METHOD OF FORMING LAYERS OF INSULATING MATERIAL IN SLOTS OF MAGNETIC CORES

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This invention relates in general to method for applying coatings on articles of manufacture and more specifically to an improved method particularly adapted for use in connection with the application of coatings of insulating material onto the desired locations of magnetic cores of electrical devices, such as stator and armature cores for dynamolectric machines.

Electroductive devices, such as dynamolectric machines, customarily include one or more core members formed on magnetic material which are provided with a series of slots for accommodating excitation windings. These windings are ordinarily composed of a number of turns of magnet wire conductors having a thin covering of insulation. Since the cores conventionally include a stack of thin laminations which have been stamped out of magnetic sheet material, the edges of the laminations, especially at the entrances of the slots on each side face of the core, contain burrs and other sharp projections produced by the stamping operation. The projections, unless properly covered with insulation material, tend to cause breaks in the wire insulation ultimately resulting in possible short circuit of the wire conductors.

For this and other reasons, it is necessary to provide an imperforate ground insulation between the core and the winding, both in the slots and at the slot edges, which is sufficiently thin in cross section to permit optimum utilization of slot area for the windings, yet will not break down at the maximum temperatures encountered during machine operation.

In the past there have been numerous proposals for providing insulating material between the windings and the walls of winding slots and slot entrances as well as end faces of cores. One of the most desirable approaches concerns the formation of an adherent, protective, integral insulating layer from fusible powder coating material, such as thermosetting epoxy resin, on these preselected core surfaces after the core has been pre-heated to a particular temperature. The heat energy emitted from the walls coalesce the applied powder material into the integral layer. Normally such material melts, flows slightly, and coalesces onto the core walls with the proper adherence in the temperature range of 190° C. to 232° C. Examples of this type of resin are “Scotchcast” Brand Resins, Nos. 260 and XR 5070, commercially available from Minnesota Mining and Manufacturing Company, St. Paul, Minn.

A practical difficulty, however, has been encountered in applying the coating material onto the core walls while the core is pre-heated in the proper range. For instance, depending upon the core mass, at the outer exposed surfaces of the core which are to receive the powder material, the core has a tendency to cool rapidly below the critical temperature range; e.g., in some cases, within one-half minute. Thus, there has been a problem in furnishing low cost equipment, suitable for the mass production manufacture of cores, which is not only capable of forming the layer of insulating material on the walls with the requisite adherence and uniformity of thickness qualities, but is also efficient and rapid in operation.

Consequently, it is a general object of the present invention to provide an improved method for applying coatings onto articles of manufacture and a more specific object to provide a machine suitable for use in connection with the formation of improved coatings or layers of insulating material on the desired surfaces of cores for electrical devices, such as stator and armature cores employed in dynamolectric machines.

It is a further object of the present invention to provide an improved method which overcomes the difficulties and problems mentioned above.

It is another object of the present invention to provide an improved method of forming layers of insulating material in slots of pre-heated magnetic cores to a particular temperature which efficiently and rapidly forms the insulation layers having the desired characteristics on a mass production basis without unduly reducing the temperature of the cores or causing powder build up between the core and its support.

In carrying out the objects of this invention in one form thereof, we provide a method especially adapted for applying a coating onto preselected surfaces of an article, such as a magnetic core of an electrical inductive device.

Initially, the core, preheated to a preselected temperature, is mounted at a core loading station onto a holder in a retracted position in which the core and holder are movable relative to one another at a core. The holder is then moved into frictional engagement with the periphery of the core and the core and holder are subsequently angularly driven into a powder spray coating station. Insulating material in powder form is applied onto the slot surfaces of the core from powder applicators disposed at least at one location adjacent each side of the core while the holder, and consequently the core, are turned at a speed sufficient to permit the disposition of powder on the slot surfaces throughout the axial lengths of the slots as well as onto the slot edges. During the application of the powder, the holder prevents the formation of a coating on the part of the core frictionally engaged by the holder.

In order to insure powder collision in the vicinity of the axial center of the slots without reducing the preheated condition of the core, the powder is applied from the powder applicators at a pressure not substantially in excess of 6 p.s.i. as the holder is turned at a speed not substantially above 30 r.p.m. In addition, during the application of powder from the powder applicators, powder which may have passed entirely through the slots is predirected by baffle means back into the slots for deposit thereof onto the slot edges and surfaces desired to be coated.

The core and holder are then angularly driven away from the coating station to a core unloading station, the holder being returned to its redirected position and the coated core being removed from the holder within twelve seconds from the time that powder was deposited on the slot surfaces. In this way, the tendency of a hardened insulation bridge to form at the periphery of the core adjacent the holder is reduced or prevented and the core may readily be dismantled from the holder.

The holder is then prepared for mounting of another core thereon in the case of stator cores by clean excess powder from the periphery of the holder and thereafter applying a film of friction-reducing material on the holder periphery.

In this way, a process is provided which is efficient and economical to use in the mass production manufacture of coated magnetic cores and is capable of forming a layer of insulating material onto the desired locations of the core in a preheated condition without appreciably reducing the temperature of the core or permitting buildup of excess material on the equipment used in connection with the process.

In addition, a method is provided for forming a layer of insulating material on the surface of axially extended
winding slot and slot edges of a magnetic core when the aforementioned machine is employed in the fabrication of magnetic cores.

The subject matter which we regard as our invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. Our 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 drawings:

In the drawings:

FIG. 1 is a front view of an article coating machine having a number of angularly spaced apart work stations, the machine incorporating the preferred embodiment of the present invention;

FIG. 2 is an enlarged side view, partially broken away to show details, of a portion of the machine seen in FIG. 1;

FIG. 3 is an enlarged rear view of the machine of FIG. 1;

FIG. 4 is an enlarged view in section of the preferred manner in which each article to be coated, a stator magnetic core in the exemplification, is supported in the machine of FIG. 1 for independent rotation when disposed in certain work stations;

FIG. 5 is an enlarged view of the rotating manifold and valve assembly seen in FIG. 2 for operating the article between the retracted and retracted and extended positions at the determined angular locations of members 25 (to be discussed later). When retracted, (solid lines in FIG. 4) the outer diameter of member 41 is slightly less than the bore diameter of the rotor to permit relative movement therebetween.

In the extended position, shown by the broken lines in that figure, flexible member 41 is expanded sufficiently to provide a firm frictional engagement throughout the axial length of bore 2.

Although any suitable means may be utilized to control the actuation of the flexible member 41 between the retracted and extended positions, we have found in actual practice that the illustrated mechanisms and fluid pressure system are advantageous to employ in view of the additional functions which the fluid, such as air, can perform. For use with the air pressure system, article holder assembly 40 may be conveniently constructed in the manner shown in FIG. 4. As shown in FIG. 4, holder assembly 40 includes, by way of example, a central, elongated tubular element 42 having a sleeve 43 attached thereto formed with enlargements 44 at each end. The outer surface of sleeve 43 and the interior of member 41 define an air receiving pocket 45. Flexible member 41 is attached in sealed relation to these enlargements by an inwardly projecting flange 46 formed integral at each end of member 41. Flange 46 is held tightly between washer 47 and the associated enlargement in an annular groove 48 provided in the side of the enlargement. These parts are secured in place on element 42 between a shoulder 49 and nut 51 threadedly received on stud 52. The stud is in turn fastened within tubular element 42. A number of radial openings 55 connect air receiving pocket 45 with hollow center 54 for transferring fluid therethrough.

Still referring to FIG. 4, the illustrated arrangement 35 for detachably mounting assembly 40 for independent rotation relative to angularly movable member 25 will now be described. Arrangement 35 comprises a coupler device 61 having a hollow shaft 62 and a sealed bearing unit 63, arranged in section 27 of member 25, rotatably supporting the coupler shaft 62. With respect to coupler device 61, a cup-shaped outer housing 65 includes an opening 66 extending one wall for mounting a hollow shaft 62 which has a passageway 67 in communication with the interior of inner chamber 68 of the housing. On the sides of the housing, remote from shaft 62, a removable plate 69 is connected thereto by bolts 70. Centralized of this plate 69 is furnished an integral extension 72 having a
central bore 73, which carries a sleeve insert 74, and a longitudinal aperture 75 running between chamber 68 and the end face of extension 72. On the outside surface thereof is formed threads 71 to engage complementing threads of collar 57 connected to the extreme end of element 42 of holder assembly 40. Suitable seals 76 may be used to make the device air tight. Confined within chamber 68 and in sealed relation with the chamber walls by annulus 77 is a piston type element 78, provided centrally thereof with a hole 79 and a needle type valve 80 outwardly thereof. A coil spring 81 is disposed between element 78 and insert 74 to bias the element towards shaft 62. The exact functions of the parts within chamber 68 will be brooked here but it should be recognized now that they permit article holder assemblies for different articles to be attached to plate 69 and passage of air therethrough.

With regard to sealed bearing unit 63, the outer races of a pair of ball bearings 82 are seated in a cast cylindrical housing 83 having a cavity 85, with the inner races being affixed to rotate with shaft 62 of coupler device 61. Resilient rings 86, 87 seal the bearing races with respect to the housing and shaft. Sleeve 91 retains the inner bearing races in their proper spaced apart relationship while a resilient annulus 92, disposed between housing 85 and sleeve 91 adjacent the bearings, provides a seal at this location for cavity 85. Very small air bleeder opening 93, formed in each annulus 92 next to the balls of the bearings, direct a fine flow of air from the cavity 85 past the balls to the ambient atmosphere to keep the balls free of powder during the coating operation. These parts are held together in assembled relation by a screw and shoulder combination indicated at 94. It should be noted at this time that cavity 85 is open to passageway 67 of coupler shaft 62 and hence chamber 45 of the holder assembly 40, by aligned holes 81 in the shaft and sleeve 91.

The extreme end 95 of shaft 62, remote from coupler device 61, is solid and protrudes beyond unit 63 to carry suitable means by which rotary motion is transmitted to the holder assembly 40, through coupler device 61, and to core 1 in the coating and reconditioning stations B and D. This means, best shown in FIGS. 2 and 3, is in the form of a sheave 96 connected to shaft end 95, which is adapted to travel into frictional engagement with belt 97, rotatably driven at stations B and D, when member 25 is turned into these stations. The belts are rotatably carried by pulleys 98 mounted to vertical wall 22 and are driven continuously by electric motor 101 by way of slotted pulley and belt-speed reduction means 102, all supported by wall 22.

Returning again to the description of the illustrated fluid pressure system, air under pressure is supplied at pre-selected times to each bearing cavity 85 of bearing unit 63 and then through coupler device 61 to holder pocket 45 from a main line pressure source shown at 110 in FIG. 11. A conventional valve 111 and pressure regulator 112 connect the pressure source by line 113 to a rotary manifold or valve assembly 115, which serves to control the flow of air to and from each bearing cavity 85 (and hence the holder assembly), through four tubes 116, 117, 118, and 119. Each of these tubes extends from bearing cavity 85 radially inward along arms 26 of revoluble member 25, through indexed drive 34 adjoins the axis of revolution thereof to a rotatable plate 121 of assembly 115, now to be described in detail in connection with FIGS. 2, 5, and 6.

On the side facing holder assemblies 40, a yoke section 123 surrounds the end of tubes 116–119 and is received in wall hole 122. This section joins the plate to ratchet driver 34 of the indexer 31. A number of identical bores 124, formed in the plate, extend from the various tubes, which are connected therein, and terminate at running face 125 in openings 127. All openings are at the same radius with respect to the axis of rotation of the plate. Integral with face 125 is a flange 130 which, with face 125, furnishes a sealed running relation to under face 132 of a stationary plate 131. The plate 131 is in turn attached to wall 22 by means of a flange and bolts 134 and studs 135. Plate faces 125 and 132 are maintained in the sealed, running relation by biasing spring 136 disposed between thrust collars 137 and pin 138, which passes entirely through bracket 134 and plate 131 to center rotatable plate 121 at its center to rotate therewith.

Formed on underface 132, best shown in FIG. 6, are four mutually isolated arc-like grooves 141, 142, 143, and 144, each having a common axis with the axis of rotation and the same radius as the bore openings 127 of face 125. Grooves 141 and 143 in the stationary plate located at the same angular positions as the loading and unloading stations A and C. The circumferential centers of grooves 142 and 144 correspond in position to the coating applying and reconditioning stations B and D, the grooves being connected to pressure source 110 through inlet ports 146. Each of the other grooves, that is 141 and 143, is in communication with the ambient atmosphere by suitably provided exhaust or outlet ports 147.

Consequently, by correlating FIG. 6 with FIGS. 1 and 11, it will be observed that as each of the holder assemblies 40 pass into and out of stations A–D, its corresponding bore in rotatable plate 121 will be either in communication with the atmosphere via stationary grooves 141 and 143 to retract flexible member 41, or with pressure source 110, by way of grooves 142 and 144, to urge and maintain flexible member in the extended position. At locations A and C, with member 41 being retracted, it is simple to unload or load the article on the machine.

In this regard, the loading at station A (FIG. 1) and unloading at station C of the article (core 1 of the exemplification), may be accomplished manually or by any well known automatic transfer loading and unloading equipment (not shown). In order to expedite loading of the article to be coated, station A may be located near an oven or the like (not shown) where the core has been pre-heated to the requisite temperature, such as in the range of 190° C. or 252° C. Thus, the heated core can readily be removed from the oven as it emerges and loaded on holder assembly 40 at station A.

The coating applying station B will be explained with reference to FIGS. 7 and 8. Special type identical powder applicators, generally indicated by numerals 151, 152, 153, and 154, are arranged in cooperating pairs for applying powder material 155, such as epoxy resin of the kind previously mentioned, onto the side faces, edges and slot walls of core 1. In particular, each of the applicators is identically formed with central Venturi channels 156 terminating in a nozzle 157 having a divergent exit. Powder is fed to channel 156 and then to nozzle 157 by any suitable manner, by way of example, from a standard fluidized bed powder source 160 in FIG. 1, and into the applicators through hoses 161 and ports 162. The channel end remote from the nozzle is attached to pressure source 110 (FIG. 11) through a timed applicator valve 163, pressure regulator 164 and air lines 165 to develop predetermined pressure in the Venturi channel to cause powder material 155 to be delivered out of the nozzles 157 at low velocity; e.g., the nozzle pressure preferably being below six p.s.i.

The axis of each nozzle is disposed generally parallel to the rotation axis of holder assembly 40, with a pair of nozzles being spaced apart in face to face relation such that the nozzle exit in each pair is located adjacent the slot edges, during the spraying operation. The axial distance between the face 4 and the exit should be over one-half inch for best coverage of the slot edges.

The manner in which the applicators are supported in powder applying station B may also be seen from FIGS.
7 and 8. The applicators are arranged in a powder collector 170 which reclaims material not deposited on the walls of the articles, and a lower hopper 171 returns this unused material to fluidized beds 160 for reuse. A rod 172 ad-
justably secures each cooperating apron of an applicator to the axis of the shaft of two sets of core 175, 176 with each cooperating pair being attached to one axle arranged below (as viewed in the drawings) but in spaced parallel relation to the axis of rotation of holder assembly 40. This arrangement permits relative adjustment of each applicator in radial, axial, and angular planes relative to the core being coated, as dictated by the dimensions and type of slots of the article. Movement of the applicators between the operative and inoperative locations is effected, as seen in FIG. 2, by a standard air cylinder 177 and crank-gear assembly 178 attached to an extremity of each axle for turning the axle and consequently the applicators. In the inoperative position, the applicators are located such that they clear core 1 and core holder assembly 40 and as these parts are rotated into and out of station B.

Since unloading station C has already been referred to, reconditioning station D will be outlined and may include, by way of illustration, the components shown in FIGS. 2, 9, and 10. More specifically, it will be recalled that flexible member 41 is maintained in its extended position in station D and is independently rotated therein. A blade unit 181 or other material stripping device supported axially beyond holder assembly 40 is driven across the outer surface of member 41 to strip it of excess material as assembly 40 is being rotated. This axially move-
ment may be achieved by attaching unit 181 to a piston rod 182 actuated by cylinder 183, the parts being rigidly supported by beam 185 and wall 22. Unit 181 is moved by the cylinder and rod in the direction of the arrows shown in FIGS. 9 and 10, the unit moving across the axial length of flexible member 41 during the scrapping action. In addition, a nozzle 186 may be attached to rod 182, directly behind unit 181, for applying a light film of lubricant or wax 188 onto the peripheral surface of flexible member 41 after the excess material has been removed from member 41 by unit 181. This film serves as a shield on member 41 to prevent the powder material of station B from becoming embedded into the flexible member. The film also reduces the frictional sliding of the core relative to member 41 when the core is loaded thereon at station A. Of course, if desired this later film applying or slicking protective operation could be performed in a separate station disposed angularly beyond station D.

The way in which machine 10 of the illustrated em-
bdiment operates, may be best understood by reference to the FIGURE 11, taken primarily in conjunction with FIGS. 1, 4, 6, and 8. The machine operator energizes the machine by closing main switch 191 which excites electric motors 101 to drive belts 97 at a pre-selected speed. Flexible member 41 of holder assembly 40, dis-
posed in loading station A, will be in a retracted position for the reasons already set forth, the holder assembly being exhausted to the atmosphere by reason of valve assembly 115 (FIG. 6). After the article to be coated (heated core 1 of the exemplification), has been slid onto flexible member 41, operation of indexer 31 may be initiated by manual control switch or timer means, indicated at 192, which in turn operates solenoid valve 194 to index cylinder 195 for the next move of assembly 40. As holder assembly 40 and bore opening 127 in valve assembly 115 are moved in concurrence from A towards station B, an angle of 15°, opening 127 in valve assembly 115 travels beyond exhaust groove 141 and into communication with groove 142 in the stationary plate, connecting holder assembly pocket 45 to the air passage through inlet port 146, tube 116, bearing unit 63, and piston end hole 79 of coupler device 61. Flexible member 41 is thus urged to its extended position (the broken lines in FIG. 4) where firm engagement is made with the entire circumference of core bore 2. A pressure of twenty p.s.i. in air pocket 45 is sufficient to perform this movement. Air moving into and out of pocket 45 has the tendency to effect a slight cooling of flexible member 41, keeping its temperature low.

Switch 192, when closed, also energizes a timer switch 193 which actuates solenoid valve 197 to open the air cylinders 177 to pressure source 1190 after rotatable member 25 has been stopped by indexer 31 with holder assembly 40 disposed in station B. The applicators are swung from their inoperative (FIG. 7, by operation of cylinders 177) to the operative (FIG. 8) positions where the applicator nozzles 157 are arranged adjacent to the faces 4 of the core. It should also be noted that as the holder assembly 40 is being turned into station B, sheave 96 on shaft end 95 travels into frictional engagement with the continuously rotating belt 97, and the holder as-
sembly 40 is independently rotated at a predetermined speed. In order to keep the powder within collector 179, a thin circular plate 29 may be supported on rotatable member 25, adjacent coupler device 61, by bolts and integral posts 28 projecting outwardly from the member 25. In addition, a generally U-shaped cover 170a may be mounted over powder collector 170 and pro-
vided with an opening sufficiently large to permit core 1 and holder assembly 40 to be rotated into and out of the powder applying station.

Powder is fed to the applicators by Venturi action after assembly 40 is in station B. Initiation of the powder application is also started by timer switch 193 which controls actuation of applicator solenoid valve 163. Powder 155 is applied onto the core faces 4, slot edges, and into the slots 3 as the core is rotated sufficiently slow to permit penetration of the powder material to the center of the core slots. Depending upon the thick-
ness of the layer desired, the nozzle pressures, speed of core rotation, and density of the powder mass being applied, are all regulated to meet the particular layer thickness requirements for the given article. However, it has been found in actual practice that for optimum coating results with respect to magnetic cores for electrical in-
ductive devices, it is desirable to rotate the cores at a relatively low speed, that is, not substantially above thirty r.p.m. while maintaining low powder velocity pass-
ing from the nozzle exit (e.g., preferably below six p.s.i.). This slow rotation does not appreciably affect the cooling rate of the core and produces results have been achieved with a synthetic polyester resin of the kind disclosed and claimed in U.S. Patent No. 2,936,296—Precipio and Fox, assigned to the General Electric Company as well as with other insulating powder resins.

Each set of applicators cooperate to direct a mass of powder into the slots from the opposed nozzles 157 such that the opposed powder flows produce particle collision of the opposed streams in the vicinity of the center of the slots. This action appears to create a slight turbulence therein for depositing the powder somewhat uniformly along the extent of the heated core slot walls. Baffles 179 may be mounted on each applicator to re-
direct the powder which does pass through the slots back into them. The heat from the core melts the powder material on the walls, with the material flowing slightly into a coating, and coalesces into a layer. Since member 41 never reaches the melting temperature of the material 155, no layer will be formed on the outer surface of the member. Moreover, due to the masking function of the expanded flexible member, no powder is deposited on the bore 2 of core 1.

Once melted, the resin usually remains in a liquid form in the neighborhood of nine to twelve seconds thereafter it has been deposited on the walls. If the powder material is allowed to coalesce on the walls of core 1 at the periphery of member 41 into a somewhat hard-
ened layer, a bridge may be formed, making it difficult to remove the core from the holder assembly. Moreover,
9 once hardened, this bridge may form an undesirable ridge at that location. Thus, it is desirable to dismantle core 1 from member 41 in unloading station C as soon as possible. When the desired amount of material 155 has been deposited on core 1, which may take no longer than seven-nine seconds, timer switch 193 opens and solenoid valves 196 and 197 are deenergized to discontinue the application of powder to the operative members to their inoperative positions. Indexer 31 then returns member 25 and holder assembly 40 from station B to unloading station C.

Just prior to entrance of holder assembly 40 into the unloading station C, bore opening 127 becomes aligned with stationary grid 143 and outlet port 147 of valve assembly 115, thus venting holder pocket 45 to the ambient. Flexible member 41 is returned to its retracted position, allowing the core 1 to be readily and rapidly dismantled from assembly 40. Consequently member 41 and core 1 are in firm engagement for the greater portion of the angular travel of the parts from station A to C to insure proper support for core 1. Moreover, since operation of flexible member 41 is performed in the preferred embodiment during each indexing part of the cycle, e.g., a duration of 1½ seconds, no time is lost at the loading and unloading stations to accomplish this function. The reconditioning operation is performed on member 41 in the reconditioning station D have already been described in detail. No further detailed explanation will be included here other than to state that its operation may also be regulated by timer switch 193 which initiates operation of solenoid valve 196 which in turn controls cylinder 183 to cause the axial travel of piston rod 182.

It is important to note that except for the indexing movement of holder assembly 40 between the stations (e.g., 1½ seconds), all operations, such as the loading and unloading of the work article and the reconditioning operation conducted on the work holder assembly 40, are performed while the powder material is being applied to the article in station B. Since the powder application part of the cycle may be completed in about ten seconds, the entire cycle through stations A-D requires no more than forty-six seconds. Of course, this time duration for a single cycle is as desired.

From the foregoing it will be recognized that the machine of the present invention can be utilized to coat articles other than stator core 1. By way of example, FIG. 12 illustrates coupler device 61 detachably mounting holder assembly 40 of which, by way of example, is adapted to support a shaft 1a of a dynamo-electric machine similar to the like. In this embodiment, holder assembly 40a comprises an outer cast coupling shell 201 having a central passageway 202 enlarged at coupling end 203 and provided with internal threads 204 for engagement with the external threads of coupler plate 69. Pins 205 may be used to lock these pieces together, if desired, to prevent angular movement. Prior to the attachment of the coupler shell 201 to device 61, a threaded pin 207 is placed into insert 74 and connected to piston element 78 via hole 79. The other end of the pin is received in a cap 208 which abuts against a sleeve 209, having a shaft 210 accommodating recess 210a for receiving shaft 1a. This sleeve in turn, is wedged tightly against a movable flexible member or collet 41a. As with flexible member 40 for supporting stator core 1, collet 41a is movable between a retracted position (shown in solid in FIG. 12) and an extended position in which the collet is forced to grip the shaft to support it. This movement is accomplished by the expanification by air pressure which enters inner chamber 68 of device 61, and applies force against the face of piston element 78, overcoming the bias of spring 81, to cause the element to travel in the direction of the arrows. Pin 207, cap 208, sleeve 209, and finally collet 41a are accordingly forced to the right as viewed in FIG. 12. The collet is reduced in cross-section and is squeezed around shaft 1a by the inner inclined wall 212 of the shell.

Air pressure is supplied to the coupler device 61 in the same manner as that already explained in connection with holder assembly 40. For instance, whenever bore openings 127 in rotatable plate 125 are in communication with grooves 142 and 144, movement of the collet into the extended position will be effected for engaging shaft 1a to support it.

Needle valve 80 of element 81, inoperative when device 61 detachably mounted on holder assembly 40a, is functional in the support of assembly 40a. It allows a small flow of air to be directed to and through the collet during the coating cycle for blowing the powder away from the collet without adversely affecting the layer being formed on the article. Air ducts 211, 214, and 215 connect the needle valve with the coupler for this purpose. When valve 115 vents device 61 to the atmosphere at the loading and unloading stations, collet 41a will be returned to its retracted position by spring 81 to permit movement of the shaft 1a relative to the collet.

The principle features and advantages of the present invention have been suggested during the description of the illustrated embodiment thereof. The process permits the use of a machine which is simple in construction, efficient and rapid in operation, and is capable of use in the mass production manufacture of articles having different configurations. The method of this invention is also versatile in nature and can be utilized in work holder assemblies and machines of different constructions. It should be appreciated that in order to increase the output of the machine, more than the four stations illustrated could be employed which, of course, would require a corresponding increase in the number of work holder assemblies. Additional stations, similar to those of the present invention, could also be located coaxial with the illustrated embodiment and operated by a single indexers. Furthermore, a satisfactory coating may be applied onto the article even though the article must be in a heated condition during the coating operation and the article has a tendency to lose its heat at a high rate from the exposed surfaces to be coated.

While in accordance with the patent statutes, we have described what at present is considered to be the preferred embodiments of our invention, it will be obvious to those skilled in the art that numerous changes and modifications may be made therein without departing from the invention and it is therefore aimed in the appended claims to cover all such equivalent variations as fall within the true spirit and scope of the invention.

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

1. The method of forming a layer of insulating material on the surface of axially extending winding accommodating slots, and slot edges of a magnetic core for use in an electric inductive device comprising the steps: mounting the core in pre-heated condition onto a holder and moving the holder into firm frictional engagement with a selected surface of the core for support thereof; driving the holder and core held thereby into a spray coating station; applying insulating material in powder form onto at least the slot surfaces thereof from powder applicators disposed at least at one location adjacent each side of the core while concurrently turning the holder at a speed sufficiently low to permit the disposition of powder on the slot surfaces throughout the axial length of the slots and covering the slot edges, thereby to form a generally uniform coating thereon with the holder being maintained in communication to a source of fluid pressure, and with the holder aiding to prevent the formation of a layer of insulating material on at least the selected surface of the core frictionally engaged thereby; driving the core and holder away from the coating station; and removing the coated core from the holder within twelve seconds from the time of powder deposition on the slot surfaces to prevent the formation of a hardened insulat-
ing bridge at the selected surface of the core adjacent holder.

2. The method of claim 1 in which the magnetic core is a salient pole stator core and during the step of applying insulating material in powder form onto at least the slot surfaces, at least some of the powder which may have passed entirely through the slots of the salient pole stator core is re-directed by baffle means back into the slots for deposit thereof onto the slot edges and surfaces.

3. The method of claim 1 in which the insulating material is applied onto at least the slot surfaces at a pressure not substantially in excess of six p.s.i. from the powder applicators as the holder is turned at a speed not substantially above thirty r.p.m., thereby to insure powder collision in the vicinity of the axial center of the slots without appreciably reducing the pre-heated condition of the core.

4. The method of forming a layer of insulating epoxy resin material on axial extending winding accommodating slots, side faces, and slot edges of a stator core for use in a dynamoelectric machine comprising the steps: mounting the stator core in pre-heated condition onto a flexible annular holder in a retracted position, increasing the transverse dimensions of the holder from the retracted position into firm frictional engagement with the bore of the stator core; driving the expanded holder and stator core held thereon angularly into a spray coating station; spraying powdered epoxy resin insulating material onto the side faces, slot edges and internal slot surfaces thereof from powder applicators disposed in operative positions at least at one location adjacent each side of the stator core while concurrently rotating the holder and core at a speed sufficiently low to permit a uniform deposition of powder throughout the axial length of the slots with the expanded holder serving to prevent formation of a coating on the stator bore; driving the stator core and holder angularly away from the spray coating station and decreasing the transverse dimension of the holder to return the holder to its retracted position, and removing the coated stator core from the retracted holder within twelve seconds from the time the powdered resin is deposited onto the side faces, slot edges and internal slot surfaces of the stator core.

5. The method of claim 4 in which, subsequent to the removal of the coated stator core from the retracted holder, the holder is prepared for mounting another stator core thereon by cleaning excess powder from the periphery of the holder and applying a film of friction-reducing material thereon.

6. The method of claim 4 in which before the step of spraying powdered epoxy resin insulating material onto the internal slot surfaces of the stator core, the powder applicators are moved from inoperative positions to the operative positions, and returned to the inoperative positions after the powdered epoxy resin has been sprayed onto the internal slot surfaces thereby to allow the core to be driven angularly into and out of the spray coating station.

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