokes are "staggered." That is to say that a spoke in one row is not exactly opposite to a spoke in the other row, but is spaced half-way between spokes.

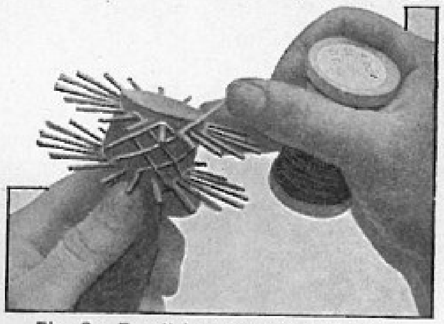


Fig. 3.—Parallel arrangement of wires on the former.

This can be seen in Fig. 2 (although the fact that the former is being held there in a sloping position must be borne in mind).

How the Spokes are Arranged

Tilt the page a little to the right, to bring the former in an upright position. It will then be noticed that the spoke from which the wire starts (near the thumb) is not exactly opposite a spoke on the top row, but stands in a line half-way between the two spokes above it.

After the inner row of spokes has been placed in the former it is a good plan to slip a tight-fitting cardboard ring over the end of the former before the second row of spokes is placed in position. This cardboard ring should be nearly an inch in breadth, so that it occupies all the space between the two rows of pins. When the coil is completed it can be slipped off with the windings, and will serve as a central core to support them.

Honeycomb winding consists essentially in arranging the wire in a criss-cross manner between the two rows of pegs. The winding of the first complete turn will present some difficulty, but when it has been successfully done, subsequent turns may be easily wound. The object is to carry the wire from one side of the boss to the other in a slanting direction so that the wire at each cross-over is the same length.

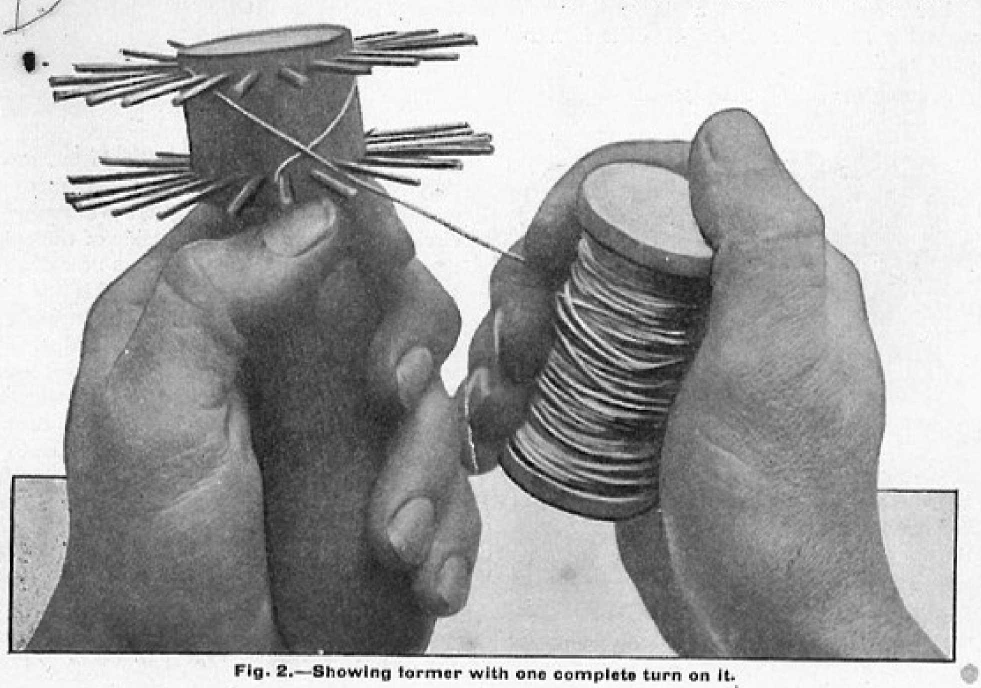


Fig. 2.—Showing former with one complete turn on it.

A convenient number to count would be six spokes at each cross over, this number being arrived at in the following manner. The spoke from which the wire starts, or round which a turn is made, is not counted. The first spoke is the one on the opposite end of the boss, but is half a space nearer in the direction of winding. On the fifth spoke from this (on the same side) the wire is crossed over and wound, so that when completed, the wire passes round every sixth spoke on the opposite side of the boss.

Selecting any spoke for the start, the wire is turned round it, and leaving about 6 in. for the connection, is held against the boss with the thumb. The wire is then

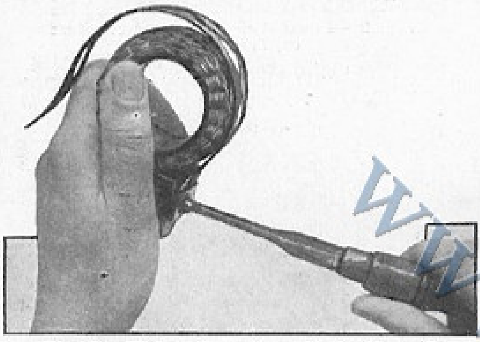


Fig. 5.—Fixing the presspahn to the coil.

taken across the boss to the sixth spoke on the other side, and then returned to the twelfth spoke on the original side. The wire is next taken over to the twelfth spoke on the opposite side of the former (counting the first turning point as 1), then across to the opposite side, and so on right round the former. Fig. 2 shows the winding of the coil where one complete turn has been made. This illustration clearly shows that the beginning of the second turn is three spokes ahead from the starting point and on the same side (counting the starting spoke as 1).

After the first turn has been correctly wound, the second and following turns are more easily dealt with, as the crossing over is, in every case, parallel to the first crossings. This is illustrated in Fig. 3, which shows the parallel arrangements of the crossings.

A more advanced stage of the winding is shown in Fig. 4, where the cellular construction of the coil is becoming apparent and several layers are completed.

Counting the Turns

After the wire has been passed round the former half a dozen times, or so, great difficulty will be found in determining the number of turns. It seems impossible to count them owing to their criss-crossing, but it is quite an easy matter to calculate them. This is done as follows: After construction is well advanced notice carefully when you have completed the first layer of turns round the former. This is seen to be the case when every spoke has one wire wound round it. In the coil in question this represents *eleven* turns. This number eleven is arrived at by multiplying by 2 the number of spokes counted, and subtracting 1 from the total. It will be remembered that 6 spokes were counted in winding from pin to pin, and this number doubled, minus one, represents the number of turns that will be found in one complete layer.

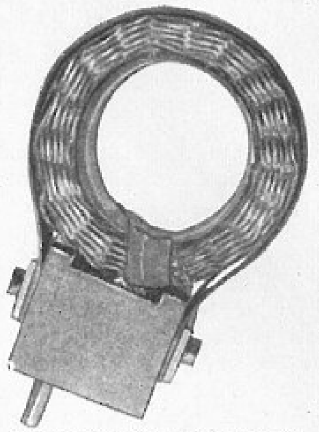


Fig. 6.—The coil with support.

Mounting the Coils

So in order to wind a 75 turn coil on such a former it is only necessary to watch when each pin has 7 turns round it. This represents 7 layers of 11 turns each (77 turns), so two turns must be removed before the coil is finished off.

To strengthen the coil mechanically it may be lightly shellacked by carefully brushing, but as usual this will increase the coils' self-capacity.

The coil is then mounted in a plug and socket mount made for the purpose. To do this, the commencing and finishing ends of the coil are soldered repectively to the plug and the socket contacts on the mount. It is necessary always to wind in one direction, preferably clock-wise, and to connect the beginning of the winding to the plug, as in this way the direction of winding is uniform and the coils can be interchanged in a set without necessitating alterations to the wiring.

A strip of presspahn, or fibre, is wrapped over the coil and secured to the connecting screws on either side of the coil mount. (Fig. 5.) A piece of insulating tape is wrapped round the coil to prevent the connecting wires at the beginning and end of the coil from coming out of position. (Figs. 1 and 6.)

CHAPTER 8
Plug-in Coils

For reception over a large band of wave-lengths, a set of plug-in coils is found very useful.

A complete set of tuning coils capable of

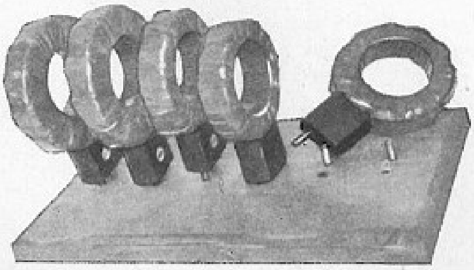


Fig. 1.—Set of coils on a baseboard.

receiving from 300 to 3,000 metres can be arranged conveniently to fit a set of plugs and sockets on a baseboard. (Fig. 1.)

This baseboard or coil rack may be designed to suit any number of coils required. If designed for six coils, the base would measure 10 in. long by 5 in. wide. It should be cut from a piece of $\frac{3}{4}$ in. deal or other wood and the top edges moulded or bevelled to give a finished appearance.

It should then be sandpapered and stained or polished. Two rows of six holes are drilled, the rows being spaced the same distance as the distance between the plug and socket of the coils to be used, the measurement being taken from centre to centre. The size of the holes should allow the projecting plugs of the coils to fit in easily. One row is then plugged with round ebonite or wooden rods to form plugs into which the sockets of the coils will fit. The plugs, if not a tight fit, may be glued into position. To enable the coils to fit more readily, the wooden or ebonite plugs may be slightly tapered or rounded at the ends.

Spacing the Layers

A set of the honeycomb or basket coils constructed as described in this book form a very convenient method of obtaining different wave-lengths.

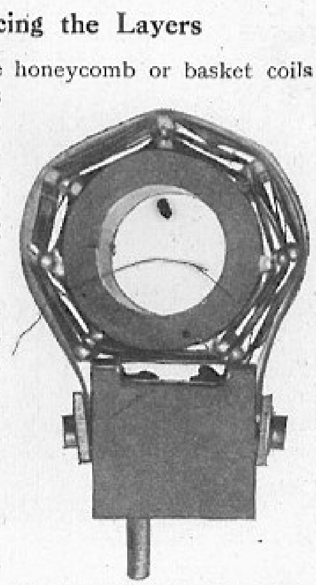


Fig. 2.—The home-made plug-in coil.

Home-made plug-in coils, as illustrated in Fig. 2, can be constructed having different numbers of turns for reception on different wave-lengths. A feature of the coil is the air spacing which exists between adjacent layers, the object being to reduce the self-capacity of the coil. A short piece of ebonite tube 1 in. long and $1\frac{1}{2}$ in. in outside diameter is required on which to wind the coil. The thickness of the tube is not important, providing it does not yield under a light pressure. The circumference of the tube is now divided into seven equal parts by lines running across the tube parallel to its length.

The Use of Dividers

The lines may be correctly found by stepping round the circumference with a pair of dividers, adjusting the latter until they are correctly set. Another method is to find the correct length by drawing a circle of the radius of the outside of the tube upon a piece of paper. A line is now drawn through the centre. From this point, another line is drawn to the circumference at an angle of $51\frac{3}{7}$ deg. The dividers are set on the points on the circumference where the lines from the centre meet it. This measurement is then stepped round the tube. Seven matchsticks are placed on these marks and temporarily secured to the tube by means of two elastic bands which are stretched over each set of ends. A small hole is drilled at one edge of the circumference, after which the coil is ready for winding.

Having adjusted the matches to rest upon the lines scribed, the beginning of a reel of No. 24 S.W.G. enamelled wire is secured to the edge of the tube at the small hole. Winding is started parallel to the adjacent edge and $\frac{1}{16}$ in. from it. The turns should be tightly wound side by side, finishing the layer $\frac{1}{16}$ in. from the edge of the tube.

Fig. 3 shows the fixing of the second set

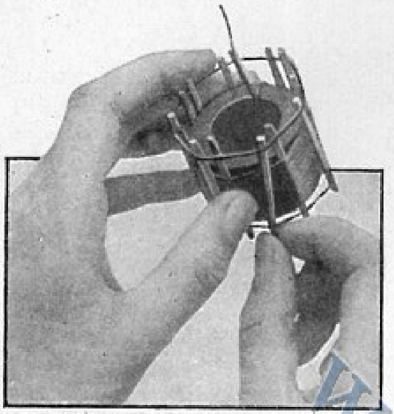


Fig. 3.—Fixing the second set of match supports.

of matches. The elastic bands are removed from the first set, which are now firmly held by the first layer of wire. The second set of matches are placed over the first. The wire at the end of the first layer is then brought over the second set of matches and the second layer wound backwards and towards the beginning of the first turn. It must be understood that although each layer is placed along the ebonite former in an opposite direction to the previous layer, the direction of winding is the same in every case.

The End of the Layer

A third layer is wound over the second as described for the second layer. If only a three-layer coil is required the projecting

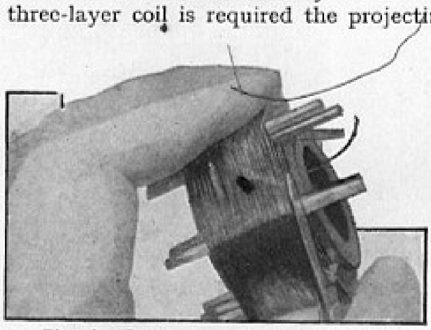


Fig. 4.—Shortening the support legs.

ends of the matches may then be cut off with a sharp knife. (Fig. 4.)

The end of the last layer is made fast to the coil by means of a small hole through which the wire is looped several times. The completed coil is then mounted to the coil mount in the manner described for honeycomb coils.

CHAPTER 9
How to Wind a Variometer

Variometer working depends upon the mutual inductance of two coils placed so that their magnetic fields interact. This principle can be applied in many different ways, the most common being an outer and fixed inductance, in the inside of which is another coil of wire capable of rotation. The fixed coil is commonly called the stator and the moving one the rotor. In one position of the rotor in relation to the stator, the inductive value of the two coils is mutually increased and a higher wave-length is obtained.

Importance of the Coupling

When the rotor is now turned through 180 deg. the two coils are in opposition and give a lower wave-length.

It is important that the windings of the rotor and the stator shall be as close together as possible. The tighter the magnetic coupling, the greater will be the efficiency of the instrument.

With a view to obtaining a maximum coupling, variometers are often designed with a rotor which takes the shape of a ball and rotates inside a slightly larger ball-shaped stator. In some cases, the coil windings of the stator are wound on the outside, but a closer coupling is obtainable when the stator windings are wound on a separate former and then fitted to the inside of the casing of the stator. In stators of the ball type, it is necessary to employ two separate halves, which are screwed or bolted together when the rotor has been fitted.

Winding the Rotor

Ball rotors of the type illustrated can be obtained cheaply from all dealers. The winding is a process which requires some care. The preliminary turns of the first half of the rotor may be wound very tightly, but if this pressure is continued when the winding of one half is nearing completion the probability is that the turns already laid will be pushed off and a fresh start must be made. If the amateur holds the rotor ball in one hand and the wire in the other the winding should be accomplished without difficulty. (Fig. 1.)

The real difficulty is found in the second half of the winding, when the direction is downhill. When, therefore, the first half is completed, the wire is cut and made fast and the second half wound uphill to meet the end of the first half. The direction of the winding of the second half of the rotor is of the greatest importance.

If the rotor is held in the position it occupied in the winding of the first part, the winding of the second half is started in the opposite direction. Another and perhaps simpler way of ascertaining the correct way of winding the second half is to imagine it

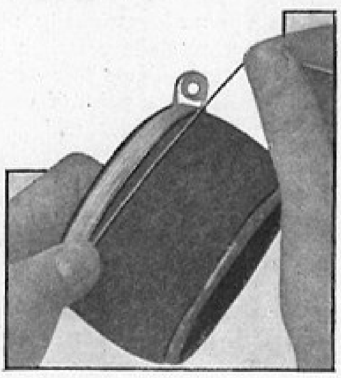


Fig. 1.—The way to hold the rotor when winding.

wound with the end joined to the end of the first half. These ends meet each other at the highest point of the rotor.

Now if an electric current were to enter at the beginning of the first half, it should flow round the whole coil without changing its direction. In Fig. 2 the winding of the rotor is shown completed where the ends

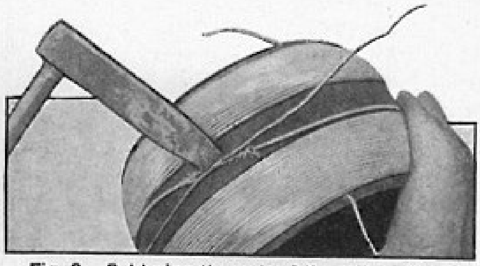


Fig. 2.—Soldering the ends of the coil sections.

of the two windings are being soldered together to form one coil in the electrical sense.

The next step is to varnish the rotor winding with shellac. This process tends to decrease the efficiency of the coil by increasing its self capacity. Nevertheless it is the safest plan for keeping the wires in position. It is especially necessary if the rotor is a wooden ball which is liable to shrinkage with a consequent slackening of the wires. The varnish should be as thin as possible. It will be found easier to unite silk or cotton-covered wires than enamelled wires.

To make the varnish a small bottle is partly filled with flake shellac to which is added a quantity of methylated spirit. It should be left for a few hours until the

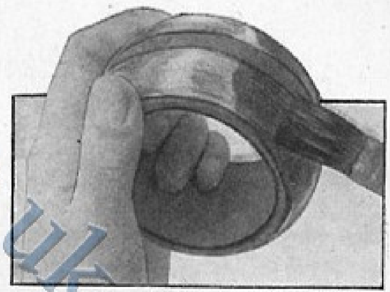


Fig. 3.—Coating the coil with shellac.

spirit has dissolved the flakes. The shellac is applied with a suitable brush. (Fig. 3.)

Connecting Up

The stator of the ball type is usually beyond amateur construction, recourse being made to the cylindrical ebonite tube. The winding of the stator usually takes the form of two half windings, the space between the two enabling the spindle to project on either side of the tube. The method of crossing over the wire at the space between the two half windings is shown in Fig. 4, where the stator winding is seen nearing completion.

One end of the stator winding is brought out to the aerial terminals, one end of the rotor to the earth terminal, while the two remaining ends are connected together.

This method of connecting up means that the two coils are in series with one another, in which arrangement an electric current may be said to flow through one coil first and then through the other.

The Variocoupler

Very similar to the variometer is the variocoupler. (Figs. 5 and 6.) In the latter, however, the stator is usually extended and wound with a number of turns of wire from which tappings are made, so that a higher wave-length range is obtainable than with

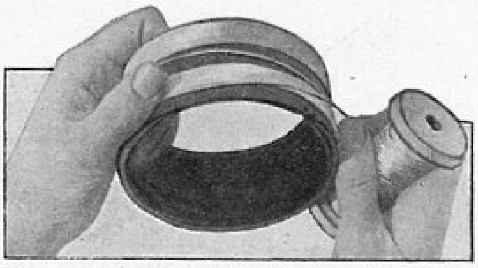


Fig. 4.—Method of crossing over the wire at the space between the two half windings.

the variometer. It is usual in the variocoupler to bring the ends of the rotor and stator windings to terminals so that the apparatus can be used in any desired way.

A common method is to use a tapped stator as the variable aerial tuning inductance and the rotor as a variably coupled reaction coil. A third method, useful where great selectivity is required, is to connect the rotor to aerial and earth to form an open aperiodic aerial circuit which may be variably coupled to the tapped stator which then acts as a closed and tuned secondary circuit.

The disadvantage of either the variometer or the variocoupler is that it is bulky as compared with plug-in coils, and the wave-lengths covered cannot be varied over a wide range.

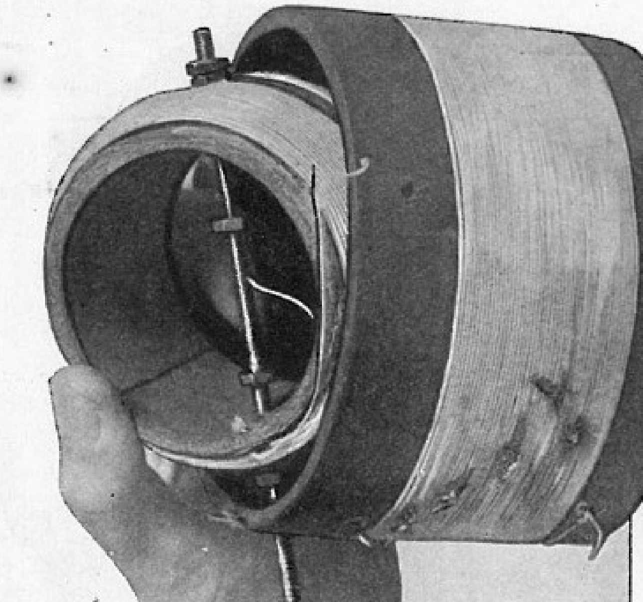


Fig. 6.—Showing the fixing of the rotor and its spindle to the stator before the wires are connected.

CHAPTER 10
Testing Faulty Coils

The faults which occur in tuning coils are generally of a mechanical nature, due to a break in the wire, or to a connection working loose. Such faults are nearly always intermittent, and whilst signals may be quite normal at one moment, the slightest movement may cause them to become very weak, or to suddenly disappear altogether. Such faults are fairly easy to locate in the manner to be described, but there is one class of fault which tuning coils develop that should be prevented rather than cured.

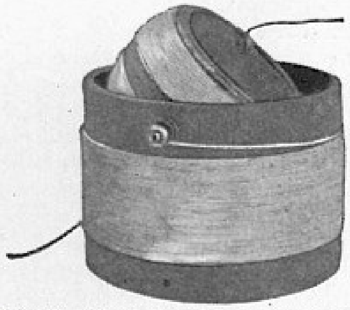


Fig. 5.—The variocoupler completed.

This arises as the result of allowing coils to become damp, and as moisture is always detrimental to a coil, and greatly impairs its efficiency, great care must be taken to keep coils stored in a cool, dry place.

Various Causes

An easier fault to trace is the entire absence of signals, and it will then often be found that one side of the coil has become broken or disconnected. Intermittent contact in an aerial coil causes intermittent reception, accompanied, especially in a valve receiver, by a series of grating noises.

Different types of aerial tuning coils have their particular weaknesses. Sliding contacts, such as are occasionally used for single-layer inductances, are liable to give trouble at the point of contact of the slider and the wire. In many cases the trouble arises through the spring which actuates the plunger being too weak. Another cause is the failure to remove all the insulation of the wire from the path along which the plunger of the slider travels.

Another method of obtaining contact from any particular wire on a single-layer inductance is by a springy metal arm capable of traversing the inductance by a pivoted action. If this arm is not sufficiently springy, it may fail to make contact at a point on the inductance.

For a rapid test to discover faults, a source of low-tension current which may be supplied from two bell batteries joined in series is required.

This is used in conjunction with any instrument which will indicate when current is flowing, the commonest being telephones, a flash-lamp, or a galvanometer. The flash-lamp is not suitable for testing coils of very fine wire, but the galvanometer would show a deflection on these, whilst a pair of telephones will prove even more sensitive as an indicator.

Connections for Testing

Fig. 1 shows how the galvanometer is connected for testing purposes. One vacant terminal of the cell or battery (say, the negative) is joined to one of the terminals of the galvanometer. A convenient length of flexible wire is securely attached to the remaining terminal of this instrument, while a similar wire is connected to the remaining battery terminal (positive). If telephones or a flash-lamp are used instead, they are connected up in place of the galvanometer.

The testing circuit will remain "dead" if connected across a broken coil, but if a continuous path is available for the current from the battery (as is the case with the coil shown in Fig. 1) the needle of the galvanometer is deflected. Similarly a flash-lamp would glow, or a loud click would be heard in the telephones.

The plug-in coil is tested as shown by touching one wire on the plug and the other on the socket. In the variable single-layer inductances previously mentioned, the test is carried out by connecting one of the free ends of the testing wires to the beginning of the coil, while the other end is joined to the sliding contact, or in the case of the pivoted arm type, to the arm itself. One point should be observed when testing coils of this type.

Usually, one end of the coil is left blank, and as it has no wire connected to it, it is called a dead end. In some cases, however, and this is particularly true where the coil is a very long one, the end is joined to the moving contact. This wire must be temporarily removed when the test, as previously described, is made.

Other Faults

In the plug and socket method of connection it is sometimes found that the contacts are bad because the plugs fit loosely in the sockets. This fault is not shown up under the test described, but may be determined by connecting the testing circuit across the internal connections of the socket, and plugging in the coil. (Fig. 2.) (In this case care should be taken to see that no other path for the current is provided by the circuit connections, such as when a crystal and transformer primary are connected across an anode coil.)

When signals are found to be intermittent and to vary in strength, the coil suspected is moved about. If the symptoms of intermittent reception follow the movements of

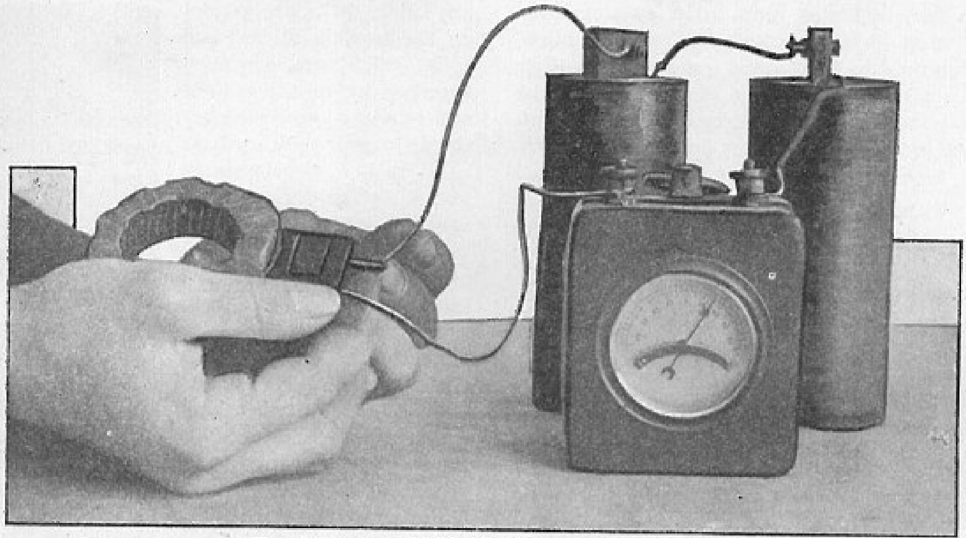


Fig. 1.—Testing for faults with a galvanometer.

the coil, it should be taken out and both plugs opened out with a knife blade. This trouble is particularly easy to discover where the coil is used in an anode circuit, as a series of loud clicks will be heard when the high-tension circuit is made or broken.

A particular fault, likely to develop in the single-layer inductance where some means of sliding contact is provided for varying the inductance, is the gradual wearing away of the wires at the place where the slider passes. The result is that the adjacent wires are connected electrically at this point across the insulation, with the result that a short circuit takes place between the turns.

The cure in this instance is to make sure that the pressure of the plunger spring is not excessive and to carefully brush from between turns the particles of metal dust.

Another fault caused by short circuiting, as distinct from faults of broken or imperfect connection, is found with tapped coils where the connecting wires between two adjacent contact studs of the switch make accidental contact, and this is therefore easily remedied. Shorting between transformer coils is yet another fault sometimes found, and the test with the telephones previously described enables the break to be located.

CHAPTER 11
H.F. Transformer Coils

The construction of a high-frequency transformer requires the careful winding of two inductance coils. The coils are placed side by side in one type of transformer while in another commonly used type one coil is wound on the top of the other.

The home-made transformer, illustrated in Fig. 1, during the winding of the secondary coil is an example of the last-mentioned type. The coils are wound in a built-up former of ebonite, the wires at the beginning and end of the coils being connected to split valve-pins arranged to fit into the standard valve-holder.

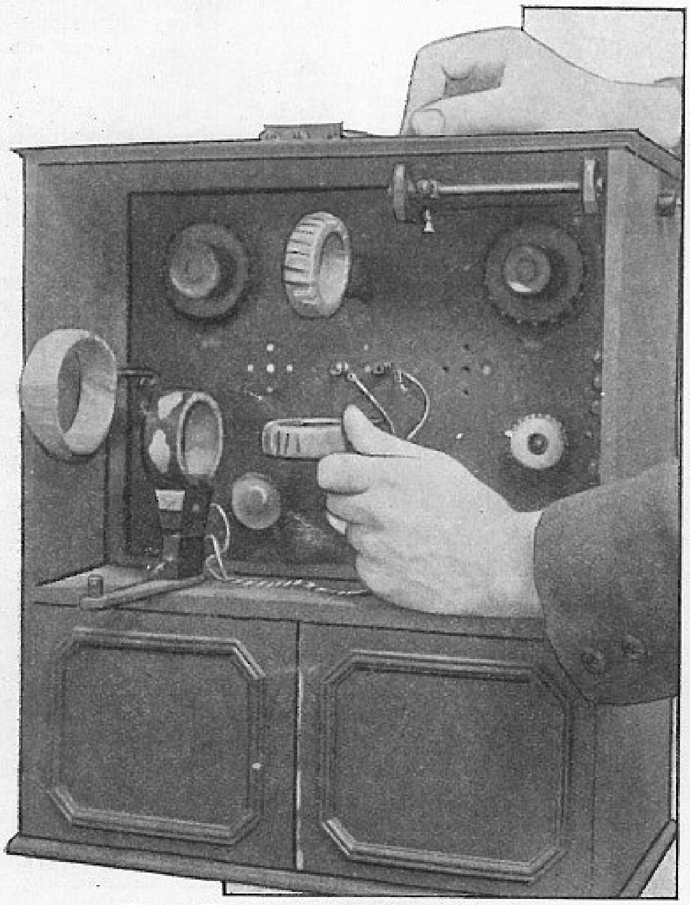


Fig. 2.—Testing plug-in coils for bad contact.

The Parts Required

In the construction of the transformer, two ebonite disks of $2\frac{1}{2}$ in. diameter and $\frac{1}{8}$ in. to $\frac{3}{16}$ in. thickness are required. A $\frac{3}{16}$ in. hole is drilled through the centre of each. Four saw cuts are made in one of the disks along two lines at right angles to each other, each line passing through the centre. The saw cuts are made with a fine saw and extend from the circumference and towards the centre of the disk for a distance of $\frac{1}{2}$ in. These two disks are separated from each other by a smaller disk of ebonite, $1\frac{1}{4}$ in. in diameter and $\frac{3}{16}$ in. thick. A centre hole, $\frac{3}{16}$ in. diameter, is again required.

Four split valve-pins are screwed to fit a standard valve-holder into a similar but thicker disk of ebonite, the centre hole in this case being tapped No. 2 B.A. The four disks are then assembled in the following manner: A No. 2 B.A. screw is pushed through the centre of the disk without the saw cuts, following which the smaller ebonite disk is slipped over the screw. The second large disk with the saw cuts is the third to follow. These disks are tightened up together by turning the screw into the tapped hole in the valve-pin disk. The former is thus completed and is ready for winding.

Winding the Coils

No. 30 S.W.G., D.S.C. wire is used for winding both coils, each of which consists of a 35 ft. length of the wire. The beginning is twisted round the "grid" valve-pin, the wire being brought into the slot through the adjacent saw cut. During the winding the ebonite former may be held in the left hand while the right hand, gripping the reel, pays out the wire at an even pressure.

When the length measured has been wound, the end is passed through the saw cut opposite to the one through which the beginning of the wire passes. It is then made fast to the "anode" valve-pin. Two turns of silk are laid over this winding to prevent actual contact of the primary and secondary coils. The silk may be worked into position with a thin strip of wood.

The second coil is then wound in exactly the same manner, taking care that the direction of winding is the same as in the first coil. After it is completed, the ends are soldered to their correct valve-pins. Coils of this description, tuned by a ·0002 variable condenser, are suitable for ordinary broadcast wave-lengths.

A Groove-wound Transformer

For a transformer in which the coils are wound side by side in special grooves, a solid roll of ebonite, measuring 2 in. long and $1\frac{1}{2}$ in. in diameter, is required. Two small holes of about $\frac{1}{16}$ in. diameter are drilled right through the rod so that each one is $\frac{1}{8}$ in. from the centre. On one of the end flat faces of the former, holes are drilled and tapped to receive the screwed stems of 4 split valve-pins. The holes are positioned round the centre of the face so that the valve-pins may be plugged into a standard valve-holder. An improved appearance is given if the sharp edge of the ebonite former is curved or tapered slightly.

To cut the grooves with a lathe the former is secured in the jaws of the chuck, the other end being steadied by a centre in the tailstock. The first groove is turned so that its nearest edge is $\frac{5}{16}$ in. from the tailstock end of the lathe. The groove is $\frac{1}{8}$ in. deep and the same distance in width. All the six grooves are of the same depth and width, the space between any two being also $\frac{1}{8}$ in. After the grooves have been cut, the former is removed from the lathe.

A slot is now cut with a hacksaw throughout the length of the former and parallel to its length. (Fig. 3.) The depth of this saw-cut is at least $\frac{1}{8}$ in. and it should be arranged so that one end falls midway between the "anode" and the filament valve-pin, which is seen to the left when the unfinished transformer is

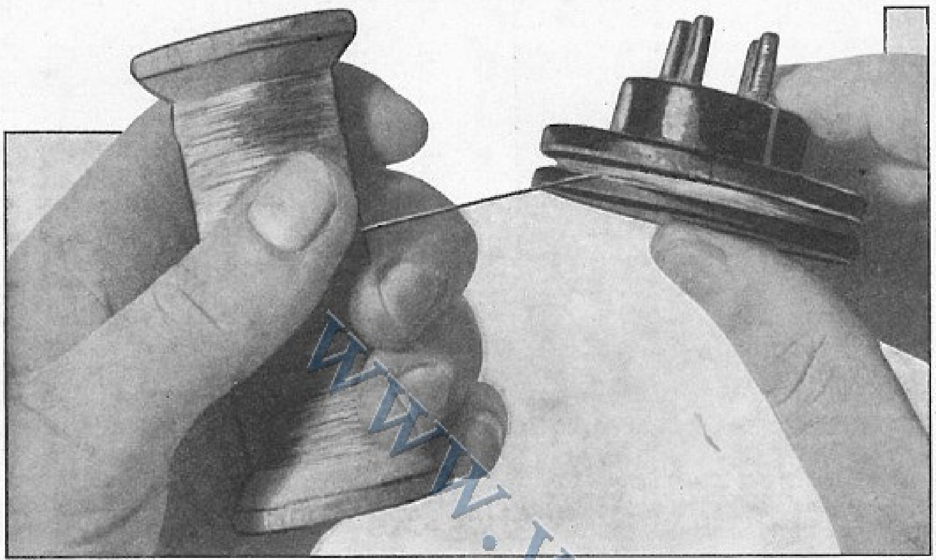


Fig. 1.—Winding the secondary of the home-made transformer.

held with the "anode" valve-pin to the bottom.

In both primary and secondary windings, No. 30 S.W.G., D.S.C., wire is employed. The beginning of the first winding is joined to the "grid" valve-pin and taken through the slot to the first groove. For broadcasting wave-lengths the groove is then evenly wound so that about 50 turns of the wire lie in the first section. The wire is not broken when the first groove has been wound, but is taken through the slot to the third groove, which is then wound in the same manner.

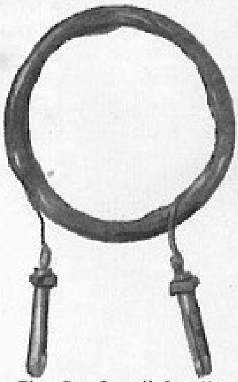


Fig. 2.—A coil for the "enclosed" type transformer.

Before starting the winding, however, it should be made quite certain that the wire in the slot has been pushed down to the bottom. When this groove has 50 turns the fifth groove is wound in the same way, and the wire broken off with about a foot to spare. It is then run in the slot to the end of the former and pushed down one of the central holes in the ebonite and connected to the "anode" valve-pin.

Winding the Grooves

A little softened wax is pressed into the slot so that when the beginning and end of the coil are run into the slot, there is no possibility of a short circuit between the two coils. This precaution having been taken, the second coil may be wound. The beginning of the wire is connected to the filament valve-pin nearer to the slot. The wire is then run into the slot, and after passing over the first groove, which is already filled, is wound into the second groove for another 50 turns. Jumping the third groove in the same way, the fourth groove is wound and when completed, the same operation is carried out to the sixth and last groove. (Fig. 4.)

The coil is cut off with a few inches to spare, the end running through the slot and the second hole to the remaining valve-pin. The temporary connections to the valve-pins are made permanent by soldering, after which the transformer is ready for use.

As the amount of wire used for the primary and secondary coils in both types of transformers is the same, it is not of vital importance which is used as the primary and which the secondary. Very often one particular way is found the better, this being ascertained experimentally. High-frequency transformers may also be made by suitably coupling any two coils selected or constructed to operate on the wave-lengths desired. Small basket, honeycomb, or slab coils lend themselves to treatment in this way. In one method where basket coils are used, disks are placed on the outside of the two coils which are clamped together by means of nuts and screws passing through the disks near their centres.

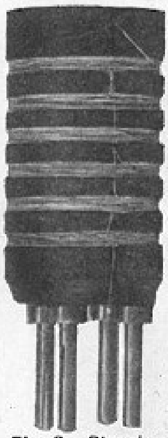


Fig. 3.—Showing the groove-winding.

A rather novel transformer of home-made construction is illustrated in Fig. 5. The advantages of this transformer are that besides being immune from the effects of dampness owing to the enclosed construction of the transformer, the outer casing which is of ebonite saves the delicate wire from injury.

For the casing two telephone ear-caps are necessary having a diameter at the internal screwed portion of about 2 in. They should be selected to match or be of such size that one is capable of resting inside the other to a slight extent.

In one ear-cap four small slots are cut at the back edge of the circumference at the four points of the compass as shown by the projecting lugs. (Fig. 5.) The coils, which may be constructed experimentally for different wave-lengths, may take one of the forms above described, or that shown in Fig. 2. Soldering tags or short metallic studs are soldered to the ends of the two coils.

Finishing Off

Having placed one pair of the soldering lugs in position in the slots previously cut, with the coil to which they are connected centrally placed in one of the ear-caps, a very little melted paraffin wax is poured in to locate the coil and keep it and the lugs in position. The second coil is then placed over the first with the lugs projecting to the outside of the second pair of slots.

A little wax is then run in to fix the second coil to the first. When the wax is set, the second ear-cap is placed in position and bolted to the other by means of a short

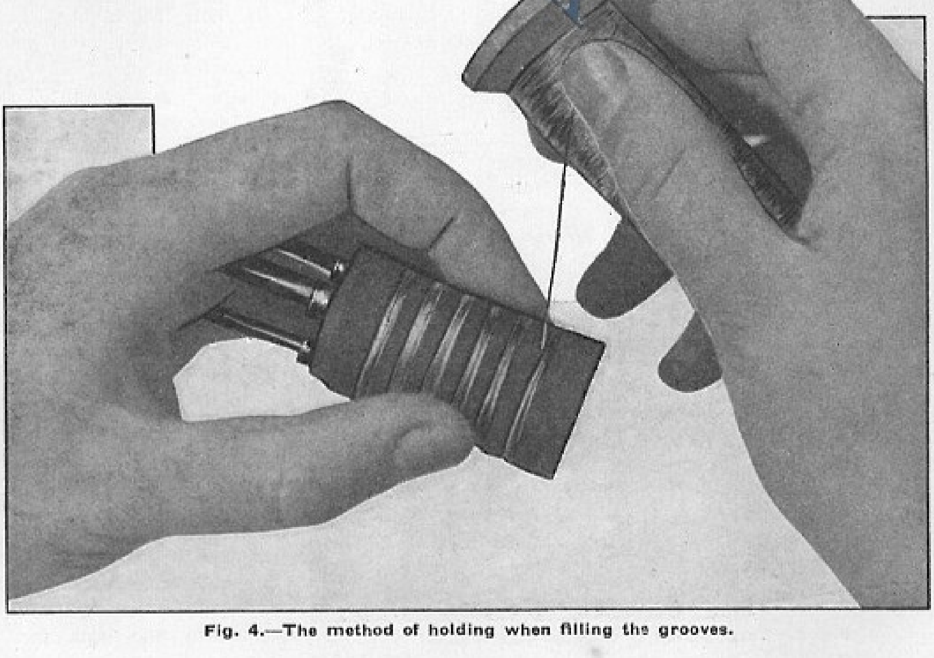


Fig. 4.—The method of holding when filling the grooves.

length of screwed rod, slipped through the central holes of the ear-caps. A nut is screwed to the end of the rod and a flat washer placed against it to prevent the rod from passing through the centre holes.

On the other side of the transformer a short length of ebonite tubing is placed over the screwed rod to raise the transformer from the panel to which it is to be attached. A second locking nut is then added to secure the whole rigidly together. At this side of the transformer the screwed rod is not cut off short, but a length of about ½ in. allowed to remain to form a means of bolting the transformer in the position desired.

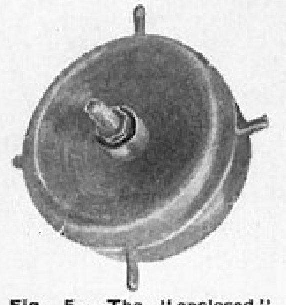


Fig. 5.—The "enclosed" type of H.F. transformer, mounted in telephone ear-caps.

Wave-length of Single-layer Tuning Coils

Many wireless amateurs experience considerable difficulty in estimating the maximum wave-lengths of their tuning coils, or in adjusting their coils to receive any particular signals. The table on page 22 gives the wave-lengths of single-layer coils, and will be found to cover a sufficiently wide range for most ordinary purposes.

The figures given in the table are calculated for use with a normal P.M.G. aerial, but the effect of a tuning condenser has not been taken into account. If the condenser is connected in parallel with the A.T.I., the wave-length of any coil or part of a coil will be longer than that given in the table; if the two are connected in series it will be shorter.

One or two examples will make clear the method of using the table. Suppose we are contemplating the construction of a coil consisting of 380 turns of No. 24 S.W.G. wire, wound upon a 5-in. diameter cardboard tube, and we wish to find out whether we shall be able to receive telephony from Paris (F.L.).

Locating Slider Positions

Towards the end of the first column of the table we find the number 380. Opposite to this in the second column are the numbers 20, 22, 24, 26, 28 and 30, representing different gauges of wire. Our coil is to be wound with No. 24, so we follow along from the figure 24, until we come to the column headed "5-in. diam." Here we find the number 2440, which is the maximum wave-length to which the coil will tune. This coil would, therefore, scarcely suffice for the reception of Paris telephony, which is transmitted on a wave-length of 2,600 metres.

Again, suppose we have a coil consisting of 500 turns of No. 22 wire, wound on a 3½-in. diameter former, fitted with a slider, and we wish to know approximately where to put the slider to receive on a wave-length of 1,100 metres.

Looking down the column headed "3½-in. diam." at those figures which are in line with the numbers 22 in the second column, we come to 1090, which is the nearest figure to the wave-length we require.

In line with this figure in the third column (headed "Length of winding in inches") is the value 5.6, so that if we put the slider of our coil about 5½ in. from the end which is connected to the aerial, we should be able to tune in to the desired wave-length by adjusting a small parallel condenser.

If the condenser were in series with the A.T.I., it would be better to place the slider a little farther along, say 6 in. from the end of the coil.

Questions and Answers About Coils

Q.—How is the wave-length of a coil found out?

A.—By first calculating its inductance in microhenries, adding this to the inductance of the aerial in microhenries, taking the capacity of the aerial in microfarads, and applying the formula:

$$\text{Wave-length} = 1885\sqrt{K(\text{in mfds.})\,L(\text{in mhs})}$$

Most results of mathematical measurements in wireless are very approximate, and even with the greatest of care this particular instance is liable to at least 10 per cent error, so that one can afford to be approximate with the minor factors. The average capacity of the amateur aerial is between ·0002 and ·0003 mfd., while the inductance will be somewhere round about 15 mhs. Check this roughly by multiplying the length of the aerial plus lead-in in feet by 1·5, this will give you approximately its fundamental wave-length in metres. Call this Y; suppose we take the capacity to be 0·0002, then the inductance must equal in microhenries

$$\frac{Y}{(1885)^2} \div \cdot 0002.$$

That will bring the K and L coefficients of the aerial to as nearly correct as possible, or, rather, as near as we require them. Calculate the inductance of the coil by means of this formula: $L = 9{\cdot}8\ D^2N^2LK$, where D = diameter of the coil in cms. N = number of turns per cm. L = length of the coil in cms. K = the correction factor, which is based on the ratio of the length of the coil to the diameter. It varies from ·96 where the diameter is ·1 of the length to ·2 to where the length is ·1 of the diameter. Where the diameter is similar to the length, this factor is ·69. Where the length is twice the diameter it is ·82, where the length is five times the diameter ·92, and from these you must guess somewhere about the figure that will meet the case of the coil you have under consideration. Having then worked the above out, the result will not be in microhenries, but cms.; and must be divided by 1,000 to bring it to microhenries.

Correction for Condenser

Add this to the inductance of the aerial, take the capacity of the aerial and apply the first formula given above—i.e., $1885\sqrt{KL}$. Where a parallel condenser is employed the various degrees of capacity can be added to the capacity coefficient in the above, and will give quite a fair approximation.

* * *

Q.—How is the inductance of a coil calculated? Give example.

A.—The following formula is an approximate method of calculating the inductance of a coil:

$$L = 4\pi\frac{A \times N^2}{l} \times 10^{-9} \text{ henries}$$

A = sectional area of the coil in sq. cms.
N = number of turns.
l = length of coil in cms.

For instance, with a coil of 10 cms. diameter, 100 cms. long, with 2,000 turns. The sectional area will be πR^2, so that

$$A = \frac{22}{7} \times 5 \times 5 \text{ sq. cms.}$$

$$\therefore\ A = \frac{550}{7} \text{ sq. cms.}$$

Substituting the formula given above:

$$L = \frac{4 \times \frac{22}{7} \times \frac{550}{7} \times 2{,}000^2}{100} \times 10^{-9} \text{ henries}$$

$$\therefore\ L = \frac{1936000000}{4^9} \times \frac{1}{10^9} \text{ henries}$$

$$\text{and } L = \frac{1{,}936}{49{,}000} \text{ henries}$$

$$= \cdot 039512 \text{ henries}$$

or 39,512 microhenries approximately, ignoring for simplicity the correction factor.

* * *

Two Useful Instances

Q.—What size former, number of pins, wire, etc., are required for primary, secondary, anode, and reaction honeycomb coils to cover broadcast wave-lengths?

A.—The coils can be wound with No. 24 or 26 D.C.C. S.W.G. wire on former 2 in. in diameter, ¾ in. in width, employing 13 pins on each side. Primary 50 turns; secondary 75, anode 75-100, reaction 50.

* * *

Q.—What windings and what size formers will be required for a variometer to tune between 300 and about 900 metres?

A.—55 turns of No. 24 S.W.G. on a 3-in. former and the same number of turns of 22 on a 4-in. former will cover that range fairly closely.

CHAPTER 12
Coil-holders and How To Make Them

Coil-holders are chiefly used for coils of the plug-in or interchangeable varieties, and there are a number of excellent patterns on the market. Those who like to make as much of the parts as possible will find it practicable and economical to do so, the following being a few suggestions.

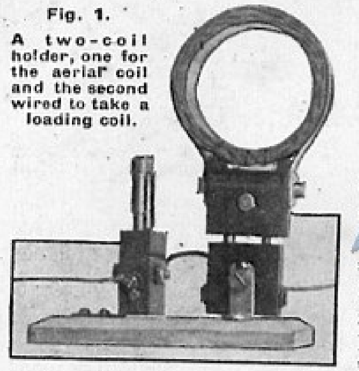


Fig. 1. A two-coil holder, one for the aerial coil and the second wired to take a loading coil.

One of the most useful types is shown in Fig. 1, and comprises a block of ebonite about $\frac{3}{8}$ in. thick, and some $1\frac{1}{2}$ in. long, and 1 in. high. In the main block a plug and a socket (both similar to ordinary valve-pins and sockets, but rather thicker) are fitted by screwing and tapping. These are spaced to suit the plug and socket on the coils to be used with it, and means of connection to the circuit are provided in the form of setscrews that pass through the ends or sides of the block and screw into the plug and socket respectively.

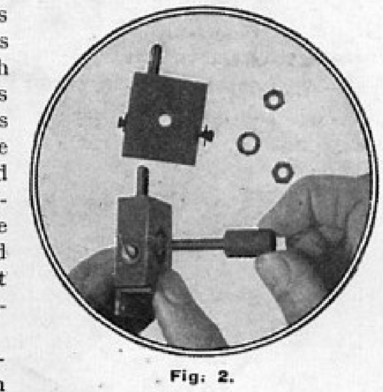


Fig. 2.

An application of two such holders is shown in Fig. 1, where the first holds an aerial coil and the second is wired to accommodate a loading coil, but is temporarily shortened by the metallic connection link at the top, which takes the place of the loading coil when the latter is not needed.

When two coils are to be variably coupled, a commonly used method is to employ two or more blocks as before and to fix them into a bracket arrangement so that one can move towards the other under the action of a handle. Another method is to arrange two such blocks and to make them turn about each other on a central pin. For this purpose one of the blocks has an angle plate screwed to the underside whereby to fix it to the panel, and also has a length of No. 2 B.A. screwed rod fixed into the larger face in the centre thereof.

Fig. 3.

The second block has a central hole in it corresponding with that for the screwed rod in the first block. To assemble the two a piece of ebonite tubing, 1 in. in length, is slipped over the screwed rod (Fig. 2), and then the second block is placed in position on the rod and held firm by a nut and spring washer, also secured by a lock nut. Arranged in this way the coils can pass each other in a plane parallel to their faces. (Fig. 3.)

Basket Coil Mounting

Basket coils are readily mounted on blocks similar to the foregoing, but with the addition of two strips of thin ebonite or cardboard, about 1 in. wide and long enough to accommodate the desired coil. The latter is merely pinched between the two strips by means of a screw which passes through the hole in the centre of the coil, and a nut, which may be tightened with a small spanner or pair of pliers. The strips are screwed at their lower ends to the sides of the block, and the ends of the coil windings are soldered to the plug and socket respectively.

Alternatively two plugs may be used on the coil mount, and a pair of sockets on the holder on the set. This arrangement is shown in Fig. 5. In this holder one pair of sockets are attached to a sub-base of ebonite, as shown in Fig. 5, and the second pair mounted on a movable arm pivoted about the centre of its length.

Connections can conveniently be made by fastening terminal tags beneath the sockets to accommodate flexible insulated wire leads.

An attractive home-made three-coil holder can be made as shown in Figs. 4 and 6.

The baseboard is a piece of ebonite, $3\frac{3}{4}$ in. long and $2\frac{1}{2}$ in. wide and $\frac{3}{16}$ in. thick. Four holes are drilled, one in each corner, and are countersunk for fixing screws. Six holes are drilled and tapped at a distance of $\frac{5}{8}$ in. from the front edge to take the six terminals. Three upright columns are made from $\frac{1}{2}$ in. ebonite rod, $2\frac{1}{2}$ in. long; the lower ends are turned down to $\frac{5}{16}$ in. diameter and fit into similar holes in the baseboard. These are located $\frac{1}{2}$ in. from the back edge, and $1\frac{1}{2}$ in. apart.

A Three-way Coil-holder

The upper ends of the columns have a flat filed at one side for a length of 1 in. (see Fig. 6), and to this is fitted the radial arm, made from ebonite $\frac{3}{16}$ in. thick and $3\frac{1}{2}$ in. long. The central column is fixed by a screw and washer at the lower side, the washer bearing against the underside of the base and holding it firm.

The three radial arms are shaped as shown in Fig. 6a, and slotted at the outer end for a length of $1\frac{1}{2}$ in. The arms, when finished, are screwed to the flats formed on the columns. The work at this stage is shown in Fig. 4, where the central column is in place, and an arm ready for fixing is shown in Fig. 6a.

To support the upper ends of the outer arms a strip of $\frac{1}{4}$ in. ebonite, $2\frac{3}{4}$ in. long, is screwed firmly to the top of the central column, and pointed small screws fitted through the ends at a distance of $1\frac{1}{8}$ in. from the centre. The assembly of the outer arm is pictured in Fig. 4, which shows how the point screws are arranged. After placing the arms, adjust the screws so that the arms can turn freely, but without shaking, and then prepare three disks of ebonite, $1\frac{1}{4}$ in. diameter, and fit a screw to the centre.

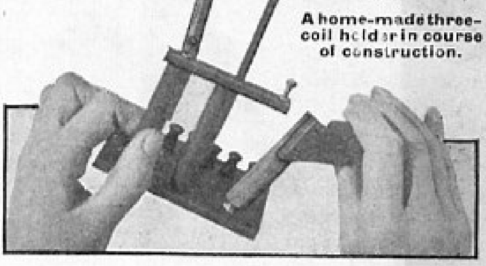


Fig. 4. A home-made three-coil holder in course of construction.

This screw needs a sufficiently large head to grip the side faces of the slot in the radial arms, the coil being held between the disk and the other face of the arm. The wiring is carried out by bringing the wires from the coils to the terminals on the front of the baseboard, clipping them beneath the lower nut on the terminal, and leaving the second nut free to accommodate the connecting wires for the aerial and other connections.

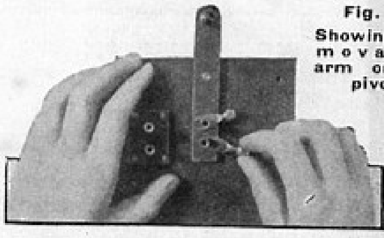


Fig. 5. Showing the movable arm on its pivot.

An Important Point

The finished article has the merit that, apart from the terminals and screws, there is no metal in its construction, and it is suitable for panel or baseboard mounting.

Cylindrical coils are usually mounted to a panel by screws or bolts and nuts passed through the panel and the ends of the former tube, separating the latter from the panel by slipping ebonite washers or a short tube over the screws, between the panel and the tube former.

Another plan is to employ shaped blocks of dry wood or ebonite, and fix the coil with a strap of ebonite or celluloid. An important point in this class of coil-holder is to maintain perfect insulation, more especially with anode coils, as the leakage of high-frequency currents through faulty coil-holders often reduces seriously the value of a set as regards signal strength.

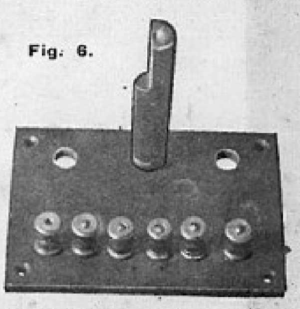


Fig. 6.

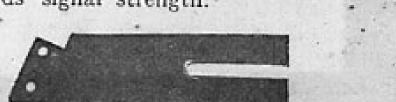


Fig. 6a.

PLUG-IN COILS

Wire for Primary	Wave-length with Average Aerial	Primary Turns	Secondary Turns	Anode Turns	Reaction Turns (approx.)
24	260–375	25	35	35–50	35–50
24	310–515	35	50	50–75	50–75
26	370–730	50	75	75–100	50–75
26	460–1030	75	100	100–120	75
26	580–1460	100	150	150–200	75
26	790–2200	150	200	200–250	75
26	1060–2850	200	250	250–300	75
26	1430–4000	250	300	300–400	75–100
28	1680–4800	300	400	400–500	75–100
28	2180–6300	400	500	500–600	100
30	3130–8500	500	600	600–700	100
30	4100–12000	600	700	700–800	100
32	5100–15000	750	850	800–900	100
32	6300–19000	1000	1100	1100–1200	100–150
34	7100–21000	1250	1350	1350–1450	100–150
36	8300–25000	1500	1600	1600–1700	100–150
		·001 MFD in parallel	·0005 MFD in parallel	·0002–·0003 MFD in parallel	

For basket coils allow about 20% off the maximum wave-length. Wind on a former of 11 slots, with centre diameter of 1½ inches. For a ·0005 MFD condenser instead of ·001 MFD allow 35% off. (Many well-known coils are subject to Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.)

WAVE-LENGTH TABLES

The wave-lengths in the following tables are for closed circuits only. When a standard P.M.G. aerial is used with these coils the aerial circuit wave-length will be consequently increased by approximately 125 metres in each specific case.

WAVE-LENGTH IN METRES WITH CONDENSERS SHOWN CONNECTED IN PARALLEL.

Make	Type of Coil	'00025 mfds. Min.	0'0003 mfds. Max.	0'0005 mfds. Min.	0'0005 mfds. Max.	0'001 mfds. Min.	0'001 mfds. Max.
ATLAS	25	57	230	—	300	—	375
	35	83	300	—	380	—	515
	40	95	360	—	470	—	650
	50	124	425	—	570	—	780
	65	140	475	—	680	—	1,000
	75	170	620	—	800	—	1,120
	100	230	850	—	980	—	1,520
	150	340	1,000	—	1,520	—	2,300
	200	420	1,400	—	2,300	—	3,100
	250	500	2,000	—	2,900	—	4,150
	300	680	2,500	—	3,400	—	4,940
	400	800	3,400	—	4,400	—	6,380
	500	1,020	4,250	—	6,000	—	8,900
	600	1,200	4,750	—	7,000	—	12,100
	750	1,500	6,000	—	8,000	—	15,000
	1,000	2,000	8,100	—	9,800	—	20,000
	1,250	2,200	9,750	—	15,000	—	22,000
	1,500	2,900	12,500	—	18,000	—	26,000
		Natural Wave-length without Condenser.	0'0001 mfs.				
IGRANIC	C_1	—	—	—	—	110	285
	C_2	—	—	—	—	205	500
	C_3	—	—	—	—	348	706
	C_4	—	—	—	—	495	1,050
	25	53	116	60	237	—	330
	35	85	170	85	338	—	471
	50	148	265	150	510	—	706
	75	200	381	200	752	—	1,046
	100	281	512	280	1,000	—	1,383
	150	355	732	360	1,473	—	2,053
	200	462	987	470	2,010	—	2,800
	250	522	1,230	530	2,540	—	3,560
	300	692	1,495	700	3,040	—	4,268
	400	910	2,005	900	4,085	—	5,720
	500	1,135	2,538	1,150	5,210	—	7,273
	600	1,337	2,970	1,350	6,122	—	8,545
	750	1,588	3,775	1,600	7,720	—	10,825
	1,000	2,160	5,080	2,200	16,450	—	14,725
	1,250	2,680	6,310	2,700	13,100	—	18,240
	1,500	3,190	7,635	3,200	15,900	—	22,210
TANGENT	25	250	—	—	—	—	—
	35	330	—	—	—	—	—
	50	430	—	—	—	—	—
	75	660	—	—	—	—	—
	100	840	—	—	—	—	—
	150	1,100	—	—	—	—	—
	200	1,610	—	—	—	—	—
	250	2,000	—	—	—	—	—

Make	Type of Coil	0'0002 mfds. Max.	'0005 mfds. Min.	'0005 mfds. Max.	'001 mfds. Min.	'001 mfds. Max.
BURNDEPT	A	—	—	—	—	—
	B	110	—	170	—	240
	C	150	—	230	—	325
	S.1	175	—	280	—	375
	S.2	220	—	355	—	475
	S.2½	265	—	425	—	575
	S.3	305	—	490	—	655
	S.4	430	—	690	—	930
	75	520	—	820	—	1,095
	100	730	—	1,150	—	1,530
	150	1,035	—	1,625	—	2,180
	200	1,420	—	2,260	—	3,020
	300	2,050	—	3,250	—	4,350
	400	2,900	—	4,600	—	6,200
	500	4,550	—	7,250	—	9,750
	750	6,900	—	11,000	—	14,600
	1,000	9,650	—	15,300	—	20,500
	1,500	12,800	—	20,200	—	27,000
LISSEN	25	—	—	—	100	325
	30	—	—	—	130	425
	35	—	—	—	160	490
	40	—	—	—	200	635
	50	—	—	—	250	800
	60	—	—	—	295	900
	75	—	—	—	360	1,100
	100	—	—	—	500	1,550
	150	—	—	—	700	2,150
	200	—	—	—	925	3,000
	250	—	—	—	1,100	3,600
	300	—	—	—	1,400	4,300

This table gives the number of turns per centimetre of various gauges of wire used in winding coils.

S.W.G.	Enamelled	S.S.C.	D.S.C.	S.C.C.	D.C.C.
18	7·8	7·8	7·3	7·3	6·8
20	10·0	10·0	10·0	9·7	8·5
22	13	13	12·5	10·5	10·0
24	16·5	16·5	15·5	14·0	12·0
26	19·5	19·5	18·5	16·5	14·0
28	24·0	23·5	22·0	19·5	15·5
30	28·5	28·0	26·0	21·0	17·5
32	32·5	32·0	29·5	25	19·5
34	38·5	36·5	33·5	27·5	21·5
36	45·5	43·0	40	34	25·0
38	56	51·0	47·0	39·9	28·0
40	71	62·5	55·5	44·5	30·5

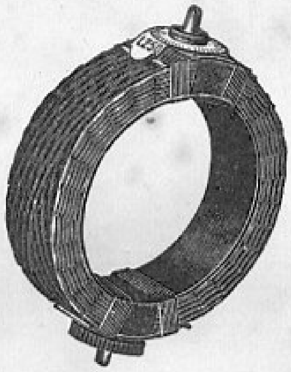
TABLE GIVING WAVE-LENGTHS OF SINGLE-LAYER TUNING COILS WOUND WITH ENAMELLED WIRE

MAXIMUM WAVE-LENGTH OF COIL IN METRES.

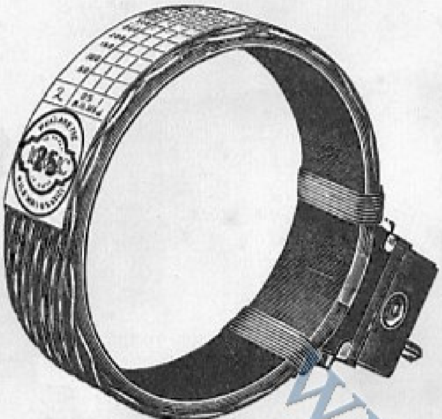
Number Turns.	Size of Wire S.W.G.	Length winding in ins.	2-inch diam.	2½-inch diam.	3-inch diam.	3½-inch diam.	4-inch diam.	4½-inch diam.	5-inch diam.	5½-inch diam.	6-inch diam.
20	20	0·75	165	185	205	225	240	255	270	285	295
	22	0·56	175	195	210	230	245	260	275	290	300
	24	0·44	180	200	215	235	250	265	280	295	305
	26	0·36	185	205	220	240	255	270	285	300	310
	28	0·3	190	210	225	245	260	275	290	305	315
	30	0·25	195	215	230	250	265	280	295	310	320
30	20	1·1	205	235	265	290	315	340	365	390	410
	22	0·84	215	245	275	305	330	355	375	400	425
	24	0·66	230	260	290	320	345	370	390	415	440
	26	0·54	240	270	295	325	350	380	405	425	450
	28	0·45	245	280	305	335	360	390	415	435	455
	30	0·37	260	290	325	350	370	395	420	435	455
40	20	1·5	240	280	320	355	390	420	450	480	510
	22	1·1	255	295	335	370	405	440	475	505	535
	24	0·88	270	310	355	395	430	465	495	525	555
	26	0·72	285	330	370	405	440	475	500	535	565
	28	0·6	300	345	385	420	455	490	525	560	590
	30	0·5	305	350	390	430	465	505	540	570	595
50	20	1·8	275	325	365	410	450	490	530	570	605
	22	1·4	295	345	390	435	475	520	560	600	640
	24	1·1	315	360	410	455	505	550	590	630	660
	26	0·9	335	385	435	480	530	570	610	650	680
	28	0·75	345	395	450	495	545	585	625	665	700
	30	0·62	360	415	470	515	565	605	645	685	725
60	20	2·2	310	355	410	460	515	555	600	645	690
	22	1·7	335	385	440	495	550	595	635	690	735
	24	1·3	355	410	470	525	580	630	675	725	770
	26	1·1	370	430	495	555	610	660	705	755	800
	28	0·9	390	455	520	580	635	685	730	780	825
	30	0·75	405	475	540	600	655	705	750	800	840
70	20	2·5	335	395	455	515	575	620	670	720	770
	22	2·0	365	425	490	550	605	660	720	770	820
	24	1·5	390	455	520	585	645	705	765	820	875
	26	1·25	415	480	550	615	680	745	800	855	910
	28	1·0	435	510	580	650	715	775	830	885	940
	30	0·87	455	530	605	675	740	800	855	910	965
80	20	2·9	365	425	495	565	630	680	740	795	850
	22	2·2	395	465	540	605	665	725	790	845	905
	24	1·8	430	500	575	645	710	775	840	905	965
	26	1·5	450	525	605	680	750	815	885	950	1010
	28	1·2	475	555	640	720	790	860	925	985	1045
	30	1·0	500	580	665	745	815	885	950	1010	1070
90	20	3·2	390	455	535	605	680	740	805	865	925
	22	2·5	425	500	580	655	730	790	855	925	985
	24	2·0	465	540	620	700	775	845	915	985	1050
	26	1·6	490	575	655	745	820	895	965	1035	1105
	28	1·3	520	605	695	785	865	940	1015	1085	1155
	30	1·1	540	630	720	810	895	970	1045	1115	1185
100	20	3·6	415	485	575	650	730	795	865	935	995
	22	2·8	450	530	620	700	780	855	925	995	1065
	24	2·2	490	575	670	750	835	915	990	1060	1140
	26	1·8	525	615	710	795	885	965	1040	1120	1200
	28	1·5	560	650	750	840	930	1015	1100	1175	1250
	30	1·25	585	685	785	880	970	1055	1140	1215	1290
120	20	4·3	460	540	640	735	825	905	980	1060	1140
	22	3·4	500	595	695	790	880	965	1055	1135	1220
	24	2·7	555	655	760	860	950	1040	1130	1210	1300
	26	2·2	590	700	805	905	1000	1095	1195	1275	1370
	28	1·8	630	745	855	960	1060	1155	1255	1345	1440
	30	1·5	660	775	895	1000	1110	1215	1315	1405	1500
140	20	5·0	495	590	705	805	910	995	1085	1175	1260
	22	3·9	550	655	770	875	980	1080	1170	1260	1350
	24	3·1	605	720	840	955	1060	1160	1260	1360	1450
	26	2·5	650	770	895	1010	1125	1230	1335	1435	1530
	28	2·1	695	825	955	1070	1185	1295	1405	1510	1615
	30	1·75	740	870	1000	1125	1245	1360	1470	1580	1690
160	20	5·8	535	640	760	870	985	1080	1180	1280	1380
	22	4·5	595	715	835	955	1070	1180	1290	1390	1490
	24	3·5	655	785	915	1040	1155	1280	1390	1490	1600
	26	2·9	705	840	970	1110	1225	1350	1460	1570	1685
	28	2·4	755	905	1050	1190	1305	1430	1545	1665	1780
	30	2·0	800	955	1100	1245	1370	1500	1625	1745	1860
180	20	6·5	575	680	810	935	1060	1160	1280	1385	1490
	22	5·0	635	745	895	1025	1150	1270	1400	1505	1620
	24	4·0	700	835	985	1120	1255	1385	1515	1625	1740
	26	3·2	755	905	1060	1200	1340	1470	1600	1715	1830
	28	2·7	820	980	1140	1280	1420	1560	1690	1810	1935
	30	2·25	870	1030	1190	1350	1490	1640	1770	1910	2040

Number Turns.	Size of Wire S.W.G.	Length winding in ins.	2-inch diam.	2½-inch diam.	3-inch diam.	3½-inch diam.	4-inch diam.	4½-inch diam.	5-inch diam.	5½-inch diam.	6-inch diam.
200	20	7·2	605	725	865	995	1125	1240	1365	1480	1595
	22	5·6	670	810	955	1090	1230	1360	1490	1615	1740
	24	4·4	745	895	1050	1200	1350	1490	1620	1750	1880
	26	3·6	805	970	1130	1290	1440	1585	1715	1845	1975
	28	3·0	870	1050	1215	1380	1535	1685	1820	1955	2100
	30	2·5	925	1100	1285	1450	1610	1765	1915	2055	2200
220	20	7·9	635	760	915	1050	1190	1315	1445	1575	1700
	22	6·2	705	855	1010	1155	1300	1440	1590	1720	1850
	24	4·9	785	945	1110	1275	1430	1580	1730	1860	2000
	26	4·0	855	1025	1200	1370	1535	1690	1840	1980	2130
	28	3·3	925	1110	1310	1470	1640	1800	1955	2095	2245
	30	2·75	985	1175	1380	1555	1725	1885	2045	2200	2360
240	20	8·7	675	800	960	1105	1250	1385	1525	1660	1790
	22	6·7	740	895	1060	1210	1375	1525	1670	1810	1955
	24	5·3	825	995	1175	1345	1510	1670	1830	1985	2130
	26	4·3	895	1080	1270	1450	1625	1790	1955	2115	2260
	28	3·6	975	1170	1370	1560	1740	1910	2080	2240	2400
	30	3·0	1040	1240	1450	1650	1830	2010	2180	2340	2510
260	20	9·4	695	835	1000	1145	1310	1450	1595	1740	1880
	22	7·3	775	940	1110	1280	1445	1600	1760	1910	2060
	24	5·7	865	1040	1230	1415	1585	1760	1930	2085	2250
	26	4·7	940	1130	1330	1525	1710	1900	2070	2235	2400
	28	3·9	1020	1225	1440	1640	1835	2025	2200	2375	2540
	30	3·25	1090	1310	1530	1740	1935	2140	2315	2480	2660
280	20	10·0	725	870	1045	1210	1370	1515	1670	1820	1970
	22	7·8	810	980	1160	1330	1505	1670	1840	2000	2160
	24	6·2	900	1090	1285	1480	1660	1840	2020	2190	2350
	26	5·0	980	1180	1390	1595	1790	1980	2160	2340	2515
	28	4·2	1065	1280	1505	1720	1930	2130	2315	2500	2680
	30	3·5	1140	1370	1605	1820	2040	2240	2430	2620	2810
300	20	10·8	750	900	1080	1250	1430	1580	1740	1900	2055
	22	8·4	835	1015	1200	1390	1570	1740	1915	2090	2255
	24	6·6	935	1120	1340	1540	1735	1930	2110	2295	2470
	26	5·4	1020	1230	1450	1665	1870	2080	2275	2460	2640
	28	4·5	1110	1340	1570	1800	2015	2230	2435	2625	2820
	30	3·75	1190	1430	1680	1915	2135	2350	2560	2750	2950
320	20	11·5	775	935	1125	1300	1480	1640	1810	1970	2130
	22	9·0	865	1050	1250	1440	1630	1810	1990	2170	2345
	24	7·1	970	1175	1390	1595	1800	2005	2195	2380	2565
	26	5·8	1055	1275	1505	1730	1950	2160	2365	2560	2750
	28	4·8	1150	1390	1640	1880	2105	2325	2540	2750	2945
	30	4·0	1230	1485	1740	1990	2225	2460	2680	2890	3090
340	20	12·2	800	965	1160	1340	1530	1695	1870	2045	2210
	22	9·5	895	1090	1290	1485	1680	1880	2070	2250	2435
	24	7·5	1000	1215	1440	1655	1870	2080	2280	2480	2680
	26	6·1	1090	1325	1560	1790	2025	2250	2460	2670	2875
	28	5·0	1195	1440	1695	1930	2185	2420	2640	2855	3060
	30	4·25	1280	1540	1810	2070	2320	2570	2795	3010	3230
360	20	13·0	825	995	1200	1385	1580	1750	1935	2115	2290
	22	10·0	920	1120	1340	1540	1740	1940	2240	2330	2510
	24	7·9	1030	1255	1490	1710	1930	2155	2365	2565	2770
	26	6·5	1130	1365	1615	1860	2095	2325	2550	2760	2980
	28	5·3	1230	1490	1760	2010	2265	2510	2740	2970	3195
	30	4·5	1320	1595	1880	2145	2410	2660	2890	3130	3355
380	20	13·7	850	1020	1230	1430	1630	1810	1990	2185	2360
	22	10·6	950	1160	1375	1580	1790	2005	2210	2410	2600
	24	8·4	1060	1290	1530	1765	1995	2220	2440	2660	2865
	26	6·9	1160	1410	1670	1920	2160	2400	2640	2865	3090
	28	5·6	1270	1540	1810	2080	2345	2600	2845	3080	3320
	30	4·75	1365	1650	1950	2225	2500	2760	3010	3250	3500
400	20	14·5	875	1050	1270	1470	1675	1860	2055	2240	2440
	22	11·2	975	1190	1410	1630	1840	2070	2275	2480	2680
	24	8·8	1095	1330	1575	1820	2060	2290	2520	2740	2960
	26	7·2	1200	1455	1720	1980	2235	2480	2720	2950	3190
	28	5·9	1320	1500	1880	2160	2435	2700	2955	3195	3440
	30	5·0	1420	1700	2000	2290	2575	2860	3120	3365	3620
450	20	16·2	925	1115	1350	1570	1790	1990	2190	2400	2605
	22	12·6	1040	1270	1505	1740	1980	2210	2415	2660	2880
	24	9·9	1165	1420	1685	1950	2210	2460	2695	2945	3185
	26	8·1	1275	1550	1840	2120	2395	2670	2925	3180	3440
	28	6·7	1400	1695	2005	2300	2600	2880	3160	3430	3700
	30	5·6	1505	1840	2150	2465	2770	3080	3360	3640	3920
500	20	18·0	970	1200	1430	1655	1895	2100	2320	2550	2760
	22	14·0	1100	1340	1595	1845	2100	2340	2590	2820	3065
	24	11·1	1230	1505	1785	2065	2340	2620	2865	3140	3390
	26	9·0	1350	1640	1955	2250	2550	2840	3110	3400	3665
	28	7·4	1480	1795	2130	2455	2770	3075	3360	3660	3960
	30	6·2	1595	1940	2290	2630	2960	3280	3600	3900	4210

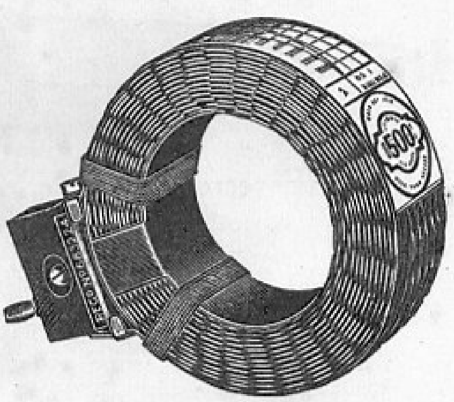
The explanation for the correct reading of this table will be found on page 17.



IGRANIC
Honeycomb Duolateral
Coil (Gimbal Mounted)



IGRANIC
Honeycomb Duolateral
Concert Coil



IGRANIC
Honeycomb Duolateral
Coil (Plug mounted)

Letters Patent
No. 141344

A Warning and Offer

The ***Western Electric Company Limited***, who are the owners of the De Forest Patent are under obligation to restrain any and every infringement of that patent and therefore desire to point out to amateurs and experimenters that Honeycomb coils must not be made—even for experimental purposes—except by permission obtained from their sole licensees under the patent, viz., the Igranic Electric Company Limited, 147, Queen Victoria Street, London. Recognising that there are cases where amateurs may wish to make their own coils and with a desire to encourage experimental work the Western Electric Company Limited have arranged for the issue of special licences to amateurs on purely nominal terms. All amateurs and experimenters are invited to apply to the Igranic Electric Company Limited for such licences if they prefer to make their own honeycomb coils rather than purchase genuine "Igranic" coils and they are at the same time warned that the manufacture or use by them of a single coil of unauthorised manufacture will render them liable to action.

Purchase Genuine "Igranic"
Honeycomb Coils
or
apply for an Amateur's Licence

Western Electric

COMPANY LIMITED,

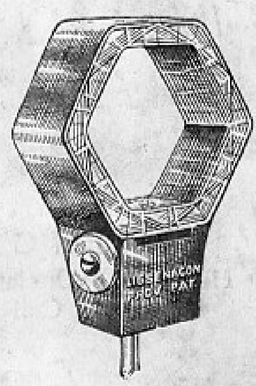
CONNAUGHT HOUSE, ALDWYCH, W.C.2 Telephone: **Central 7345** (9 lines)

Branches: GLASGOW, LEEDS, MANCHESTER, NEWCASTLE, BIRMINGHAM, CARDIFF, SOUTHAMPTON, LIVERPOOL, DUBLIN.

LISSENIUM

How to get sharp-tuning coils——

THE secret is in the making. The impedance of a circuit tuned to a frequency corresponding to a given wave-length should be as near infinity as possible, but on each side of the optimum point the impedance to the same frequency should be as near zero as possible. If, instead of nearly zero, this impedance is appreciable, signal voltage will be built up and signals heard on each side of the optimum point—in other words, the coil will be a flat-tuning, or unselective one. As well as responding to a *broad* (instead of a narrow) band of frequencies, flat-tuning coils do not respond as *strongly* to a desired frequency as one well-known make of coil does, so that with the wrong make of coil you lose *signal strength* as well as *selectivity*.



THE design and making of a plug-in coil largely determine the sharpness of its response to a given wave-length—the air spacing, the disposition of the conductors, the dielectric absorption, and many other interesting considerations. YOUR COIL IS THE PRODUCT OF ALL THESE, and the manner in which they have been dealt with by the maker gives you the strong signal strength and the extreme sharp-tuning qualities you notice when using LISSENAGON (pronounced LISSEN-AGON) coils.

LISSENAGON TUNING CHART

Note the Intermediate Coils, 30, 40, and 60.

Table I. Wave-length range when used as Primary Coils with Standard P.M.G. Aerial and ·001 mfd. condenser in parallel.			TABLE II. Wave-length range when used as Secondary Coils with ·001 mfd. condenser in parallel.		
No. of Coil.	Minimum Wave-length.	Maximum Wave-length.	Minimum Wave-length.	Maximum Wave-length.	PRICE
25	185	350	100	325	4/10
30	**235**	**440**	**130**	**425**	4/10
35	285	530	160	490	4/10
40	**360**	**675**	**200**	**635**	4/10
50	480	850	250	800	5/-
60	**500**	**950**	**295**	**900**	5/4
75	600	1,300	360	1,100	5/4
100	820	1,700	500	1,550	6/9
150	965	2,300	700	2,150	7/7
200	1,885	3,200	925	3,000	8/5
250	2,300	3,800	1,100	3,600	8/9
300	2,500	4,600	1,400	4,300	9/2

The best tuning combination you can get — LISSENAGON COILS with the LISSEN MARK 2 MICA VARIABLE CONDENSER.

If you ever want coils which intensify tuning—use Lissenagon Coils.

DON'T MIX YOUR PARTS—
There is a LISSEN part for every vital place.

PARTS THAT PULL TOGETHER——BUILD WITH THEM

LISSEN LIMITED, 58-60 WOODGER ROAD, GOLDHAWK ROAD, LONDON, W.12
Telephones: RIVERSIDE 3380, 3381, 3382, 1072. Telegrams: "LISSENIUM, LONDON"

Printed and published by Fashions for All, Ltd., The Fleetway House, Farringdon Street, London, E.C.4. Paper Pattern Department, 291a, Oxford Street, London, W.1. Subscription
... The Central News Agency, Ltd. Sole agents for Australia and New Zealand, Messrs. Gordon & Gotch, Ltd.;