Sept. 30, 1969 E. F. CHRISTIANSEN 3,470,010

METHOD FOR APPLYING STREAMS OF INSULATING PARTICLES TO STATOR AND ROTOR WINDING SLOTS

Filed Jan. 10, 1968

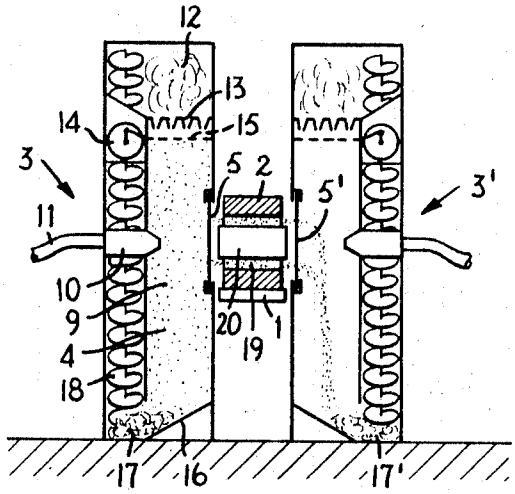


FIG. 1

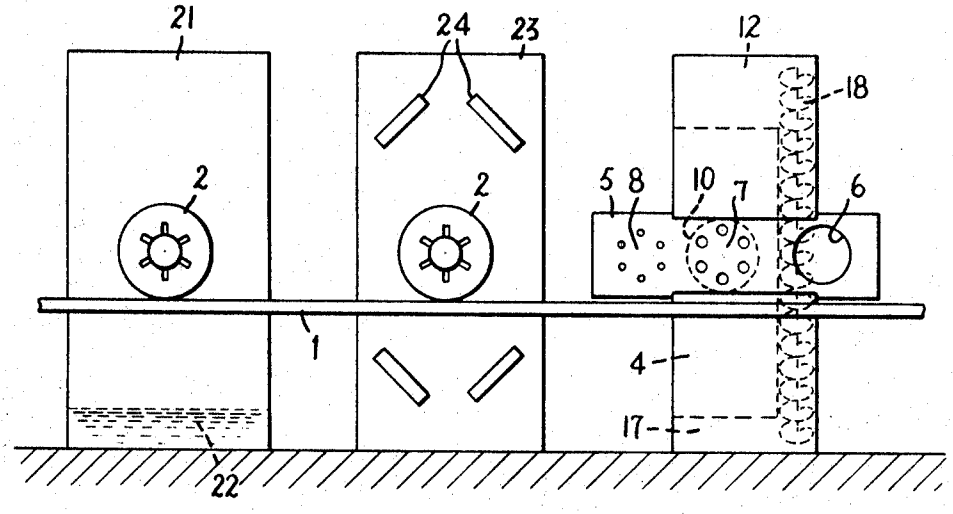


FIG. 2

United States Patent Office

3,470,010

Patented Sept. 30, 1969

3,470,010

METHOD FOR APPLYING STREAMS OF INSULATING PARTICLES TO STATOR AND ROTOR WINDING SLOTS

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Continuation-in-part of application Ser. No. 341,257, Jan. 30, 1964. This application Jan. 10, 1968, Ser. No. 698,683

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

Int. Cl. B44d *1/08, 1/22*

U.S. Cl. 117—18

6 Claims

ABSTRACT OF THE DISCLOSURE

A method 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 those surfaces of the slots desired to be 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 without contamination of the atmosphere in which the unit being coated is disposed so that the is substantialy no deposition of insulating particles on surfaces other than those being coated. Particles are suspended in a chamber defining a confined area and then subjected to gas flow through the chamber exiting from the chamber as a divided gas flow as different sets each of a plurality of insulating particle streams and sequentially of different cross sections. The streams are in a configuration corresponding to the cross section of the slots and enter the slots of the core coaxial therewith simultaneously. The streams of particles increase in cross section and a build-up of particles on the surfaces desired to be coated takes place. The particles not adhered to the slot surfaces pass through and exit from an end of the slots into a second chamber where they are recovered and from which reverse flow streams of particles can be applied to the core.

This is a continuation-in-part application of my copending application Ser. No. 341,257, filed Jan. 30, 1964 and now abandoned.

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

Heretofore, the slots of rotor and stator 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 techniques to be applied. Various methods 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 tecnique. 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.

It is a principal object of the present invention to provide a new and improved method of 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 a method in which sets of streams, of increasing cross section, of finely divided heat fusible, insulating particles are 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 method according to the invention comprises preheating cores or elements of electrical rotary machines having axially extending and angularly spaced slots thereon for receiving individual windings therein. The steps of the method include suspendnig finely divided particles of insulating material in a chamber defining a confined area provided with shutter means defining a mask to preclude the application of particles to undesired portions of the cores. The shutter 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. A gaseous fluid under pressure is applied to the chamber and shutter incorporated into the apparatus to flow the particles outwardly of the chamber confined area through the apertures as a set of 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 method 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 position. The cores, which may be rotor or stator 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 positions 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 condiut 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 powdered 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 the gas flow is divided and separate streams of gaseous fluid under the powder suspended therein will be caused to exit from the chamber or confined area 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 particles 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 method according to the invention makes provision for precleaning and preheating of the cores before insulating them by 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 stator 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 of 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 heat-set, 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. 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 as above-described. Thus, the method of the invention provides for controlled buildup of the insulation by use of different cross-sections of insulating particle streams.

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 method according to the invention air is employed to develop the streams of powdered material, however, other gaseout 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 method likewise provides for regulating the thickness of the coating as desired by controlling the length of time of application of particles. The coating is smooth and free of irregularities generally found in coatings applied by methods making use of insulating materials in a fluid or plastic state. The method 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 preferred embodiment of the method 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. A method of insulating cores comprising rotors and stators and the like for rotary electrical apparatus comprising, providing in a given area a core for an electrical apparatus and having a plurality of axially extending spaced slots for receiving windings, therein, developing a plurality of streams of finely divided heat fusible, insulating particles exteriorly of said area in another area adjacent to the first mentioned area, and directing through one end of said slots said streams of insulating particles simultaneously in a configuration corresponding to the cross section configuration of said slots to adhere some

of said particles to surfaces of said core defining the individual slots thereby to form an insulating coating over said surfaces, and recovering particles not adhered to said surfaces as they exit from the opposite end of the individual slots thereby to pass streams of particles through said slots and through said first-mentioned area without excess particles exiting from said slots to contaminate the atmosphere of said first-mentioned area.

2. A method according to claim 1, in which said streams are developed as different sets of streams of different cross sections from one set of streams to another set, said cross section increasing from one set to the next successive set of streams.

3. A method according to claim 1, in which the streams of particles of said sets of streams positioned in said different sets of streams in corresponding positions in said configuration are applied successively from a substantially corresponding individual subspaces adjacent said first-mentioned area.

4. A method according to claim 1, including heating the core to be insulated prior to applying said streams of insulating particles thereto.

5. A method according to claim 4, including applying a heated cleaning agent for cleaning said core while heating it.

6. A method according to claim 1, in which developing said plurality of streams comprises fluidizing said heat fusible insulating particles while confining them in said area adjacent to the first-mentioned area, subjecting the confined fluidized particles to a gas flow, and dividing the flow into said plurality of streams and discharging them from the confined area in said configuration.

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U.S. Cl. X.R.

117—21, 24