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COIL INSULATION

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Fig. 1.

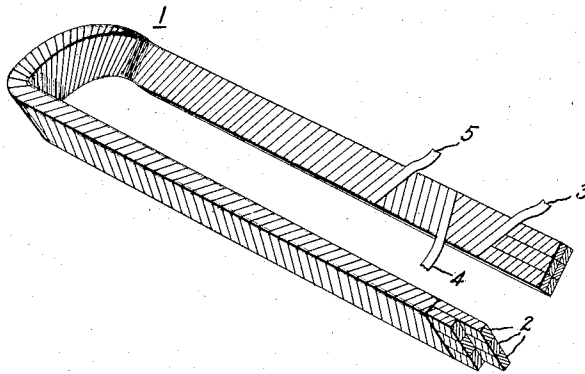
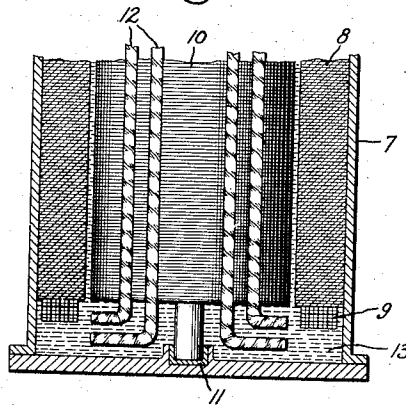


Fig. 2.



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COIL INSULATION

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3 Claims. (Cl. 175—21)

The present invention relates to conductor coils for use in translating devices such as induction regulators and transformers, and more particularly to insulating coverings for such coils.

5 In translating devices of the class enumerated above, the size and cost of the structure required is a direct function of the thickness of the coil insulation needed to obtain the desired degree of voltage protection. It is one object of our invention
10 to provide an insulating covering having an improved space factor and an increased dielectric strength.

A further object is to produce coil insulation fulfilling the above requirements which is additionally characterized by a high mechanical strength and resistance to the solvent action of the liquid dielectrics or treating compounds with which the finished coils are conventionally impregnated.

20 For the attainment of these objects our invention contemplates wrapping the coil bundle with alternate layers of a cellulose ester material and paper in a manner more fully specified hereinafter.

25 The novel features which we consider to be characteristic of our invention will be pointed out with particularity in the appended claims. Our invention itself may best be understood by reference to the following specification taken in connection with the accompanying drawing in which
30 Fig. 1 represents a perspective view of a coil section embodying our invention, while Fig. 2 represents an elevation, partly in section, of a translating device utilizing coils of the type with
35 which our invention is concerned.

Referring more particularly to Fig. 1 we have illustrated a formed coil designated as a whole by the numeral 1. In the embodiment shown the coil structure is made up of a number of
40 separate conductors 2 suitably separated from one another by insulating wrappings. These conductors are of such configuration as to fit together in a compact unit and are held in assembly both by their own shape and by the fact that the
45 bundle which they comprise is wound externally with a number of layers of insulation.

In accordance with a preferred method of utilizing our invention the insulating wrapping is applied by first winding on a substantially complete sheath or layer 3 of sheet cellulose ester material in tape form. The cellulose ester material may suitably comprise cellulose acetate. This
50 is followed by a similar layer of a second tape 4 preferably comprising a good quality of insulating paper and shown as being reversely wound

with respect to the helical convolutions of the tape 3. It should be understood, however, that the reverse winding is not essential to the purposes of our invention which contemplates only that the successive wrappings shall be concentrically superimposed on one another.

The tapes 3 and 4 may assume any dimensions suitable for convenient manipulation, but will typically be of a thickness on the order of about 3 to 5 mils. The paper layer formed by the winding of the tape 4 may be followed by an additional
10 concentric layer 5 of cellulose acetate, and the building up process continued until the desired insulation thickness has been attained. For finishing the surface of the coil it will generally be
15 found advantageous to employ one or more additional layers of cellulose acetate. We have also found it advantageous to employ cellulose acetate tape as a sheath for the individual conductors 2.

It is characteristic of insulating sheaths formed as above described that their dielectric strength per unit of thickness is greater than that of either cellulose acetate, or paper taken alone. Actual tests have shown that the extent of their
20 superiority may be as much as 50 per cent over that of the uncombined materials. Furthermore, the mechanical strength and resistance to abrasion of a surface layer consisting of cellulose acetate is found to be at least twice that of paper. For this reason our improved insulation is eminently fitted for applications in which the coil
30 sides are to be imbedded in slotted iron core structures.

The completely assembled coil is finally subjected to a treatment designed to remove all absorbed moisture and gas. This procedure is greatly facilitated by the assembly contemplated by our invention since the paper between the layers of cellulose acetate is porous enough to allow the removal of substantially all of the volatile material from the insulation structure. This same advantage is of increased importance in applications such as that shown in Fig. 2 in which the completed coil is to be mounted in a translating device filled with a liquid dielectric material such as transformer oil. For such uses the permeable quality of the covering as a whole and the natural porosity of the paper greatly favor the infiltration of the impregnating material and the elimination of voids or gas pockets which tend to be detrimental to the life of the insulation under electrical stress. The interstices between the overlapping edges of adjacent elements of tape are preferably left unsealed so as to

render the insulating structure as highly permeable as possible.

In Fig. 2 we have shown in elementary fashion a section of an induction regulator as typical of the translating devices in connection with which our invention is appropriately used. In brief, the structure illustrated comprises an enclosing casing 7 having assembled on the interior surface thereof a magnetic structure 8 comprising an assembly of relatively thin iron or steel laminations. It will be understood that these are slotted to receive and support primary induction windings 9, the coils of which may be insulated in the manner already described. Centrally disposed and in inductive relation with the stator 8 we have shown a magnetic rotor 10 freely supported at its lower end upon a thrust bearing 11 which rests on the end-plate of the enclosing tank. Secondary current coils 12, which correspond in essential particulars to the coil 1 described in connection with Fig. 1, are retained in slots properly formed for that purpose in the face of the cylindrical rotor 10. All free spaces within the tank 7 are filled with a liquid dielectric or impregnating medium 13 which is intended to eliminate gas spaces and to increase the voltage protection between adjoining conductors.

We have found coil insulation constructed in accordance with the principles of our invention to be particularly advantageous when the impregnating dielectric 13 is of a non-inflammable type comprising a halogenated hydrocarbon, particularly of the aromatic class, as for example, chlorinated diphenyl in combination with trichlorobenzene. Such compounds and their uses are described in detail in Patents Nos. 1,931,373 and 1,999,004 to Frank M. Clark, assigned to the same assignee as the present application. It has been observed that insulating wrappings comprising cellulose ester materials and, in particular, cellulose acetate are much more highly resistant to the solvent action of non-inflammable dielectric mixtures of the class specified above than is any other known treated insulation. For this reason, the useful life of the insulating sheath and the freedom of the impregnating liquid from harmful dissolved impurities are greatly enhanced by the use of our invention. At the same time, thorough penetration of the liquid medium into the wrapping sheath is assured by the porous quality of the paper and the discontinuous nature of the wrappings formed by the helically wound tape.

While we have shown a particular embodiment of our invention, it will of course be understood that we do not wish to be limited thereto since many modifications in the structure may be made. The description of our improved insulation in connection with induction regulator apparatus is to be taken as merely exemplary, since it is equally applicable to all analogous electrical devices such as cables, transformer windings and dynamo-electric machinery. By the appended claims we contemplate covering all such equivalent modifications as fall within the true spirit and scope of our invention.

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

1. An insulated conductor comprising a conducting core and a plurality of superimposed layers of insulating material thereon, certain of said layers consisting of complete sheaths of paper tape, and certain others of said layers consisting of complete sheaths of cellulose acetate tape, the layers of paper being alternated with the layers of cellulose acetate and all the layers being liquid permeable by virtue of the interstices which exist between adjacent elements of tape.

2. An insulated conductor comprising a conducting core and a covering including a plurality of superimposed layers of insulating material thereon, certain of said layers consisting of complete sheaths of helically wound paper tape, and certain others of said layers consisting of complete sheaths of helically wound cellulose acetate tape, the layers of paper being alternated with the layers of cellulose acetate and the interstices between successive turns of tape in all layers being unsealed so as to leave the covering as a whole permeable to liquid impregnants.

3. An insulated coil comprising a bundle of juxtaposed conductors insulatingly separated from one another and a covering for said bundle comprising a plurality of superimposed layers of insulating material, certain of said layers consisting of complete sheaths of wrapped paper tape, and certain others of said layers consisting of complete sheaths of wrapped cellulose acetate tape, the layers of paper being alternated with the layers of cellulose acetate and all the layers being liquid permeable by virtue of the interstices which exist between adjacent elements of tape.

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