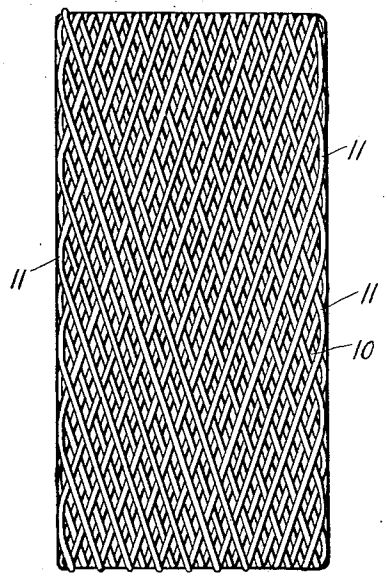
T. P. GIBLIN.

ELECTRICAL COIL.

APPLICATION FILED NOV. 12, 1919.

1,342,209. Patented June 1, 1920.

Fig. 1



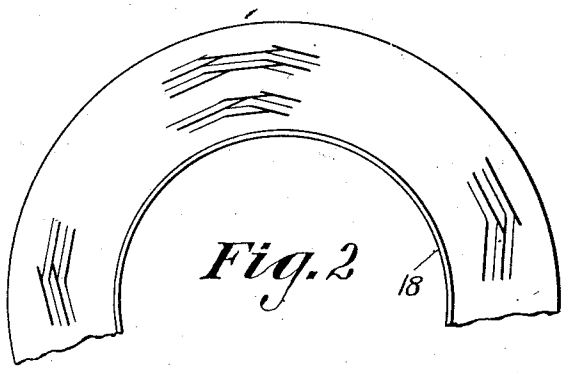


Fig. 2

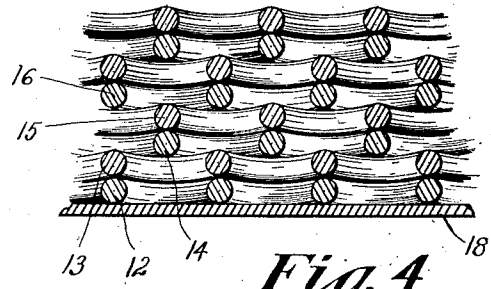
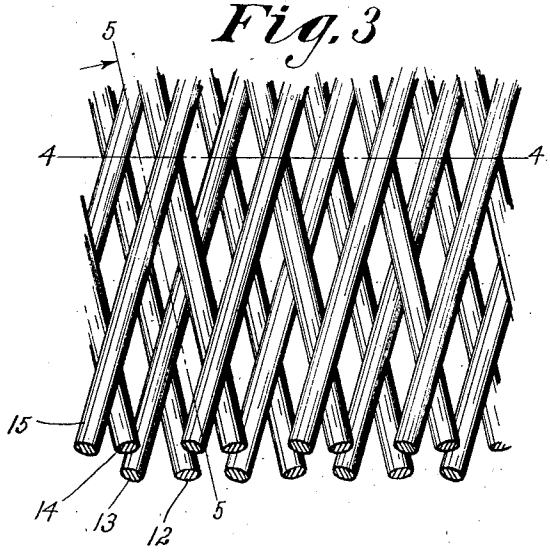


Fig. 4

Fig. 3



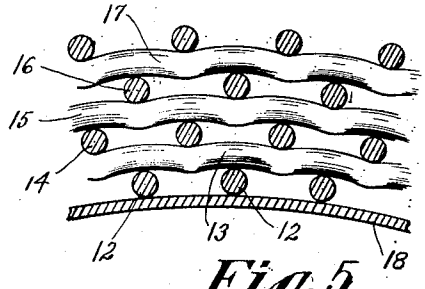


Fig. 5

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ELECTRICAL COIL.

1,342,209. Specification of Letters Patent. Patented June 1, 1920.

Application filed November 12, 1919. Serial No. 337,503.

To all whom it may concern:

Be it known that I, THOMAS P. GIBLIN, a citizen of the United States, and resident of the city of Pawtucket, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Electrical Coils, of which the following is a specification.

This invention relates to an improvement in electrical coils and to the method of winding the same, and more particularly to inductance coils used for tuning circuits, such as space telegraphy and telephony circuits, and for loading telephone or other lines.

One object of this invention is to provide such a coil which is particularly adapted for radio use and in which for a given inductance the distributed capacity, high frequency resistance and natural period, shall all be reduced to the minimum for use in alternating or other fluctuating current circuits, uni-directional of low frequencies or radio frequencies.

A further object of the invention is to improve the mechanical construction of inductance coils of this character so that they can be wound rapidly and at small expense by machinery to produce a self-supporting coil, or one that can be wound and maintained without the aid of end flanges or spool heads, and so produce a coil having high efficiency, for tuning circuits, leading lines, and for other analogous purposes.

With these and other objects in view, this invention consists of certain novel features of construction, and the method of producing the same, as will be hereinafter more fully described and particularly pointed out in the appended claims.

In the accompanying drawings:

Figure 1— is an elevation showing the surface of the coil.

Fig. 2— is a side elevation of a portion of the circular coil.

Fig. 3— is a greatly enlarged view looking at the surface of the coil, and showing the general arrangement of the different layers of wire of which the coil is constructed.

Fig. 4— is a vertical section on line 4—4 of Fig. 3, illustrating the staggered relation of the overlying turns of the coil.

Fig. 5— is a transverse vertical section on line 5—5 of Fig. 3, looking in the direction of the arrow, and best illustrating the sagging of the unsupported portions of the conductor thereby increasing the number of turns in a given volume of coil.

In radio communication the inductance or tuning coils constitute one of the chief sources of loss, both in the sending and receiving apparatuses, and it is well known that such apparatuses are made more efficient and more selective, and static disturbances are more readily eliminated, when the tuning coils have the smallest distributed capacity, high frequency resistance and natural period for a given volume of inductance. Also in loaded lines it is necessary not only to reduce the above-named characteristics of a loading coil to the lowest practicable value per unit of inductance but also to make the volume of the coil as small as possible. It will be understood that my invention is applicable to coils of all proportions and is not necessarily limited to an ideal or mathematically perfect coil.

Inductance coils used for tuning circuits, for loading telephone or other lines and for other similar purposes, should have a minimum of capacity resistance and natural period to fluctuating current for a given inductance or a maximum inductance for a given fluctuating current resistance or distributed capacity and natural period and it is often desirable that for such maximum fluctuating current characteristics the coil should have the smallest possible volume.

By the term "fluctuating current capacity" or "distributed capacity" of a coil I desire to be understood as meaning the summation of the capacity between turns and layers in a coil of a given inductance which tends to interfere with sharp tuning in circuits to be tuned to a high degree of selectivity, such for instance as radio circuits.

By the term "resistance" I mean an opposition in the coil or conductor to the flow of current other than direct current of constant amplitude, for example alternating current, oscillating current or varying unidirectional current. It generally includes besides ohmic resistance due to the copper, the skin effect, eddy current loss, etc.

By "natural period" I mean the electrical natural period of vibration of the coil which generally varies directly with the linear feet of conductor in the coil, that is a piano wire

of two feet in length has a different natural period of vibration from one of 10 feet in length.

With reference to Fig. 4, it will be noted that the turns of every alternate layer are placed in staggered relation, that is every coil in every other layer is offset laterally and set substantially midway between the corresponding turns of the alternate layers either above or below, which construction provides the maximum spacing between these parallel turns in the alternate layers.

Among other electrical advantages of this construction are first, the greater the distance between the parallel turns of conductor the less is the distributed capacity in the coil, second, it is a well known fact that when we reduce the distributed capacity we also reduce the high frequency resistance since they both tend to vary directly with one another.

Another feature of my present invention is that by offsetting the turns in alternate layers and locating them substantially midway between those of the other corresponding or parallel layers I cause each turn to cross those of the next preceding layer between the points of support, as illustrated in Fig. 5, whereby I am enabled to cause the wire to sag between its supports or in other words to draw the unsupported portions of the wire nearer to the center of the coil with the next turn or revolution of wire, by which construction I obtain a greater number of turns in the coil for a given volume (of inductance) thus producing the advantage of reducing the natural period and high frequency resistance to a minimum for this given volume. In other words 200 turns of conductor disposed in a coil of this construction is smaller in diameter than 180 turns of a similar conductor when wound with the corresponding turns of the different layers one directly over the other.

My improved coil is wound by what is known as diagonal or V wind employed in the textile art for producing cops or packages of yarn and thread. By such winding the wire or other strand of conductor is laid in helices which extend from one end of the coil to the other and back again with the turns crossing each other at sharp angles at regular intervals.

With reference to the drawings my improved coil 10 may be of any desired proportions and as herein shown is preferably in ring shape having flat sides or ends. The drawing illustrates the coil as wound from a strand of suitable insulated wire and I have found "Litzendraht" wire preferable, although not specifically shown. This coil is wound on any suitable core or mandrel from which it may be removed when completed, one of its characteristics being that it is self supporting, that is, it permits building-up without the aid of flanges or spool heads for retaining the windings in place. As the mandrel on which the wire is being laid makes a half revolution the guide through which the wire is led completes its traverse motion in one direction the length of which motion corresponds to the width of the coil to be produced. The movement of the guide is then reversed to lead the wire back in the opposite direction. As the wire being wound reaches the end of its traverse and starts back in the opposite direction it makes a relatively sharp bend or loop which is termed a knuckle 11, which knuckles are alined in a plane at right angles to the axis of the coil to form the flat sides or ends thereof.

In winding the coil after one turn of the winding has been completed, the next succeeding turn is placed away or spaced apart from the previously laid turns for the purpose of producing the electrical results herein described.

I have described the windings as crossing the coil in one half its circumference but the lead may be changed to cross the coil at a one-third, one quarter or any multiple thereof to lay the wire at any angle to suit varying requirements.

In constructing my improved coil the turns 12 in the first layer are laid spaced apart a predetermined distance on a suitable core 18 and the turns 13 of the next layer are caused to cross those of the first layer preferably at a sharp angle, as illustrated in Figs. 1 and 3. The turns 14 of the third layer are then spaced to lie in staggered relation, in a vertical plane, to the turns 12 of the first layer and such lateral offsetting results in the turns of each alternate layer 12, 14, 16, etc., being forced to sag or yield at their unsupported points under the tension of winding the wires 13, 15, 17, etc., and thus to be drawn closer to the center of the coil and thereby permit more turns of the wire to be made in a coil of a given cross sectional area or volume than would be wound when the corresponding or parallel turns of the different layers are located one above the other.

It has also been pointed out above that this staggered relation provides the maximum separation between the turns 12, 14, 16, etc., thereby also producing the electrical advantage of reducing the distributed capacity in the coil.

My improved coil is very simple and practical, and inexpensive in construction and effective in its operation.

Having thus described one illustrative embodiment of my invention and the best mode known to me for carrying out my method, I desire it to be understood that although specific terms are employed, they are used in a generic and descriptive sense

and not for the purpose of limitation, the scope of the invention being defined and limited only by the terms of the appended claims.

I claim:

1. An electrical coil composed of insulated wire wound in concentric layers, the turns of wire in each layer being spaced apart from each other and arranged at an angle to those of the adjacent layers and the turns of each alternate layer being offset laterally with reference to those of the alternate layers either above or below.

2. An electrical coil comprising superimposed layers of helically disposed turns of conductor, the turns in each layer being disposed to cross those of each succeeding layer and the turns of each alternate layer being offset laterally and positioned substantially midway between those of the other corresponding layers either above or below.

3. An electrical coil comprising successive windings of insulated conductor disposed in diagonal convolutions, the turns of each layer being disposed at an angle to those of the next succeeding layer and at an angle to the axis of the coil, the turns of the conductor in the same layer being spaced apart and the turns in the alternate layers being offset laterally and arranged in staggered relation in a vertical plane with the other corresponding layers above or below.

4. An improved method of producing an electrical coil which consists in winding succeeding layers of wire in helical turns, disposed at an angle to each other and to the axis of the coil, spacing the wires in each layer definitely apart and disposing them to cross those of the next preceding layer at regular intervals between the supported points thereof and thereby drawing such unsupported portions nearer to the center of the coil.

In testimony whereof I affix my signature.

THOMAS P. GIBLIN.