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APPARATUS FOR INSULATING SLOTS IN STATORS AND ROTORS OF ELECTRICAL ROTARY MACHINES

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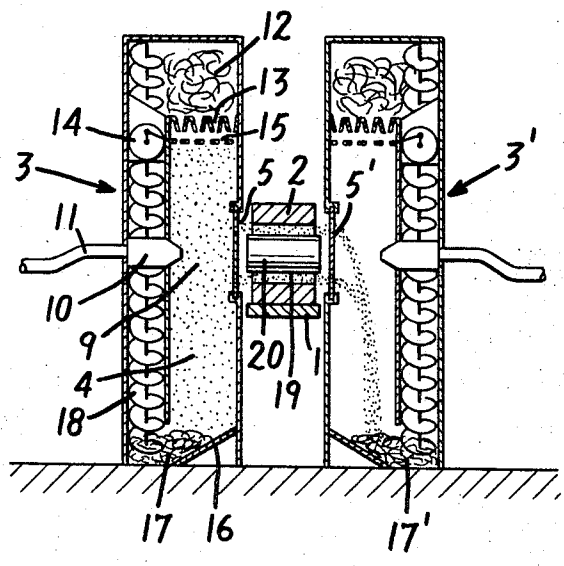

FIG. 1

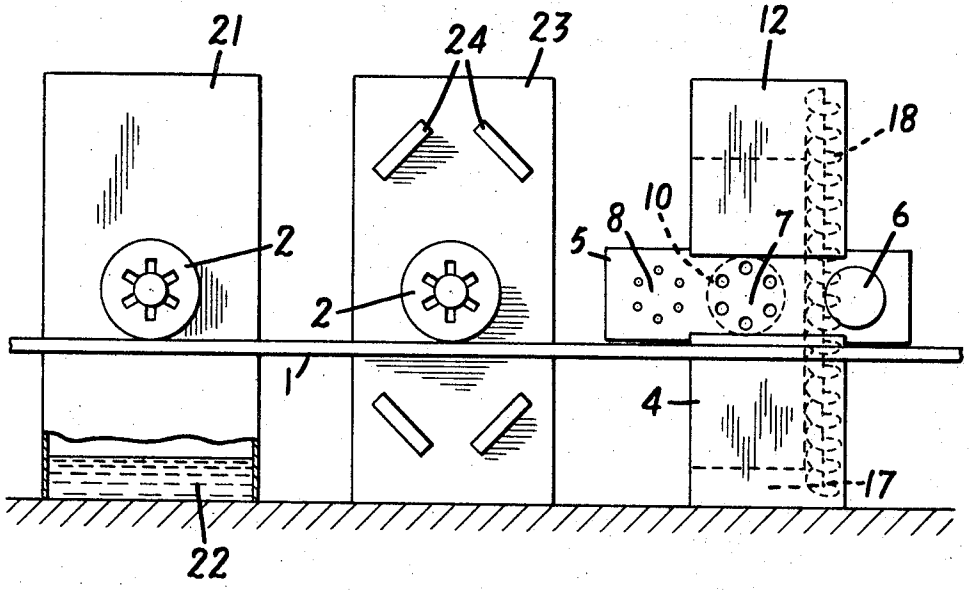

FIG. 2

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APPARATUS FOR INSULATING SLOTS IN STATORS AND ROTORS OF ELECTRICAL ROTARY MACHINES

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Claims priority, application Germany, Feb. 1, 1963, D 40,803

Int. Cl. B05c 5/00

U.S. Cl. 118—641 8 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for coating winding slots of electrical motor cores such as stators or rotors with streams of insulating particles developed externally of an area in which the unit to be insulated is disposed and applying the coating particles only on desired surfaces of the slots being coated without contamination of the atmosphere in which the unit being coated is disposed so that there is substantially no deposition of insulating particles on surfaces other than those being coated. Particles are suspended in a chamber and then subjected to gas flow through the chamber and an outlet shutter or mask so that the insulating particle streams of different cross sections are formed sequentially as the gas flow leaves the chamber and enter the area in which the core being coated is displaced. The area and atmosphere in which the core is disposed is thus free of particles except for the streams of particles passing through the area in the slots. Excess particles leaving the slots are recovered in a second chamber outside of the area in which the core is disposed. The second chamber is opposite to and spaced from the first-mentioned chamber and the core is disposed therebetween. A reverse flow of insulating particle streams can be applied from the second chamber and recovery of excess material made at the first chamber.

This is a divisional application of my copending application Ser. No. 341,257 filed Jan. 30, 1964, now abandoned.

This invention relates generally to rotors and stators of electrical rotary machines and more particularly to an apparatus for insulating the winding slots in rotor and stator cores and the like.

Heretofore, the slots of rotors and stators cores of electrical rotary machines, for example motors and generators, have been provided during the manufacture of such machines with insulation inserts for receiving windings therein. More recently, the slots of stator and rotor cores have been insulated by application of a plastic insulation coating over the surfaces of the core defining the individual slots.

The advantage of applying the insulation as a coating is that variable thicknesses can be applied and various complex shapes of slots can be insulated. Moreover, the application of insulation coatings permits mass production tecnhiques to be applied. Various methods and apparatus are employed for applying these coatings, for example, a liquid plastic material may be applied, however, the coating material will tend to flow under the effect of gravity and is hard to control. Such insulation coatings are also applied by the fluidized-bed process which employs the use of finely divided plastic and electrically insulating powder. A durable insulating film or coating on the interior of the slot surfaces is formed with this technique. The rotor or stator core is preheated and is then dipped into the bed of powder, which is suspended in air, after which the powder particles may be fused in

an industrial oven. The use of the fluidized-process, however, has several difficulties in that the whole part or component dipped into the bed is covered by a plastic insulating coating while it is intended that only the slots be coated. This results in a waste of material and requires an additional operation of removing the plastic material from those areas where it would cause interference structurally or otherwise. In other apparatus the electrical machine core to be coated is placed in a chamber and then the slots thereof are subjected to a stream of insulating powder which is adhered to the slots. The chamber in which the core is disposed is subjected to a vacuum or airflow in an attempt to keep the chamber free of excess particles that would adhere on areas of the core which are not desired to be coated.

It is a principal object of the present invention to provide a new and improved apparatus for insulating the surfaces of rotor and stator cores defining slots therein by applying an insulating plastic coat only over the surfaces defining the individual slots.

A feature of the invention is the provision of an apparatus in which a sequence of streams having different cross sections, of finely divided heat fusible, insulating particles is directed through the individual slots of preheated stator and rotor cores to adhere the particles to substantially only the surfaces of the core defining the individual slots and thereby to form an insulating coating over the slot surfaces of controlled thickness.

The invention comprises an apparatus comprising means for receiving preheated cores having axially extending and angularly spaced slots thereon for receiving individual windings therein. Means are provided for suspending finely divided particles of insulating material in a chamber provided with means defining a mask to preclude the application of particles to undesired portions of the cores. The mask is provided with a plurality of spaced apertures communicating with the interior of the chamber and aligned coaxially with the slots of the core to be coated. Means to apply a gaseous fluid under pressure to the mask is incorporated into the apparatus to flow the particles outwardly of the chamber through the apertures as a plurality of directed gaseous streams having the particles suspended therein and passing axially through the respective ones of the slots. The preheated core has the particles coming into contact with it adhered thereto to form an insulating coating over the slots only which are further masked by a non-reactive mask cooperative with the core and assisting in defining with the axial slots therein channels through which the streams of powdered material pass.

Other features and advantages of the apparatus in accordance with the present invention will be better understood as described in the following specification and appended claims, in conjunction with the following drawings in which:

FIG. 1, is a vertical cross-section view of an apparatus for applying the method according to the invention; and

FIG. 2, is a diagrammatic side elevation view partly in section of the apparatus in FIG. 1.

According to the invention, a driven conveyor 1 transports individual cores of rotary electrical machines in axially spaced positions. The cores comprise axially extending slots which are open on one side and at the opposite ends thereof and generally arranged angularly spaced. In the illustration in the drawings, a stator core 2 is transported between means comprising two devices 3, 3' defining a first chamber and a second chamber as later described on opposite sides of the conveyor belt 1. Internally of each the devices, only one will be described in detail, is provided a space or chamber 4 for receiving in suspension therein fluidized, insulating material for use as hereinafter described.

Each device is provided with an axially displaceable shutter 5 positioned in operation, closely adjacent the core, for example in the order of five millimeters. The shutter 5 comprises an aperture 6 and a mask portion 7 provided with radially spaced openings or apertures as illustrated in FIG. 2 and a third mask area 8 provided with openings therein arranged in the same arrangement as in the mask portion 7 with the openings having a smaller diameter or cross sectional area. The openings in the mask portions 7 and 8 are disposed angularly spaced in position corresponding to the angular positions of the slots in the stator core 2 and are coaxial and in correspondence therewith as the stator 2 is moved into a position of alignment of the slots and openings or apertures.

Opposite to the shutter 5 is disposed an opening 9 in an opposite wall of the device through which is inserted a nozzle 10 connected to a source, not shown, of gaseous fluid under pressure through conduit means 11. Above the chamber 4 is disposed a storage space 12 in which is contained a powdered plastic material having insulating qualities and made up of finely divided heat fusible particles. The powered material enters a plurality of delivery nozzles of a distributing device 13 onto a shaking screen 15 driven by an electric motor 14 to fluidize the powder and temporarily suspend it in the chamber 4 as illustrated in the drawings. The apparatus is provided on the bottom of the chamber with a deflector or chute 16 that receives the material not used in the coating operation and transports it to a collecting space 17 from which a screw conveyor 18 driven from the motor returns it to the storage space or chamber 12.

When the apparatus is turned on the vibratory or shaking screen 15 starts to operate and finely divided powder particles enters or falls into the space 4 and falls downwardly slowly. At the same time the nozzle 10 is switched on and applies gaseous fluid under pressure interiorly of the chamber 4 to the inner side of the shutter 5 to whatever mask is in position. It will thus be seen that separate streams of gaseous fluid under the powder suspended therein will be caused to exit from the chamber and transport the powder through the corresponding and axially aligned slots of the core which is in position under control of the properly cycled and controlled conveyor 1. The streams of particles enter respective slots 19 defined by surfaces of the core.

A cylinder 20 made of a material that will not react with the powder particles is disposed internally of the core thus masking the inner surfaces that are not to be coated and forming in conjunction with the slots 19 channels through which the streams of powder flow. The stator 2 is preheated, as later explained, to a temperature which is above the reaction temperature of the plastic powdered material so that the heat fusible patricles passing through the slots 19 are deposited or adhered on the surfaces defining the slots and adhering to or fusing with each other upon deposition thereby forming a desired insulation coating. Those particles that do not adhere are propelled out the opposite open end of the slots through a shutter 5' of the device 3' which is in a completely open position or may be in a position with an opening such as the opening 6 in registry with the core slots to allow the unused powder particles to enter a collecting space 17' of the chamber 3' in order to be further used in the apparatus as hereinafter described.

The apparatus according to the invention makes provision for transporting the cores to be insulated, for example the stator core 2 through a cleaning device 21 which is filled with cleaning vapors, for example perchlorine-ethylene saturated vapors formed through the application of heat to a bath of perchlorine-ethylene fluid 22. The stators core 2 leaves the cleaning device with a temperature of approximately 120° centigrade and enters a drying device 23 provided with a plurality of electrical heating elements 24 which further heat up and dry the

stator core. The preheated stator leaves the drying device with a temperature in the order of 220° centigrade and is transported to the area or zone in which the coating takes place between the two devices 3 and 3'. The coating material can be a powdered epoxy-resin powder insulating plastic which is heat fusible and can be heatset, for example the reaction temperature of which is in the order of 210° centigrade.

The sequence of masks used in the treatment of the core are first the mask portion 8 and then the mask 7 and finally the mask portion having the large opening 6 therein. The use of the smaller openings first coats the interior of the slots and the larger openings cause the edges of the surfaces defining the slots adjacent the ends thereof to be coated with a coating rounding off the edges. Moreover, there is a controlled build-up of the coating in the slots since the streams have increasing cross section. The largest opening can permit face surfaces adjacent the open end of the slots to be coated and insulated. It being understood, that the stator core 2 is maintained aligned with the openings of the individual mask portions. After the stator has been treated, the device 3 is switched off and the device 3' is switched on for applying streams of particles in the opposite direction, for example, in the order or sequence as above-described.

Those skilled in the art will readily recognize that the operation may be made continuous by properly controlling the cycle of travel of the conveyor 1 and the selective positioning of the shutters 5 and 5' in sequence and maintaining the mask portions and apertures in them coaxially aligned with the core slots which can be maintained traveling.

In the embodiment of the apparatus according to the invention air is employed to develop the streams of powdered material, however, other gaseous fluids may be employed. Moreover, a mixture of different heat set or fusible particles can be employed to carry out the invention. The coating material can be a suitable heat fusible powdered material and the mask cylinder 20 can be made of a suitable material which will not react with the powder particles employed. In the present example the cylinder is made, for example of polytetrafluorine-ethylene. Those skilled in the art will further recognize that although an insert 20 has been used in the stator 2 in the event a rotor is to be coated, a sleeve, not shown, of similar composition can be employed and the method according to the invention is carried out in the manner as above described.

Thus, the invention provides for easily conditioning or treating the cores in preparation for adhering thereto the insulating material. The invention provides for regulating the thickness of the coating as desired by controlling the length of time of application of particles. The coating is mooth and free of irregularities generally found in coatings applied by methods making use of insulating materials in a fluid or plastic state. The apparatus is highly efficient in recovery of material not used and the cleaning stage imparts a considerable amount of preheating to the cores during condensation of the cleaning vapors thereby conserving heat energy required for preheating.

While a preferred embodiment of the apparatus according to the invention for carrying out the new and improved inventive method has been shown and described, it will be understood that many modifications and changes can be made within the true spirit and scope of the invention.

What I claim and desire to secure by Letters Patent is:

1. Apparatus for insulating winding slots in cores for rotors, stators and the like for rotary electrical apparatus comprising, means for receiving individual cores having axially extending surfaces defining a plurality of spaced slots for receiving windings therein and for positioning said cores in an area externally of said apparatus and atmosphere free of insulating particles, means for form-

ing a suspension of finely divided, heat fusible, insulating particles directable as a stream through the individual slots to adhere particles of said stream to the surfaces defining the individual slots thereby to form an insulating coating over said surfaces, means defining a first chamber in which said suspension of particles is contained, means comprising shutter means having a plurality of spaced apertures communicating with the interior of said first chamber and aligned coaxially with said slots of the core, means to apply gaseous fluid under pressure interiorly of said first chamber to said shutter means to flow said particles outwardly of said first chamber through said apertures as a plurality of gaseous streams having said particles suspended therein and directly axially through respective ones of said slots, means for recovering particles directed through said slots and not having adhered to said core, said means for recovering particles comprising means defining a second chamber spaced from the first chamber so that said stators and rotors are positioned between said first and second chambers, means comprising another shutter means having a plurality of spaced aperatures communicating with the interior of said second chamber and aligned coaxially with said slots of the core, means to apply gaseous fluid under pressure interiorly of said second chamber to said another shutter means to flow the recovered particles outwardly of said second chamber as a plurality of gaseous streams having said particles suspended therein and directed axially through respective ones of said slots.

2. Apparatus according to claim 1, comprising means to preheat the individual cores before directing said streams of insulating particles through the individual slots.

3. Apparatus according to claim 1, in which said shutter means comprising said apertures has sets of apertures

of different cross sections and is operable to apply said gaseous streams having particles suspended therein as streams of different cross sections in a sequence in which the cross section of the streams increases.

4. Apparatus according to claim 3, in which said means for forming said suspension in said chamber comprises a device having means to fluidize a powdered insulation material.

5. Apparatus according to claim 3, in which said shutter means comprising said apertures has said apertures in a configuration in which said apertures are coaxial with said slots.

6. Apparatus according to claim 5, in which said shutter means comprises means defining a single aperature positionable in position selectively coaxially with said slots.

7. Apparatus according to claim 3, including a mask comprising a material to which said particles will not adhere positionable on said core and cooperative therewith in defining with said slots channels through which said streams of particles flow.

8. Apparatus according to claim 3, including means to apply a chemical agent to said cores for heating and cleaning said cores prior to directing said streams therethrough.

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JOHN P. McINTOSH, Primary Examiner

U.S. Cl. X.R.

118—72, 310, 301, 312