

July 25, 1944.

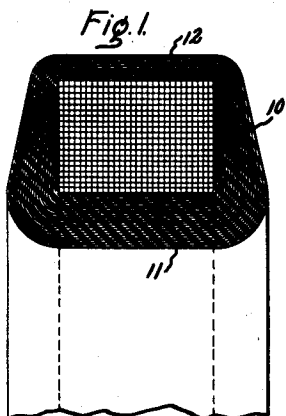
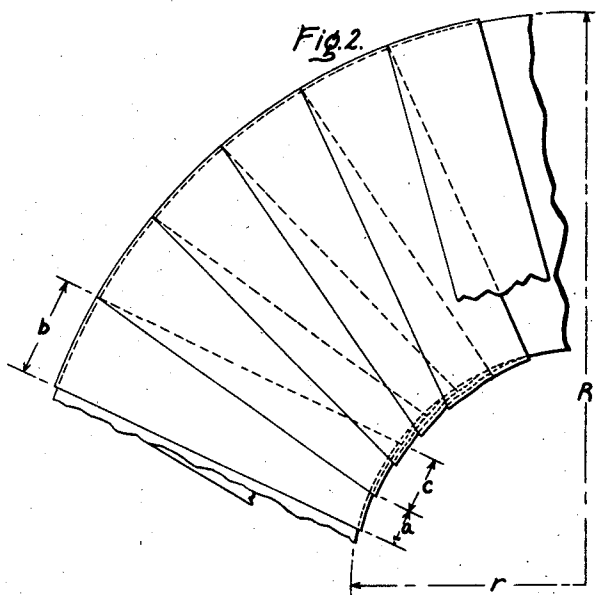
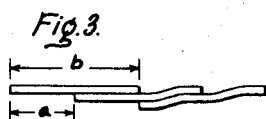
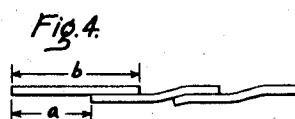
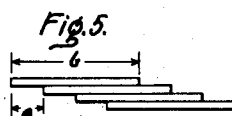
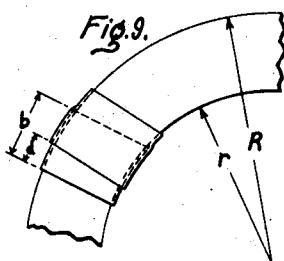
G. CAMILLI

2,354,500

INSULATED COIL

Filed Oct. 22, 1942

2 Sheets-Sheet 1



Inventor:
Guglielmo Camilli,
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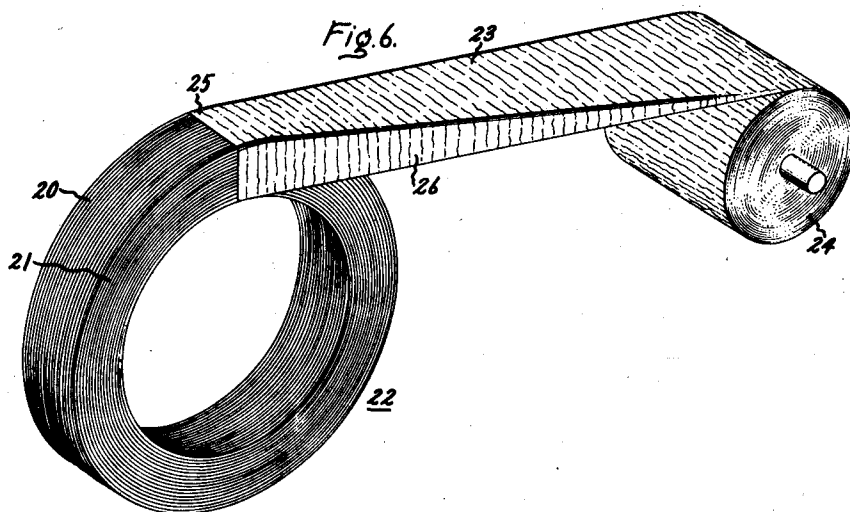
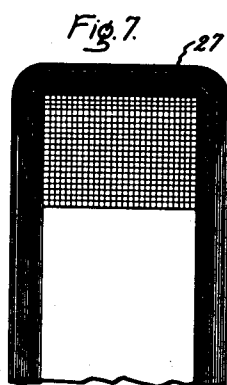
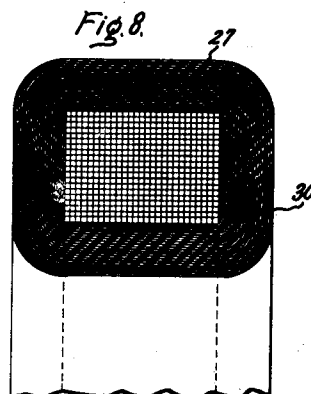
G. CAMILLI

2,354,500

INSULATED COIL

Filed Oct. 22, 1942

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,354,500

INSULATED COIL

Guglielmo Camilli, Pittsfield, Mass., assignor to
General Electric Company, a corporation of
New York

Application October 22, 1942, Serial No. 462,915

5 Claims. (CL 175—21)

My invention relates to an insulated coil and to a method of insulating the coil, and to an arrangement for providing an approximately equal thickness of insulation at the inside and outside peripheral of a generally toroidal shaped coil.

It has been common practice to insulate a generally toroidal or ring-shaped coil by winding a flexible strip of insulating material such as crepe paper through and around the coil until a sufficient thickness of insulation has been built up. However, such a method of insulating a coil will build up insulation around the inside periphery of the winding more rapidly than around the outside periphery due to the difference between the inside and outside radii. This is an uneconomical method of insulating a coil since for a given set of voltage conditions if sufficient insulation has been built up around the outside periphery of the coil then too much insulation will be built up around the inside periphery.

It is, therefore, an object of my invention to provide a coil insulated with a wound strip of flexible insulating material, the coil having approximately the same thickness of insulation built up around the inside and outside peripheries of the coil.

Another object of my invention is to provide an improved and efficient insulating covering for an electrical coil.

A further object of my invention is to provide an improved method for covering a generally toroidal shaped electrical coil with a wound flexible strip of insulating material.

Further objects and advantages of my invention will become apparent from the following description referring to the accompanying drawings, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In the drawings Fig. 1 illustrates a coil which has been wound in the conventional method; Fig. 2 is a side view of a portion of one of the layers of insulation of Fig. 1; Figs. 3, 4 and 5 diagrammatically illustrate different amounts of overlap of a strip of insulating material wound on a coil, and which figures will be employed in the explanation of my invention; Fig. 6 illustrates a coil being wound with one of the coverings of my improved insulation; Fig. 7 is a sectional side elevation of a portion of the winding illustrated in Fig. 6, having been insulated with the one covering of my improved composite insulation; Fig. 8 is a sectional side elevation of

a coil which has been insulated with my improved insulation, and Fig. 9 illustrates a portion of one layer of insulation of the type shown in Figs. 1 and 2, there being an overlap on the outside circumference, and this figure will be used in the description of my invention.

I have illustrated in Fig. 1 a coil which has a generally toroidal or ring shape and which has been insulated by a plurality of layers of a suitable flexible strip of insulating material such as crepe paper, which strip has been passed through and around the coil until the layers have been built up, as is illustrated in Fig. 1. As will be seen from an inspection of Fig. 1 when using a strip of insulating material of constant width, the insulation at the inside periphery, that is, at 11 will have a greater thickness than the insulation on the outside periphery as is illustrated by the numeral 12. However, in applications of a coil of this type, such as in high voltage electric induction apparatus, it is usually desirable to have the same amount of insulation on all the peripheries of the coil.

The ratio of the thickness of the insulation at the inside and outside peripheries of coils of the conventional type, as is illustrated in Fig. 1, is dependent upon the ratio between the inside and outside diameters of the coil. Referring to Fig. 2 I have illustrated a portion of a coil wound with a strip of insulating material having a width b , the coil being wound through and around a portion of the coil in such a manner that the strips on the outside periphery are in abutting relation or do not overlap. At the inside periphery of the winding, however, the strips will overlap equal to a distance c and the amount of the strip which is not overlapped during the first layer is a width a . Thus for each layer of tape which is wound on the outside diameter, the number of thicknesses of overlap of tape on the inside diameter depends on the values of a and b which values in turn depend upon the ratio of the outside radius R and the inside radius r . Thus

$$\frac{2\pi R}{b} = \frac{2\pi r}{a} \quad (1)$$

For example, if a is equal to one-half b , then for each layer of taping which is butted on the outside diameter the number of overlaps on the inside diameter is equal to three. This is illustrated by the diagram in Fig. 3. If the dimension a is greater than one-half b but less than b the number of thicknesses on the inside diameter will be equal to two, as is illustrated in the dia-

gram in Fig. 4; while if a is equal to one-fourth b then the number of thicknesses on the inside diameter is equal to four, as will be seen in the diagram of Fig. 5.

It will, therefore, be apparent that with a given thickness of strip insulating material the ratio of the thicknesses at the inside and outside peripheries of insulation formed by winding the strip through and around the toroidal shape winding will be a function of the ratio of the inside and outside diameters.

It is usually desirable, however, when applying a coil to an electric induction apparatus to have the insulation approximately the same on all the sides of the winding. In order, therefore, to accomplish this, before winding the strip of insulating material through and around the coil in the conventional manner, I first build up the desired amount of insulation around the outside periphery and the outer edges of the coil. It will be understood that the composite insulation including the first and second coverings may be applied in any suitable relative relationships. Thus, when the insulation strip is wound through and around the coil to a predetermined amount a point will be reached at which the total thickness of insulation on the inside and outside peripheries will be approximately the same.

I have illustrated in Fig. 6 an arrangement for building up a covering such as a first covering of insulating material around the outside periphery 20 and the edges 21 of a generally toroidal shaped core 22. Thus a web of suitable insulating material 23 such as crepe paper is wound off a roll 24, the end 25 of the web being suitably attached to the coil. The coil 22 may then be rotated around its axis in any suitable manner and the insulation built up to any suitable thickness, such as that shown in Fig. 7. It will be seen that the total width of the insulating web 23 in the arrangement illustrated in Figs. 6 and 7 is approximately equal to the width of the coil plus twice its thickness. Furthermore, in order to have the outer edge portions 26 of the web 23 fit snugly around the end portions of the coil 22 the crepe paper may be creped in an axial direction, as is illustrated in Fig. 6. Thus, while rotating the winding 22 and holding the web 23 snug as it is unrolled from the roll 24 the creepings as the web surrounds the outside periphery 20 will give more, thus making the covering tightly fit the outside periphery and the two edge portions of the winding. It will also be seen that as the first covering is built up, the thickness of insulation on the outer edge portions of the winding will be tapered, as is illustrated clearly in Fig. 7, the greatest thickness being at the outside periphery of the coil and no thickness being at the inner periphery thereof. Thus, by winding insulation around the coil in this manner the insulation will be built up on the outside periphery and the edges which is just opposite to the way the insulation is built up on the inside periphery when wound by the method illustrated in Figs. 1 and 2.

A second covering of insulation is then wound around the coil as partially insulated as is illustrated in Fig. 7 by passing a strip of insulating material through and around the coil in the manner illustrated in Figs. 1 and 2. When a sufficient amount of insulation has been built up as indicated by the numeral 30 it will be seen that an approximately equal amount of total insulation will be built up on both the inside and outside peripheries of the coil 22. This insulation will be

composite on the outside, being composed partly by the first covering and partly by the second covering, while the insulation on the inside periphery will be entirely composed of the second covering.

By knowing the inside and outside radii and the width b of the strip of insulating material which forms the covering 30 one can determine ahead of time the number of layers which should be applied to the winding by the method illustrated in Fig. 6 to form the insulating covering 27 before winding a predetermined number of layers to form the covering 30.

Referring to Fig. 9 there is shown strip insulation wound through and around a coil as is shown in Figs. 1 and 2, but with an overlapping of the insulation on the outside circumference. With insulation built up in this manner on a coil for a predetermined insulation thickness W_i on the inside periphery of the coil, the amount of thickness on the outside W_o may be given by the expression

$$W_o = W_i \times \frac{r}{R} \quad (2)$$

where r and R are the inside and outside radii, as is shown in Fig. 9.

Therefore, in order to obtain a finished coil which has equal insulation thickness on the inside and outside peripheries, the outside periphery must be covered by a first covering, such as by the method shown in Fig. 6, by an amount T , where

$$T = W_i \left(1 - \frac{r}{R} \right) \quad (3)$$

Knowing the thickness, m , of the taping which is to be employed, and the width, d , not overlapped on the outside circumference (see Fig. 9), then a thickness W_i on the inside circumference will be obtained by a number of layers N , where

$$N = \frac{W_i}{m} \times \frac{r}{R} d \quad (4)$$

Although I have shown and described particular embodiments of my invention, I do not desire to be limited to the particular embodiments described, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

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

1. In a coil for an electric induction apparatus having a general toroidal shape, a first covering including a plurality of layers of crepe paper wound around the outer peripheral surface of the coil, the paper having a width greater than the width of the coil so that the outer edge portions of the layers overlie the end portions of said coil, and a second covering including a plurality of layers of crepe paper wound through and around said coil.

2. A coil for an electric induction apparatus having a general toroidal shape comprising a covering including a plurality of layers of flexible insulating strip material wound around the outer peripheral surface of said coil, said strip having a width greater than the width of said coil so that the outer edge portions of said layers overlie the end portions of said coil, and a second covering including a plurality of layers of flexible strip insulating material wound through and around said coil.

3. A coil for an electric induction apparatus having a general toroidal shape comprising a covering including a plurality of layers of flexible

insulating strip material wound around the outer peripheral surface of said coil, said strip having a width greater than the width of said coil so that the outer edge portions of said layers overlie the end portions of said coil, and a second covering including a plurality of layers of flexible strip insulating material wound through and around said coil to such a thickness that the total thickness of said covering at the inner and outer peripheries of said coil are approximately equal.

4. A coil for an electric induction apparatus having a generally toroidal shape comprising a covering including a plurality of layers of flexible insulating strip material wound around the outer peripheral surface of said coil, said strip having a width approximately equal to the width of the coil plus twice its thickness with the outer edge portions of said layers overlying the end portions of said coil so that said covering has a tapered build-up on the outer end portions of the coil, and a second covering including a plurality of layers of

flexible strip insulating material wound through and around said coil to such a thickness that the total thickness of said coverings at any point on said coil is approximately the same.

5. In a coil for an electric induction apparatus having a generally toroidal shape, a composite insulation for said coil comprising a covering including a plurality of layers of flexible insulating strip material wound around the outer peripheral surface of said coil, said strip having a width greater than the width of said coil so that the outer edge portions of said layers overlie the end portions of said coil, and another covering adjacent said first mentioned covering including a plurality of layers of flexible strip material wound through and around said coil so that the total thickness of said composite insulation at the inner and outer peripheries of said coil are approximately equal.

GUGLIELMO CAMILLI.