Jan. 13, 1931. L. A. GEBHARD 1,789,229

INDUCTANCE COIL

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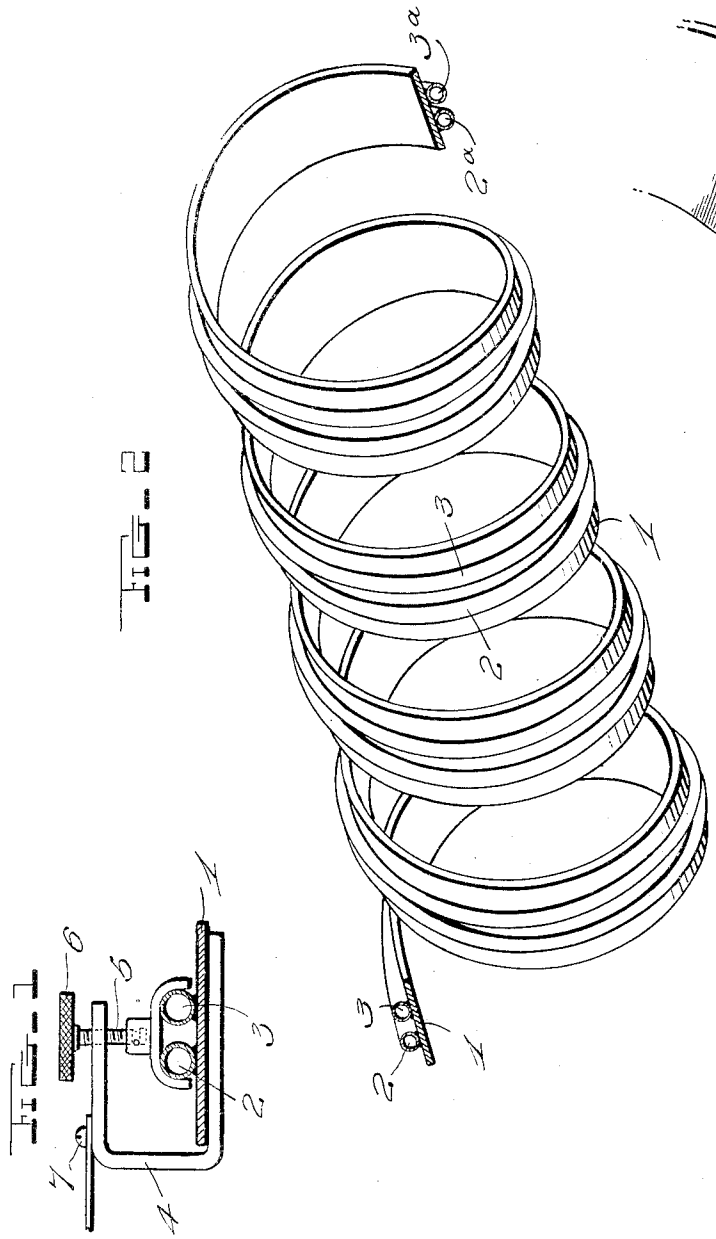


FIG. 2

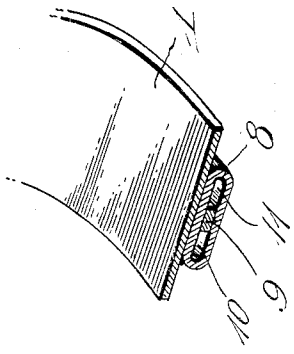


FIG. 3

FIG. 1

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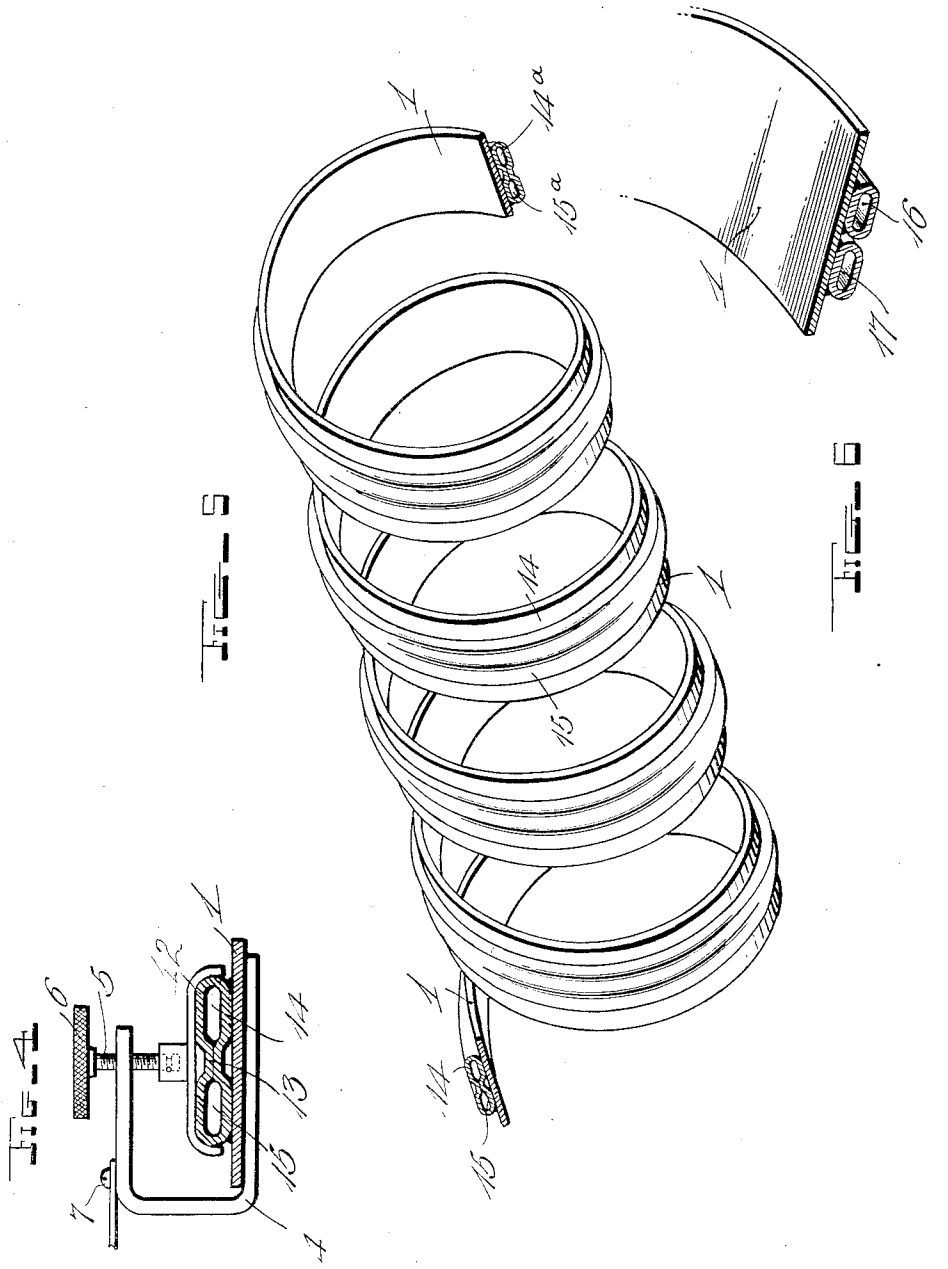
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Patented Jan. 13, 1931

1,789,229

UNITED STATES PATENT OFFICE

LOUIS A. GEBHARD, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO WIRED RADIO, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

INDUCTANCE COIL

Application filed March 9, 1929. Serial No. 345,740.

My invention relates to inductance coils in general and more specifically to inductance coils of the type employed in high frequency transmitting systems.

An object of my invention is to provide an inductance coil wherein the temperature of the coil remains substantially constant irrespective of the current in the coil.

Another object of my invention is to provide an inductance coil wherein the internal capacity is relatively small.

A further object of my invention is to provide an inductance coil wherein the resistance of the coil is substantially independent of the current in the coil and wherein the internal capacity is of a low value.

Other and further objects of my invention reside in certain improvements in the design and structural features of inductance coils, a better understanding of which can be had from the specification following and from the accompanying drawings, wherein:

Figure 1 represents a cross section of one turn of an inductance coil embodying my invention; Fig. 2 is a perspective view of the inductance coil of my invention; Figs. 3 and 4 show sections of modified forms of my invention; Fig. 5 shows another modification of the inductance coil of my invention; and Fig. 6 shows a section of still another modification of the inductance coil of my invention.

In high frequency inductances the resistance is affected by skin effect upon the high frequency currents. For continuous current and low frequency alternating current, the current density is substantially uniform throughout the section of the conductor. If the conductor is large in cross-section or the frequency is high, the inner sections of the conductor carry a relatively small part of the total current, the density of the current being greatest at the surface of the conductor. The distribution of current in a helical wound inductance is not uniform, however, throughout the surface of the conductor. The current is very high in the inside area of the conductor and of a low order on the outer surface. When the turns of the inductance are close together this distribution will be modified to a certain extent. With the turns close together, however, the capacity between the turns is increased. This increase in capacity is, in many instances, undesirable. The inductance coil of my invention is adapted to avoid the disadvantages of other types of coils, heretofore mentioned, a better understanding of which can be had from the specification following and by referring to the accompanying drawings.

Fig. 1 shows a cross section of a turn of inductance embodying my invention. A flat metallic ribbon or strip 1 represents the construction of the usual type of inductance coil which is wound in a helical form as shown in Fig. 2. Metallic tubes 2 and 3 are soldered, brazed or welded to one side of strip 1, which side is to be on the outside of the helical wound coil. Water or other liquid is admitted to tubes 2 and 3, the circulation of the liquid therethrough serving to carry off any increase in the temperature. In Fig. 1 is shown a clip by means of which electrical connection with the turns of the inductance coil may be readily obtained. The clip consists of a metallic strip 4 bent in the manner illustrated whereby the same fits around tubes 2 and 3. A screw 5 is threaded through member 4 and provided with a knurled head 6. Screw 5 may be replaced by a screw having a slotted head of small dimensions when the rough adjustments of the clip have been completed. Screw 5 is threaded in member 4 and provides means for associating an electric circuit therewith. In Fig. 2, the ends 2*a* and 3*a* of tubular members 2 and 3 may be connected together; in this manner the inflow of liquid would be in one of the members and the outflow from the other. Rubber tubing may be employed for conducting the liquid to and away from tubular members 2 and 3. Members 2 and 3 may be placed close together and the source of cooling fluid admitted to the two members at one end and conducted away from the members at the other end of the inductance. Tubular members 2 and 3 increase the capacity between the turns of the inductance only in proportion to the diameter of members 2 and 3 and this dimension, when considered that the tubular members are in the

center of strip 1, adds only a relatively small amount to the normal capacity of the strip. The surface area is greatly increased however and as the current density is normally greater on the inner side of the coil than on the outer side, the circumference or circular area serves adequately to carry the heat and the resistance does not rise to an excessive value. The eddy currents created by the magnetic field around the helix tend to produce undesirable heating but by continuously withdrawing such heat as generated the resistance of the coil remains substantially constant.

Fig. 3 shows a section of a modified form of the inductance coil of my invention. In this modification metallic strip 1 corresponds to strip 1 shown in Figs. 1 and 2. Metallic tubular shaped member 8 is welded, brazed or soldered to strip 1. Tubular shaped member 8 is flattened and a part 9 is inserted through the tube in the center thereof, the walls of member 8 being pressed against part 9 whereby two individual passages 10 and 11 are obtained.

Figs. 4 and 5 show another modification of the inductance coil of my invention. In Fig. 4, a section is shown in detail, wherein a clamping connector similar to that shown in Fig. 1 is adapted to be associated with an inductance of this design. A single tubular shaped member 12, of metal or an alloy thereof, is soldered, brazed or welded to metallic strip 1. Member 12 is partly flattened and has a depression 13 along the length thereof in such a manner as to provide two passages 14 and 15 for the circulating liquid. The opposite walls of member 12 are deformed to provide the closed dividing portion 13.

Fig. 5 shows the inductance coil in its entirety with the clips removed therefrom. As explained in connection with Fig. 2 the cooling fluid may be admitted to tubular members 14 and 15 and carried from these members at the other ends 14*a* and 15*a* by rubber tubing. Without departing from my invention the cooling liquid may be admitted to member 14 or 15 where the ends 14*a* and 15*a* are interconnected and the outflow is from the same end of the inductance as the inflow. As in the arrangement shown in Fig. 2, the construction shown in Fig. 5 serves adequately to carry off the excessive temperature which arises on the inside of the inductance coil, the heat being conducted to the fluid conductors and away from the area where it is desired to maintain the resistance of a low value.

Fig. 6 shows an arrangement somewhat similar to that shown in Figs. 4 and 5. In the construction shown in Fig. 6, the area of the adjacent walls of tubular members 16 and 17, provide greater surface for conducting the heat, than does the arrangement shown in Fig. 5. The section shown in Fig. 6 may be wound in a helical form similar to the construction shown in Fig. 5.

I realize that many modifications of my invention other than those shown in the accompanying drawings and described in the foregoing specification are possible and it is to be understood that my invention is not limited by the foregoing specification or by the accompanying drawing but only by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. An inductance coil comprising in combination a helical wound metallic strip having associated therewith a hollow metallic fluid conducting member positioned on the side of said strip furthest from the axis of said coil.

2. An inductance coil comprising in combination a helical wound metallic strip having associated therewith a plurality of hollow metallic fluid conducting members positioned on the outside of said strip.

3. An inductance coil comprising in combination a metallic strip coiled in a helix having positioned on an electrically connected to the outermost side thereof a metallic tubular member running lengthwise with said metallic strip.

4. An inductance coil comprising in combination a helical formation of metallic strip wound flatwise with respect to the axis of said helix and a fluid conducting member of metallic material positioned upon the outside of said strip.

5. An inductance coil comprising in combination a length of metallic strip in the form of a helix wherein the edges of said strip in one turn are adjacent to the edges in the other turns and metallic fluid conducting members positioned upon the outside of said strip and running parallel with the turns thereof.

6. In an inductance coil wherein the current density is greatest in the portions of the conductor nearest the axis of said coil the combination of metallic tubing associated with the portions furthest from the axis of said coil and adapted to prevent a rise in the temperature of said conductor without causing a substantial increase in the internal capacity of said coil.

7. An inductance coil comprising a helical wound conductor and fluid conducting members associated with the outside portions of said conductor for maintaining said helical wound conductor at substantially constant temperature.

8. An inductance comprising a helically wound metallic conductor and a plurality of fluid conducting members associated with said helically wound metallic conductor and fluid conducting members being positioned with respect to said helically wound conduc-

tor at the portions thereof where the current density is a minimum.

9. In a helical wound high frequency inductance the combination of a tubular metallic member positioned on the outermost side of the conductor comprising said inductance.

10. In a helical wound high frequency inductance the combination of a metallic tubular shaped member having the walls thereof depressed to form a plurality of individual fluid conducting paths positioned on and running parallel with the length of the electrical conducting member constituting said inductance.

LOUIS A. GEBHARD.