April 8, 1924. 1,490,041

M. W. STERNS

ELECTRICAL COIL

Original Filed Feb. 10, 1919

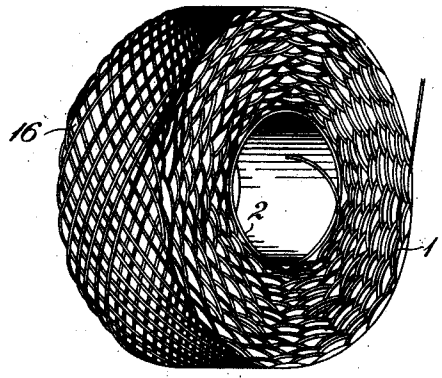



Fig. 1.

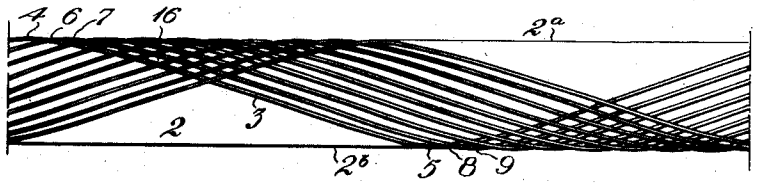



Fig. 2.

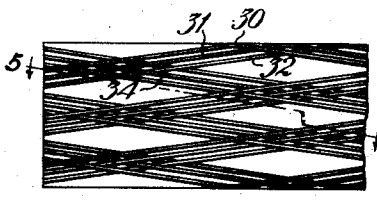



Fig. 3.

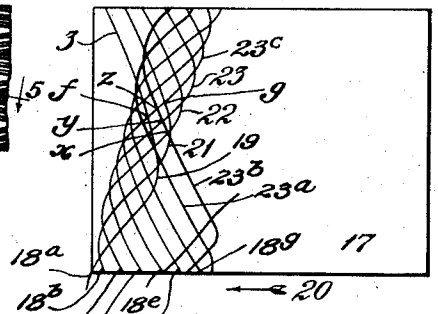
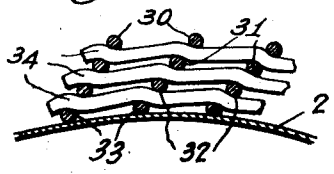



Fig. 4.

Fig. 5.




Inventor:
Morton W. Sterns.
By
Herbert H. Thompson
his Attorney.

Patented Apr. 8, 1924. 1,490,041

# UNITED STATES PATENT OFFICE.

MORTON W. STERNS, OF JAMAICA, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO COTO-COIL CO., OF PROVIDENCE, RHODE ISLAND, A CORPORATION OF MASSACHUSETTS.

## ELECTRICAL COIL.

Original application filed February 10, 1919, Serial No. 275,989. Divided and this application filed December 18, 1923. Serial No. 681,328.

*To all whom it may concern:*

Be it known that I, MORTON W. STERNS, citizen of the United States, residing at Jamaica, in the county of Queens and State of New York, have invented certain new and useful Improvements in Electrical Coils, of which the following is a specification.

This application is a division of my prior application Serial No. 275,989, filed February 10, 1919.

The invention relates to electrical coils and has for its object to provide a coil having a minimum high frequency resistance and low distributed capacity, and which is therefore particularly adapted for radio instruments. A further object of the invention is to provide a self-supporting coil which can be wound by machinery and thus produced rapidly and cheaply.

My prior application covers several different forms of coils in which the successive turns of wire are wound diagonally back and forth and spaced apart in the layers to reduce the high frequency resistance and distributed capacity; the present application relating more particularly to a coil of this type in which the corresponding turns of successive layers in the coil are laterally offset from each other whereby to space the turns of the overlying layers apart. In order that the construction and method of winding the particular form of coil covered by this application may be clearly understood it is deemed advisable to illustrate and briefly describe herein the principal form of coil which is shown and described in detail in my prior application.

Referring to the accompanying drawings:

Figure 1 is a perspective view of the principal form of coil covered by my prior application;

Figure 2 is a fragmentary development of a portion of the winding as illustrated in Figure 1;

Figure 3 is fragmentary development of a form of winding to which the present application is particularly directed; and

Figure 4 is a fragmentary development of a modified form of winding in accordance with the present invention.

Figure 5 is an enlarged fragmentary cross-section of a coil embodying the present invention, this section being taken substantially on a line indicated at 5, 5 in Figure 3, and showing four turns of wire instead of three as in Figure 3.

Referring first to Figure 1 of the drawings, the form of coil designated therein by the numeral 1 is wound with the turns of wire spaced apart and with corresponding turns of successive layers overlying each other so that diamond shaped air spaces exist and extend substantially radially from the center of the coil outward to its periphery. In other words, corresponding turns of wire in successive layers of the coil lie directly above each other, when the coil is viewed looking straight down at right angles to its axis. The coil 1 may be wound on any suitable core or drum 2, such as a bakelite or paper tube. In winding, the wire 3 may be started at a point 4, see Figure 2, and fed diagonally across the drum 2 to a point 5 at the opposite edge of said drum. It then turns back and feeds diagonally across the drum, crossing over the first turn at 6. Reaching the edge $2^a$ at a point 7, a slight distance in advance of the starting point 4, it turns and starts across the drum again, crossing the first turn once more at 8, and reaching the edge $2^b$ at 9. This method of disposing the wire in place may go on until the desired number of turns are obtained, the turns of wire being spaced apart as before noted so as to form air cells 16 therebetween as shown in Figure 1. This method of winding, as explained in my previous application, will reduce the distributed capacity caused by proximity and parallelism of the turns inversely as the square of the distance between the turns.

In the construction thus far described, and as illustrated in Figure 1, the turns of wire of a given direction in successive layers lie directly over the corresponding turns of the same direction in preceding layers. It is obvious, however, that in winding the coil the turns of each layer need not be placed directly over corresponding turns of preceding layers but may be positioned slightly to one side or the other thereof. That is, the overlying turns of a given direction may be laterally offset one in relation to another from the center of the coil outwardly. One form of coil wound in accordance with this latter method is illustrated in Figures 3 and 4 of the drawings.

In these views, 30 designates a turn of an outer layer and 31 a turn running in the same direction in the layer beneath, the turn 31 being shown as offset to one side of the turn 30; while 32 indicates still another inner turn of the same direction in another layer which is offset relative to the turn 31. In Figure 5 the numeral 33 indicates an additional turn of wire not shown in Figure 3 which extends in the same direction as the turns 30, 31 and 32. The numeral 34 indicates the turns of wire which are crossed by the turns 30, 31, 32 and 33.

Figure 3 is a diagrammatic development of the winding and illustrates several turns of a given direction as offset one from another a distance equal substantially to the thickness or diameter of the wire, but it is obvious that the turns may be offset to a greater extent if desired. In machine winding the spacing between the turns and the off-setting of the corresponding turns of different layers is regulated by adjusting the ratio between the speed of the rotating drum or core on which the winding is performed and the speed of the traversing guide which feeds the wire in place on the coil.

Figure 4 illustrates diagrammatically another modified form of winding having the corresponding turns of wire in successive layers laterally offset, or in some cases they may be staggered, in relation to each other. In this form of the invention the offsetting or staggering of the turns may be accomplished by shifting the core or drum back and forth in the direction of its axis during the winding. For instance, the core 17 shown in Figure 4 may be moved bodily in the direction indicated by the arrow 20 during its rotation while the wire is being wound back and forth in helical turns extending diagonally thereof. In this way the successive turns of the wire will be advanced across the drum or core 17 in the direction of its axis, as indicated at 21, 22 and 23 in Figure 4, so that the turns extending in a given direction in each layer will be offset to one side or the other of the turns of the same direction in preceding layers. This last-described method of winding may be used to good advantage when a relatively wide or long coil is desired.

The relative position of the turns in this form of coil will be understood by reference to Figure 4 where seven turns designated $18^a$, $18^b$, $18^c$, $18^d$, $18^e$, $18^f$, and $18^g$ are illustrated as extending first in one direction and then in another across a portion of the width of the core 17, with two of the next succeeding turns $23^a$ and $23^b$ crossing turns $18^c$, $18^d$ and $18^e$ at points $x$, $y$ and $z$, between the points $f$ and $g$ which represent the crossing points of the first series of turns referred to. In this way the turns of successive layers are disposed between the turns extending in the same direction in preceding layers.

It has been found that the particular coil herein shown and described in several modifications has a very low distributed capacity, due to the fact that in addition to the spacing of the turns in each layer the corresponding turns of adjacent layers are offset from each other and therefore do not lie as close together as when corresponding turns in successive layers are wound directly above each other.

Furthermore, in this form of coil the wires of one layer cross the wires of the preceding layer between the points at which the latter are supported, so that there is a tendency for the unsupported portions of the wires to be drawn inwardly toward the axis of the coil, as clearly indicated in Figure 5 thus producing a more compact structure. Stated briefly, the turns will be drawn closer to the axis 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 the case when the corresponding or parallel turns of the different layers are located one above the other.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. 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.

2. An electrical coil composed of insulated wire wound in concentric layers, the turn 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.

3. 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.

4. 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 predetermined layers being offset laterally and positioned between those of other layers either above or below.

5. An electrical coil comprising successive winding 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 in a vertical plane with respect to the other corresponding layers above and below.

In testimony whereof I have affixed my signature.

MORTON W. STERNS.