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ELIMINATION OF CORONA IN ELECTRICAL APPARATUS

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Fig. 1.

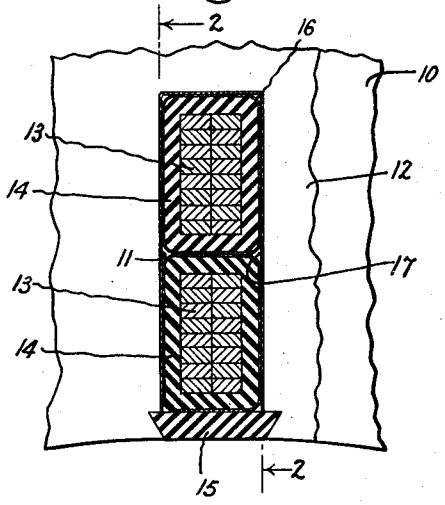
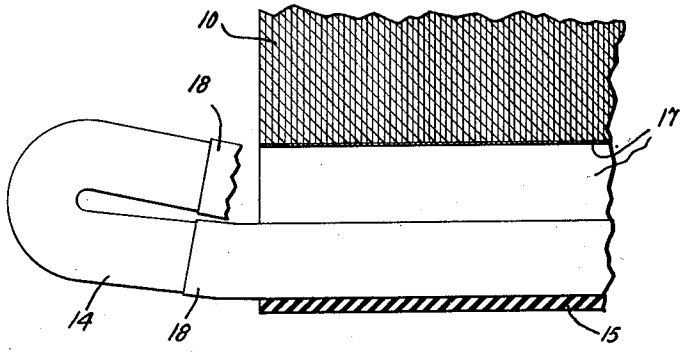


Fig. 2.



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ELIMINATION OF CORONA IN ELECTRICAL APPARATUS

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3 Claims. (Cl. 171—252)

1

My invention relates to constructions and processes which have significance in connection with the problem of eliminating corona between an insulated conductor and an adjacent metallic member.

Heretofore, it has been known to coat the surface of conductor insulation with a semi-conducting material such as a paint, lacquer or varnish containing dispersed particles of a conductor such as metal or graphite. Thus it has been known in the past to paint the surface of insulated conductors lying in core slots of large electrical machines with such a semi-conducting material in order to establish around the conductor a sheath of reasonably uniform potential. While this has proved satisfactory in many installations, for some applications and particularly in the newer machines of larger size and of higher voltage than those formerly known, such a procedure has not entirely eliminated the formation of corona adjacent localized points along the winding slot, nor entirely eliminated electrical discharges at the end portions where the coil projects beyond the magnetic core. Such corona and discharges are objectionable from the standpoint of creating radio interference, and even if they do not reach such proportions as to be damaging to insulation they cause the creation of ozone, a very small trace of which is readily perceivable by smell and this is sometimes objectionable from the standpoint of customer acceptance.

It is an object of the present invention to provide simple and inexpensive means for overcoming the above-mentioned difficulties.

A further object of the present invention is to provide an improved method of constructing electrical apparatus so as to prevent formation of corona, reduce radio noise and reduce dielectric power factor.

I have found that semi-conducting coatings as presently used and applied to the slot portions of high voltage armature windings prevent the formation of corona and ozone only if each coating forms a sheath in substantial contact with the adjacent core slot surfaces throughout the co-extensive lengths, but if sufficient voltage appears across any small air space between the coated coil insulation surface and the slot surface, corona may form. From a manufacturing standpoint it is not practical to eliminate all air spaces between coil surfaces and slot surfaces because the slots vary in width a small amount, and the slot portion widths of the coils vary a small amount, and a small clearance space is required to place the coils in the slots without damaging the coil insulation.

2

It is, therefore, a still further object of the present invention to provide in a dynamoelectric machine having a stator comprising interinsulated laminations provided with winding slots with an insulated winding in said slots, means for eliminating corona and ozone formation regardless of manufacturing clearances and consequent small air spaces between coil and slot walls.

Another object of the present invention is to provide means for reducing end discharges which occur when a coil slot sheath is not at ground potential.

In accordance with one aspect of my invention, I completely eliminate or minimize the corona effect in large high voltage alternating current dynamoelectric machines by not only coating the insulated conductors with a semi-conducting material but also scuffing the slot sides and thereafter applying semi-conducting material to such sides along the lamination edges to insure that all semi-conducting sheaths are sufficiently grounded by contact with each other and with the core.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 is a cross-section and Fig 2 is a longitudinal section showing a portion of a dynamoelectric machine stator core provided with winding slots with a winding therein and incorporating the present invention.

Referring to the drawing, the stator core is made up of a plurality of punchings 10 each provided with a plurality of winding slots 11 and each provided with interlamination insulating varnish 12. As is well known in the art, the varnish is applied as by dipping the individual punchings after the slots have been formed and the burrs removed, for if the slots were punched out after the varnishing operation, the laminations would be short circuited.

The number of conductors with which the present invention is used is immaterial, but in the illustrated embodiment it may be assumed that two segmented conductors or coil sides 13, each provided with coil insulation 14 are disposed in a single slot. The insulated conductors are held in place in each slot 11 by means of a conventional slot wedge 15. As is customary for high voltage conductors, the insulation of each conductor is first sprayed or otherwise coated with a semi-conducting paint or other semi-conduct-

ing material 16 before the insulator conductor is placed in the slot. This semi-conducting coating extends throughout the slot region and for a creepage distance therebeyond at each end of the core as indicated at 18 in Fig. 2. In accordance with the present invention, each slot side is also first prepared before placing the insulated and semi-conductor material coated conductor therein, by scuffing, as with a file, the lamination edges along the slot walls and thereafter, preferably immediately thereafter, applying a semi-conducting paint or varnish containing conductive graphite particles or other semi-conducting material, to the slot walls so scuffed to provide a semi-conducting coating 17 on the slot walls.

When the insulated conductor is thereafter placed in the slot as shown in the drawing, coating 17 is immediately adjacent the semi-conducting layer 16 coated over the conductor insulation.

The invention is not limited to a method of construction where semi-conducting varnish or paint is used but obviously includes the use of other semi-conductors, such as one of the semi-conducting rubbers, and it follows that the invention is not limited to a particular means of applying, as with a brush or spray, since the semi-conducting material may be applied in any other manner, as by winding or otherwise applying a semi-conducting tape or cloth mat to the conductors adjacent the slot portion and to the slot walls themselves. With the process and construction of the invention, the semi-conducting sheaths around the coil conductors are sufficiently grounded by a satisfactory contact between the two coatings and with the core. One explanation of the difficulties encountered with prior art arrangements may be that the insulating varnish applied to the core laminations always extended over the slot edges adjacent the slot walls and had sufficient ohmic resistance to prevent sufficient electrical contact between the slot surface and the semi-conducting sheath on the armature coil so that the sheath is a floating sheath with a varying potential above ground and, therefore, incapable of completely eliminating corona. With the prior art arrangement, mere scuffing of the slot walls was not enough, possibly because the scuffed portions tended to oxidize or rust thereby to eventually prevent a good contact with the conductor sheath or to provide a sheath ground resistance which varied from slot to slot with the result that corona might form in some slots and not in others. It is, of course, desirable that the ohmic resistance of a semi-conducting sheath applied to bare laminations be made high enough so that the insulated core laminations are not short-circuited to the extent of causing excessive magnetic losses, and yet the resistance is low enough so that it is not too high to establish electrostatically a sufficient ground sheath.

In connection with the development of the present invention, tests have rather conclusively indicated that it is not always sufficient to merely coat the slot walls with semi-conducting paint and leave semi-conducting material off of the coil insulation. This is so because if there is any small air space between the insulation and the

semi-conducting coating, the entire voltage gradient will appear across this air gap, with none across the insulation, and corona will form. The tests also indicated that when the slot wall is covered with a semi-conductor (rather than with a pure insulating varnish or enamel), and the coil insulation in the slot region and for a creepage distance therebeyond is likewise coated with a semi-conductor, localized corona, may be completely eliminated at all common operating voltages not only in the slot regions but, because the creepage portions of the conductor sheath are well grounded, at the end portions of the coils as well. There is thus provided a construction and method of the character described capable of meeting the objects hereinabove set forth.

While I have illustrated and described a particular embodiment of my invention, modifications thereof will occur to those skilled in the art. I desire it to be understood, therefore, that my invention is not to be limited to the particular arrangement disclosed and I intend in the appended claims to cover all modifications which do not depart from the true 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 electrical apparatus having a magnetic core member provided with winding slots, the combination of a coating of a semi-conducting material on the walls of said slots, high voltage insulated conductors located in said slots, and a semi-conducting coating covering the insulation of said conductors adjacent said coating of semi-conducting material on the walls of said slots.

2. In a dynamoelectric machine having a stator core portion comprising varnish insulated laminations provided with winding slots, an insulated winding in said slots, said winding having a semi-conducting coating applied to the outer surface of the insulation thereof in the region of said slots, and said slots having a semi-conducting coating applied to varnish free edges of said laminations along the walls of each slot, said two coatings being in substantial contact with one another to provide a reasonably uniform potential sheath extending around said winding insulation in the slot region thereof with said sheath adequately grounded to said slot walls to prevent corona formation between said winding and said slot walls.

3. In a high voltage dynamoelectric machine having a slotted core structure, an insulated winding extending through the slots in said core structure and projecting therefrom, a semi-conducting coating covering the insulation in each of the slot regions of said winding and extending therebeyond to provide a creepage distance at each end of said core, and a semi-conducting coating covering the walls of said slots and in contact with said first mentioned coating to prevent the formation of corona between said conductors and said slotted core structure.

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No references cited.