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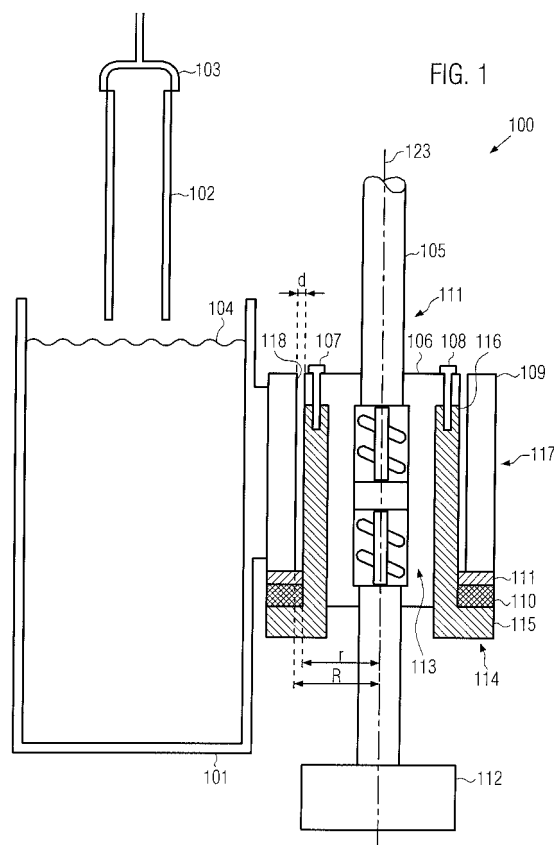
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Remarks:

Amended claims in accordance with Rule 86 (2) EPC.

(54) System and method for dip coating a component

(57) The present invention relates to an apparatus (100) for dip coating a component (102), and an apparatus (200) and a method for wiping an edge of a cylindrical component (230). In the apparatus (100) for dip coating a component (102), a damping element (117) is provided between a spindle nut (113) and one of the component (102) and the tank (101) which is connected to the spindle nut (113) in order to be movable in a vertical direction. Thus, a transfer of vibrations to the component (102) and/or the tank (101) which might adversely affect the quality of a coating layer formed in the dip coating process can be reduced. In the apparatus (200) for wiping an edge of a cylindrical component (230), a plurality of first brushes (211,212,217,218) and a plurality of second brushes (209,210,219,220), respectively, are arranged around an outer circumference of a first support member (203) and an inner circumference of a second support member (202). The plurality of first brushes (211,212,217,218) is offset relative to the plurality of second brushes (209,210,219,220) in a direction of an axis (206). The first and the second brushes may be rotated around the axis (206) in order to wipe a coating layer off the cylindrical component (230). The offset allows removing portions of the coating layer having a different height from the inside and the outside of the cylindrical component (230).



Description

[0001] The present invention is generally directed to the dip coating of a component with a material layer and to the cleaning of a dip coated component after the coating process.

[0002] In reproduction devices like photocopying machines and laser printers, an image is first generated on a photosensitive member and then transferred from the photosensitive member to a sheet of paper or another material such as transparent plastic. The photosensitive member can comprise a drum of an electrically conductive material coated with a photoconductor layer. The electrically conductive material can comprise a metal, for example aluminum.

[0003] In operation, the photoconductor layer is electrically charged in the dark. Then, portions of the photoconductor layer are irradiated with light and the drum of electrically conductive material is grounded. The irradiated portions become electrically conductive and their charge flows off via the drum. Other portions of the photoconductor layer which were not irradiated with light remain electrically insulating. Hence, substantially no charge can flow off and the non-irradiated portions remain electrically charged.

[0004] Subsequently, electrically charged toner particles are supplied to the drum. The charge of the toner particles is opposite to that of the electrically charged portions of the photoconductor layer. Therefore, the toner particles are attracted by the non-irradiated portions of the photosensitive members and accumulate in these portions. Thereafter, the photosensitive member is brought into contact with an electrically charged sheet of paper to transfer the toner to the paper. The sheet of paper is then heated in order to fix the toner on the paper.

[0005] In the manufacturing of the photosensitive member, the drum of electrically conductive material is coated with the photoconductor. The coating of the drum can comprise a dip coating.

[0006] In dip coating, a component to be coated is inserted into a bath comprising a coating material solved in a solvent. For example, in the manufacturing of the photosensitive member described above, the drum of electrically conductive material is inserted into a solution of the photoconductor. Then, the component is removed from the bath. After the removal, the component is wetted with the solution of the coating material. The solvent evaporates, leaving the coating material behind on the surface of the component.

[0007] In order to insert the component into the bath and to remove the component from the bath, either the component or a tank comprising the bath may be moved in a vertical direction. This can be done by means of a spindle known to persons skilled in the art.

[0008] After the dip coating of the drum of electrically conductive material, portions of the photoconductor layer located close to the edges of the drum are removed in order to avoid an abrasion of such portions in the oper-

ation of the reproduction device. Abraded particles of the photoconductor layer might contaminate the reproduction device, thus adversely affecting the quality of reproduction and/or the functionality of the device.

[0009] To this end, at least one of the edges can be wiped by means of first brushes rotating around an inner circumference of the drum and second brushes rotating around an outer circumference of the drum. The first and second brushes can be provided inside a recess of a support member and may be fixed to the support member. The support member is rotated around an axis. A solvent adapted to dissolve the photoconductor is supplied to the recess through the axis. The action of the brushes and the solvent together remove portions of the photoconductor layer located below a surface of the solvent.

[0010] A problem of the method of dip coating a component according to the state of the art is that vibrations generated in the vertical motion of the solvent tank or the component to be coated may be transferred to the bath and/or the component. Thus, an unevenness of the motion of the component relative to the surface of the bath and/or wavelets on the surface of the bath may be generated, which may lead to an undesirable unevenness of the thickness of the coating. In particular, in the formation of photosensitive members for reproduction machines, circumferential non-uniformities which may reduce product yields by up to 45 % have been observed.

[0011] A problem of the method of wiping the edges of the drum according to the state of the art is that, since portions of the photoconductor layer below a level of the solvent in the recess of the support member are removed, a height of the portion of the photoconductor layer removed from the inside and the outside of the drum, respectively, is about equal. This, however, may be undesirable in some applications. Instead, it may be desirable to obtain a greater height of the removed portion of the photoconductor layer on the inside of the drum.

[0012] It is an object of the present invention to provide an apparatus for moving a member in a vertical direction allowing a reduction of vibrations transferred to the member. In particular, it is an object of the present invention to provide an apparatus for dip coating a component wherein vibrations of a tank for a coating solution and/or the component to be coated can be reduced.

[0013] According to an aspect of the present invention, this object is achieved by an apparatus for moving a member comprising a spindle comprising a spindle nut. The member is connected to a spindle nut. A damping element is provided between the spindle nut and the member. Advantageously, the damping element absorbs vibrations generated in the operation of the spindle. Thus, a transfer of vibrations from the spindle nut to the member can be significantly reduced.

[0014] According to another aspect of the present invention, this object is achieved by an apparatus for dip coating a component. The apparatus comprises a tank for a coating solution and a spindle. The spindle is adapt-

ed to move one of the component and the tank in a vertical direction. The one of the component and the tank is connected to a spindle nut of the spindle. A damping element is provided between the spindle nut and the one of the component and the tank. Hence, the damping element absorbs vibrations generated in the operation of the spindle and helps reduce a transfer of the vibrations to the tank and/or the component.

[0015] Advantageously, the damping element comprises a bushing supported by the spindle nut. The bushing comprises a cylindrical portion and a protrusion running circularly around the cylindrical portion. Additionally, the damping element comprises a housing comprising a cylindrical opening. The cylindrical portion of the bushing is provided inside the cylindrical opening. A damping ring comprising an elastic material is provided between the protrusion and the housing. In the operation of the apparatus, the housing seats on the damping ring. Due to its elasticity, the damping ring dampens vibrations of the bushing, in particular longitudinal vibrations in a direction parallel to a longitudinal axis of the cylindrical portion of the bushing. Thus, a transmission of vibrations of the bushing to the housing, in particular a transmission of longitudinal vibrations, can be reduced.

[0016] Conveniently, a gap is provided between the cylindrical portion of the bushing and inner walls of the cylindrical opening of the housing. Thus, a direct contact between the bushing and the housing which might allow a transfer of vibrations from the bushing to the housing can substantially be avoided.

[0017] Advantageously, the damping element further comprises a linear bearing allowing a motion of the housing relative to the bushing in at least one direction substantially perpendicular to a longitudinal axis of the cylindrical portion of the bushing. Thus, a mobility of the housing relative to the bushing in a direction transverse to the longitudinal axis can be increased, which helps reducing a transmission of transverse vibrations of the bushing to the housing.

[0018] Conveniently, the linear bearing comprises a ring-shaped member coated with Teflon and provided between the damping ring and one of the bushing and the housing. Thus, a linear bearing having a low complexity and a high robustness can be provided.

[0019] It is a further object of the present invention to provide an apparatus for wiping an edge of a cylindrical component allowing a different height of wiped portions on the inside and the outside of the cylindrical component.

[0020] According to an aspect of the present invention, this object is achieved by an apparatus for wiping an edge of a cylindrical component comprising a plurality of first brushes arranged around an outer circumference of a first support member. The first support member is rotatable around an axis. A plurality of second brushes is arranged around an inner circumference of a second support member connected to the first support member. The cylindrical component is insertable between the first

brushes and the second brushes. A liquid supply is adapted to supply a liquid to the plurality of first brushes and the plurality of second brushes. The plurality of first brushes is offset relative to the plurality of second brushes in a direction of the axis. Due to the offset of the first brushes, the first brushes wipe a portion of the inside of the cylindrical component having a different height than a portion of the outside of the cylindrical component wiped by the second brushes. The supply of the liquid to the brushes allows bringing substantially only the wiped portions of the cylindrical component into contact with the liquid.

[0021] Conveniently, the liquid supply comprises a cup provided above the first support member and having a plurality of openings. Each of the openings is located above one of the brushes. Thus, the liquid may flow from the cup to the first brushes and thus can directly be supplied to the first brushes.

[0022] Advantageously, the liquid supply further comprises a tube running along the axis. An outlet opening of the tube is located above the cup. This arrangement allows a convenient feeding of the liquid to the cup while the first and second support members rotate.

[0023] Conveniently, each of the second brushes comprises a plurality of bristles. The bristles are inclined opposite a direction of rotation of the first and the second support members and in a direction of insertion of the cylindrical component into the apparatus. The inclined arrangement of the bristles allows reduce a scratching of the component by the bristles and increases an effectiveness of the wiping.

[0024] Advantageously, the apparatus further comprises a contact ring located above the brushes. Thus, a misarrangement of the bristles of the brushes may be substantially avoided.

[0025] According to yet another aspect of the present invention, a method of wiping an edge of a cylindrical component comprises rotating a plurality of first brushes around an inner circumference of the component. A plurality of second brushes is rotated around an outer circumference of the component. A liquid is supplied to the plurality of first brushes and the plurality of second brushes. A height of a first surface portion of the component contacted by the first brushes is greater than a height of a second surface portion of the component contacted by the second brushes. Due to the supply of the liquid to the brushes, and the different height of the surface portions contacted by the first and the second brushes, respectively, portions of a coating layer having a different height may be removed from the inside and the outside of the component.

[0026] Advantageously, the supply of the liquid comprises feeding the liquid to a cup provided above the plurality of first brushes and having a plurality of openings. Each of the openings is located above one of the first brushes. Thus, an even distribution of the liquid over the first brushes and a wetting of the first brushes can be achieved.

[0027] Conveniently, the bristles of the second brushes are inclined opposite a direction of rotation of the second brushes and in a direction of insertion of said cylindrical component between the first brushes and the second brushes. Thus, a scratching of the component during the insertion of the component and during the rotation of the brushes may be reduced significantly.

[0028] The invention will now be described in more detail with respect to specific embodiments and the accompanying drawings referring to these embodiments, wherein:

Fig. 1 shows a schematic cross-sectional view of an apparatus for dip coating a component;

Fig. 2a shows a schematic cross-sectional view of an apparatus for wiping an edge of a cylindrical component; and

Fig. 2b shows a schematic top view of the apparatus shown in Fig. 2a.

[0029] Fig. 1 shows a schematic cross-sectional view of an apparatus 100 for dip coating a component 102. The apparatus 100 comprises a tank 101 for a coating solution 104. A spindle 111 is adapted to move the tank 101 in a vertical direction. The spindle 111 comprises a shaft 105. The shaft 105 is provided with a thread extending along a substantial portion of a length of the shaft 105. A motor 112 is adapted to rotate the shaft 105 around a substantially vertical axis 123 of the shaft 113. The spindle 111 further comprises a spindle head 106 provided with a spindle nut 113. The shaft 105 extends through the spindle nut 113. Additionally, the spindle may comprise a frame adapted to prevent a rotation of the spindle head 106 around the axis 123 (not shown).

[0030] If the shaft 105 is rotated by the motor 112, the spindle nut 113 moves in a vertical direction parallel to the axis 123. Depending on the direction of rotation of the shaft 105, the spindle nut 113 may be moved upward or downward. A speed of the motion of the spindle nut 113 can be controlled by varying a number of revolutions of the motor 112, a greater number of revolutions yielding a faster motion of the nut 113.

[0031] In some embodiments of the present invention, the spindle nut 113 can comprise a ballscrew nut. As persons skilled in the art known, a ballscrew nut comprises a plurality of balls running through the thread of the shaft 105 and a corresponding chamfer inside the nut 113. Advantageously, a ballscrew nut provides a low frictional drag between the shaft 105 and the nut 113. Moreover, a ballscrew nut can be preloaded, which allows a significant reduction of a clearance of the nut 113. Thus, a greater precision of the motion of the spindle nut 113 along the shaft 105 can be achieved.

[0032] The apparatus 100 further comprises a damping element 117 provided between the spindle nut 106 and the tank 101. The damping element 117 is adapted

to absorb vibrations which are generated as the spindle nut 106 is moved by means of a rotation of the shaft 105.

[0033] The damping element 117 comprises a bushing 114. The bushing 114 is supported by the spindle nut 106. To this end, the bushing 114 and the spindle nut 106 can be screwed together by means of a plurality of screws 107, 108. The bushing 114 comprises a substantially cylindrical portion 116. A longitudinal axis of the cylindrical portion 116 can be substantially identical to the axis 123 of the shaft 105. The cylindrical portion 116 has a radius r . In a particular embodiment of the present invention, the radius r has a value of about 89 mm. Additionally, the bushing 114 comprises a protrusion 115 running circularly around the cylindrical portion 116. The protrusion 115 can be provided at a lower end of the bushing 116 and may comprise a substantially horizontal top surface.

[0034] The damping element 117 further comprises a housing 109. The housing 109 comprises a cylindrical opening 118 having a radius R . A longitudinal axis of the housing 109 can be substantially parallel to the axis 123 of the shaft 105. The cylindrical portion 116 of the bushing 114 is provided inside the cylindrical opening 118 of the housing 109. The radius R of the housing 109 can be greater than the radius r of the cylindrical portion 116 of the bushing 114. In one particular embodiment of the present invention, the radius R can have a value of about 92 mm. Thus, a gap d can be provided between the cylindrical portion 116 and the inside wall of the cylindrical opening 118. The housing 109 is connected with the tank 101 for the coating solution 104.

[0035] A damping ring 110 is provided between the protrusion 115 of the bushing 114 and the housing 109. The damping ring 110 may comprise an elastic material configured to substantially absorb longitudinal vibrations of the bushing 116 in the vertical direction. In one embodiment of the present invention, the damping ring 110 can comprise polyurethane having a Shore hardness of about 65° and a thickness of about 10 mm. An inner diameter of the damping ring 110 can be about the same as the radius r of the cylindrical portion 116 of the bushing 114. The damping ring 110 can cover the top surface of the protrusion 115 completely.

[0036] In the operation of the apparatus 100, the weight of the tank 101 and the housing 109 rests on the damping ring 110. Thus, the damping ring 110 is compressed by the weight force of the tank 101 and the housing 109. If the bushing 114 exhibits longitudinal vibrations, the damping ring is additionally subjected to acceleration forces. Such forces may compress or relax the damping ring 110. Thereby, energy of the vibration is transferred to the damping ring 110 and dissipated therein. Thus, the longitudinal vibrations are dampened. Hence, a transfer of the longitudinal vibrations of the bushing 114 to the housing 109 and the tank 101 may be significantly reduced.

[0037] Additionally, the damping element 117 can comprise a linear bearing. The linear bearing can be pro-

vided in the form of a ring-shaped member 111. The ring-shaped member 111 can be adapted such that a friction between a top surface of the ring-shaped member adjacent the housing 109 and the surface of the housing 109 is relatively low. Due to the low friction, the housing 109 and the bushing 114 may move relative to each other in at least one direction substantially perpendicular to the axis 123. In one specific embodiment of the present invention, the top surface of the ring-shaped member is coated with Teflon.

[0038] If the spindle nut 106 and the bushing 114 connected thereto exhibit transversal vibrations having at least one component in a direction perpendicular to the axis 123, the bushing 114 moves transverse to the axis 123. Since the linear bearing allows a motion of the bushing 114 and the housing 109 relative to each other, a transmission of the motion of the bushing 114 to the housing 109 can be significantly reduced. Therefore, a transmission of transverse vibrations of the spindle nut 106 to the housing 109 and the tank 101 connected thereto may be reduced significantly.

[0039] In the operation of the apparatus 100 for dip coating, the tank 101 filled with the coating solution 104 is moved to a starting position wherein the spindle nut 106 is located in a lower portion of the shaft 105. This can be done by operating the motor 112 to rotate the shaft 105. Then, a component 102 to be coated is provided above the tank 101. To this end, the component 102 may be grasped by means of a picker arm 103 of a type known to persons skilled in the art and moved to a position above the tank 101.

[0040] In some embodiments of the present invention, the apparatus 100 may be used in the formation of a photosensitive member for a reproduction machine. In such embodiments, the component 102 can comprise a drum of an electrically conductive material, for example a metal such as aluminum. The coating solution 104 can comprise a solution of a photoconductor material, for example an organic photoconductor such as an alkoxy/hydroxyl/halo gallium photogenerating component, wherein alkoxy can be, for example, from 1 to about 25 carbon atoms, from 2 to about 18 carbon atoms, from 2 to about 7 carbon atoms, and wherein halo comprises for example chlorine. In one particular embodiment of the present invention, the photoconductor material can comprise (alkoxy/hydroxyl/chloro) gallium phthalocyanine pigment. Additionally, the coating solution may comprise a solvent such as n-Butyl Acetate or Tetrahydrofuran (THF).

[0041] The tank 101 is moved upward in the vertical direction by means of a rotation of the shaft 105. Due to the motion of the tank 101, the component 102 is dipped into the coating solution 104. The component 102 may totally be inserted into the coating solution 104. In other embodiments of the present invention, the insertion of the component 102 into the coating solution 104 may be only partial, leaving a portion of the component 102 adjacent an upper edge thereof outside the coating solution

104.

[0042] Then, a direction of rotation of the shaft 105 is reversed in order to move the spindle nut 106 back to its starting position. Thus, the tank is moved downward and the component 102 is pulled out of the coating solution 104. The surface of the component 102 is wetted with the coating solution. Outside the tank 104, the solvent evaporates, leaving the dissolved coating material behind on the surface of the component 102. Thus, a layer of the coating material is formed on the surface of the component 102.

[0043] While the tank 101 is moved by means of a rotation of the shaft 105, vibrations of the spindle nut 106 may be generated. The presence of the damping element 117 significantly reduces a transmission of such vibrations to the tank 101. Thus, a formation of wavelets on the surface of the coating solution 104 and an unevenness of the motion of the component 102 relative to the coating solution 104 may be reduced. Advantageously, this helps improve a uniformity of the layer of the coating material formed on the surface of the component 102 and increase a product yield.

[0044] In an apparatus for dip coating according to the present invention, the tank 101 need not be connected to the housing 109 of the damping element 117. In other embodiments of the present invention, the tank 101 is fixed and the component 102 is connected to the housing 109. In one embodiment of the present invention, a picker arm similar to the picker arm 103 configured to grab the component 102 is supported by the housing. In the operation of the apparatus 100, the component 102 is grabbed by the picker arm. Then, the picker arm is lowered towards the surface of the cleaning solution 104 by rotating the shaft 105. Subsequently, the direction of rotation of the shaft 105 is reversed to pull the component 102 out of the coating solution 104.

[0045] The present invention is not restricted to an apparatus for dip coating, as described above. In other embodiments, the present invention may be applied for moving an arbitrary member in a vertical direction. To this end, the member may be connected to the housing 109 instead of the tank 101.

[0046] Figure 2a shows a schematic cross-sectional view of an apparatus 200 for wiping an edge of a cylindrical component 230. A schematic top view of the apparatus 200 is shown in figure 2b.

[0047] The apparatus 200 comprises a plurality of first brushes 211, 212, 217, 218. The first brushes 211, 212, 217, 218 are arranged around an outer circumference of a first support member 203. A plurality of second brushes 209, 210, 219, 220 are arranged around an inner circumference of a second support member 202. The first support member 203 and the second support member 202 are connected to each other by a base 201. The base 201 and the support members 202, 203 connected thereto are rotatable around an axis 206 in a direction of rotation indicated by arrow 220.

[0048] Each of the first brushes 211, 212, 217, 218

takes up a portion of the outer circumference of the first support member included by a first center angle (ϕ , as exemplarily shown in figure 2b for the brush 217. Similarly, each of the second brushes 209, 210, 219, 220 takes up a portion of the inner circumference of the second support member 202 included by a second center angle γ (exemplarily shown for the brush 210 in figure 2b). In some specific embodiments of the present invention, the first center angle ϕ may have a value in a range from about 30° to about 60°, a value in a range from about 40° to about 50°, or a value of about 45°. The second center angle γ can have a value in a range from about 20° to about 60°, a value in a range from about 30° to about 50°, or a value of about 40°. Advantageously, greater values of the first center angle ϕ and the second center angle γ allow using the available area on the first support member 203 and the second support member 202 more efficiently.

[0049] The apparatus 200 further comprises a liquid supply 221 adapted to supply a liquid to the first brushes 211, 212, 217, 218 and the second brushes 209, 210, 219, 220. The liquid supply 221 comprises a cup 205. The cup 205 has a round shape. The axis 206 runs through a center of the cup 205. A fastener 208 secures the cup 205 to the axis 206 and seals the bottom of the cup 205, thus preventing a leakage of the cup 205. An edge of the cup 205 is bent upward. At the edge of the cup 205, a plurality of openings 213, 214, 215, 216 are provided. Each of the openings 213, 214, 215, 216 is located above one of the plurality of first brushes 211, 212, 217, 218. Each of the openings 213, 214, 215, 216 takes up a third center angle η , as exemplarily shown in figure 2b for the opening 215. The third center angle η can be greater than the first center angle ϕ . Thus, each of the first brushes 211, 212, 217, 218 may be wetted completely by the liquid flowing out of the respective one of the openings 213, 214, 215, 216.

[0050] The first brushes 211, 212, 217, 218 are offset with respect to the second brushes 209, 210, 219, 220 in a direction of the axis 206.

[0051] A height h_i of an upper edge of the first brushes 211, 212, 217, 218 above the top surface of the base 201 can be greater than a height h_o of an upper edge of the second brushes 209, 210, 219, 220 above the top surface of the base 201. Thus, the first brushes 211, 212, 217, 218 are offset upward by a height difference $\Delta h = h_i - h_o$ with respect to the second brushes 209, 210, 219, 220. The height difference Δh can be about 5 mm.

[0052] In some embodiments of the present invention, bristles of the second brushes 209, 210, 219, 220 can be inclined opposite to the direction of rotation of the first support member 203 and the second support member 202 connected by the base 201. In such embodiments, an end of each of the bristles points backwards relative to the direction of rotation indicated by the arrow 220. More specifically, an angle β between a tangent of the circumference of the second support member 202 and a direction of a bristle of one of the second brushes 209,

210, 219, 220 located at the osculation point of the tangent can have a value of less than 90°. In some specific embodiments of the present invention, the angle β can have a value in a range from about 50° to about 89°, a value in a range from about 60° to about 80°, or a value of about 70°. In further embodiments, the angle between the bristles of the second brushes 209, 210, 219, 220 and the respective tangent may increase from a front end of the brushes 209, 210, 219, 220 towards a backward end thereof.

[0053] The bristles of the second brushes 209, 210, 219, 220 can also be inclined in a direction of insertion of a cylindrical component 230 into the apparatus 200. In the apparatus shown in figures 2a and 2b, the cylindrical component 230 can be inserted vertically between the first brushes 211, 212, 217, 218 and the second brushes 209, 210, 219, 220 from above. Hence, an angle α between a vertical direction parallel to the direction of the axis 206 and the direction of the bristles can have a value of less than 90°. In one particular embodiment of the present invention, the angle α can have a value of about 85°.

[0054] Above the second brushes 209, 210, 219, 220, a contact ring 204 can be provided. The contact ring 204 protrudes over the edge of the second support member 202 and protects the second brushes 209, 210, 219, 220. Thus, a misarrangement of the bristles of the second brushes 209, 210, 219, 220 may substantially be avoided.

[0055] Similar to the bristles of the second brushes 209, 210, 219, 220, bristles of the first brushes 211, 212, 217, 218 may also be inclined in the direction of insertion of the component 230 and/or opposite the direction of rotation of the apparatus 200 indicated by the arrow 220. In other embodiments of the present invention, the bristles of the first brushes 211, 212, 217, 218 and/or the bristles of the second brushes 209, 210, 219, 220 can be arranged perpendicularly to the circumference of the first support member 203 and the second support member 202, respectively.

[0056] The bristles of the first brushes 211, 212, 217, 218 and/or the bristles of the second brushes 209, 210, 219, 220 may comprise nylon and can have a diameter of about 0.15 mm.

[0057] In some embodiments of the present invention, the cylindrical component 230 can comprise a blank of a photosensitive member for a reproduction device comprising a drum of an electrically conductive material coated with a coating layer comprising a photoconductor. In particular, the coating layer can comprise an organic photoconductor, for example an alkoxy/hydroxyl/halo gallium photogenerating component, wherein alkoxy can be, for example, from 1 to about 25 carbon atoms, from 2 to about 18 carbon atoms, from 2 to about 7 carbon atoms, and wherein halo comprises for example chlorine. In one particular embodiment of the present invention, the organic photoconductor can comprise (alkoxy/hydroxyl/chloro) gallium phthalocyanine pigment. The present in-

vention is, however, not restricted to such embodiments. Instead, the apparatus 200 may be applied whenever it is desirable to wipe a portion of a coating layer away from a cylindrical component.

[0058] In the operation of the apparatus 200, a is fed to the tube 207. The liquid flows out of the tube 207 into the cup 205. Subsequently, the liquid flows out of the openings 213, 214, 215, 216 onto the first brushes 211, 212, 217, 218 and fills a space between the first support member 203 and the second support member 202. Thus, the liquid is supplied to the first brushes 211, 212, 217, 218 and the second brushes 209, 210, 219, 220.

[0059] The liquid can comprise a solvent adapted to dissolve at least one material of the coating layer provided on the cylindrical component 230. In embodiments of the present invention wherein the cylindrical component 230 comprises a blank of a photosensitive member for a reproduction device, the liquid may comprise n-Butyl Acetate.

[0060] Once the space between the first support member 203 and the second support member 202 is filled with the liquid, the liquid may flow over the edge of the second support member and/or the contact ring 204. Thus, a level of the liquid in the apparatus 200 may be maintained at a level close to the upper edge of the second brushes 209, 210, 219, 220.

[0061] In other embodiments of the present invention, channels may be provided in the second support member 202. The channels may be provided at the upper edge of the second brushes 209, 210, 219, 220, below the contact ring 204. The channels may be substantially horizontal or can be slightly inclined in a downward direction. The liquid can flow out of the apparatus 200 through the channels. Hence, the level of the liquid may be maintained lower than the height of the edge of the contact ring 204.

[0062] The cylindrical component 230 is inserted into the space between the first support member 203 and the second support member 202 from above. A spacing between the first brushes 211, 212, 217, 218 and the second brushes 209, 210, 219, 220 can be smaller than a diameter of a wall of the component 230. Thus, the first brushes 211, 212, 217, 218 touch the inner circumference of the component 230 and the second brushes 209, 210, 219, 220 touch the outer circumference of the component 230.

[0063] The component 230 can be maintained in a fixed position while the apparatus 200 is rotated around the axis 206. Thus, the first brushes 211, 212, 217, 218 rotate around the inner circumference of the component 230 and the second brushes 209, 210, 219, 220 rotate around the outer circumference of the component 230.

[0064] The first brushes 211, 212, 217, 218 and the second brushes 209, 210, 219, 220 exert a mechanical force on portions of the component 230 adjacent its edge. Additionally, the brushes 209-212, 217-220 supply the liquid to the component 230.

[0065] Due to the inclined arrangement of the bristles

of the first brushes 211, 212, 217, 218 and/or the second brushes 209, 210, 219, 220, a scratching of the component 230 during the insertion of the component 230 into the apparatus 200 and during the rotation of the apparatus 200 may be reduced compared to embodiments wherein the bristles are arranged perpendicularly to the circumference of the component 230.

[0066] Since the first brushes 211, 212, 217, 218 are offset relative to the second brushes 209, 210, 219, 220 in the direction of the axis 206, a height of a first surface portion on the inside of the component 230 contacted by the first brushes 211, 212, 217, 218 is greater than a height of a second surface portion of the component 230 on the outside of the component 230 contacted by the second brushes 209, 210, 219, 220. Due to the supply of the liquid to the first brushes 211, 212, 217, 218 and the second brushes, it is insured that the liquid is brought to the portions of the component touched by the brushes 209-212, 217-220, whereas a contact of the liquid with the rest of the component may substantially be avoided. Hence, it may advantageously be avoided that the liquid affects a coating layer provided in portions of the component other than those contacted by the brushes 209-212, 217-220.

[0067] Thus, portions of the coating layer on the inner circumference of the component 230 and the outer circumference of the component 230 may selectively be wiped off, a height of the removed portion of the coating layer on the inner circumference being greater than a height of the removed portion of the coating layer on the outer circumference.

Claims

1. An apparatus (100) for dip coating a component (102) comprising:

a tank (101) for a coating solution; and
a spindle (111) adapted to move one of said component (102) and said tank (101) in a vertical direction, said one of said component (102) and said tank (101) being connected to a spindle nut (113) of said spindle (111);

characterized by

a damping element (117) provided between said spindle nut (113) and said one of said component (102) and said tank (101).

2. An apparatus for dip coating according to claim 1, wherein said damping element (117) comprises:

a bushing (114) supported by said spindle nut (113), said bushing (114) comprising a cylindrical portion (116) and a protrusion (115) running circularly around said cylindrical portion (116);
a housing (109) comprising a cylindrical opening

- (118), said cylindrical portion (116) of said bushing (114) being provided inside said cylindrical opening (118);
a damping ring (110) comprising an elastic material and being provided between said protrusion (115) and said housing (109). 5
3. An apparatus for dip coating according to claim 2, wherein said damping element further comprises a linear bearing (111) allowing a motion of said housing (109) relative to said bushing (114) in at least one direction substantially perpendicular to a longitudinal axis of said cylindrical portion (116) of said bushing (114). 10
4. An apparatus (200) for wiping an edge of a cylindrical component (230) comprising: 15
- a plurality of first brushes (211, 212, 217, 218) arranged around an outer circumference of a first support member (203), said first support member (203) being rotatable around an axis (206); and 20
- a plurality of second brushes (209, 210, 219, 220) arranged around an inner circumference of a second support member (202) connected to said first support member (203), said cylindrical component (202) being insertable between said first brushes (211, 212, 217, 218) and said second brushes (209, 210, 219, 220); 25
- characterized by**
- a liquid supply (221) adapted to supply a liquid to said plurality of first brushes (211, 212, 217, 218) and said plurality of second brushes (209, 210, 219, 220); and 30
- said plurality of first brushes (211, 212, 217, 218) being offset relative to said plurality of second brushes (209, 210, 219, 220) in a direction of said axis (206). 35
5. An apparatus for wiping an edge of a cylindrical component according to claim 4, wherein said liquid supply (221) comprises a cup (205) provided above said first support member (203) and having a plurality of openings (213, 214, 215, 216), each of said openings (213, 214, 215, 216) being located above one of said first brushes. 40
6. An apparatus for wiping an edge of a cylindrical component according to claim 5, wherein said liquid supply (221) further comprises a tube (207) running along said axis (206), an outlet opening of said tube (207) being located above said cup (205). 45
7. An apparatus for wiping an edge of a cylindrical component according to one of claims 4 to 6, wherein each of said second brushes (209, 210, 219, 220) 50

comprises a plurality of bristles, said bristles being inclined opposite a direction of rotation (220) of said first (203) and second (202) support members and in a direction of insertion of said cylindrical component (230) into said apparatus.

8. A method of wiping an edge of a cylindrical component (230) comprising:

rotating a plurality of first brushes (211, 212, 217, 218) around an inner circumference of said component (230); and
rotating a plurality of second brushes (209, 210, 219, 220) around an outer circumference of said component (230), 15

characterized by

supplying a liquid to said plurality of first brushes (211, 212, 217, 218) and said plurality of second brushes (209, 210, 219, 220); and
a height of a first surface portion of said component (230) contacted by said first brushes (211, 212, 217, 218) being greater than a height of a second surface portion of said component (230) contacted by said second brushes (209, 210, 219, 220). 20

9. A method of wiping an edge of a cylindrical component according to claim 8, wherein said supply of said liquid comprises feeding said liquid to a cup (205) provided above said plurality of first brushes (211, 212, 217, 218) and having a plurality of openings (213, 214, 215, 216), each of said openings (213, 214, 215, 216) being located above one of said first brushes (211, 212, 217, 218). 25

10. A method of wiping an edge of a cylindrical component according to one of claims 8 and 9, wherein bristles of said second brushes (209, 210, 219, 220) are inclined opposite a direction of rotation (220) of said second brushes (209, 210, 219, 220) and in a direction of insertion of said cylindrical component (230) between the first brushes (211, 212, 217, 218) and the second brushes (209, 210, 219, 220). 30

Amended claims in accordance with Rule 86(2) EPC.

1. An apparatus (100) for dip coating a component (102) comprising:

a tank (101) for a coating solution; and
a spindle (111) adapted to move one of said component (102) and said tank (101) in a vertical direction, said one of said component (102) and said tank (101) being connected to a spindle nut (113) of said spindle (111); 35

characterized by

a damping element (117) provided between said spindle nut (113) and said one of said component (102) and said tank (101).

2. An apparatus for dip coating according to claim 1, 5
wherein said damping element (117) comprises:

a bushing (114) supported by said spindle nut (113), said bushing (114) comprising a cylindrical portion (116) and a protrusion (115) running 10
circularly around said cylindrical portion (116);
a housing (109) comprising a cylindrical opening (118), said cylindrical portion (116) of said bushing (114) being provided inside said cylindrical opening (118); 15
a damping ring (110) comprising an elastic material and being provided between said protrusion (115) and said housing (109).

3. An apparatus for dip coating according to claim 2, 20
wherein said damping element further comprises a linear bearing (111) allowing a motion of said housing (109) relative to said bushing (114) in at least one direction substantially perpendicular to a longitudinal axis of said cylindrical portion (116) of said 25
bushing (114).

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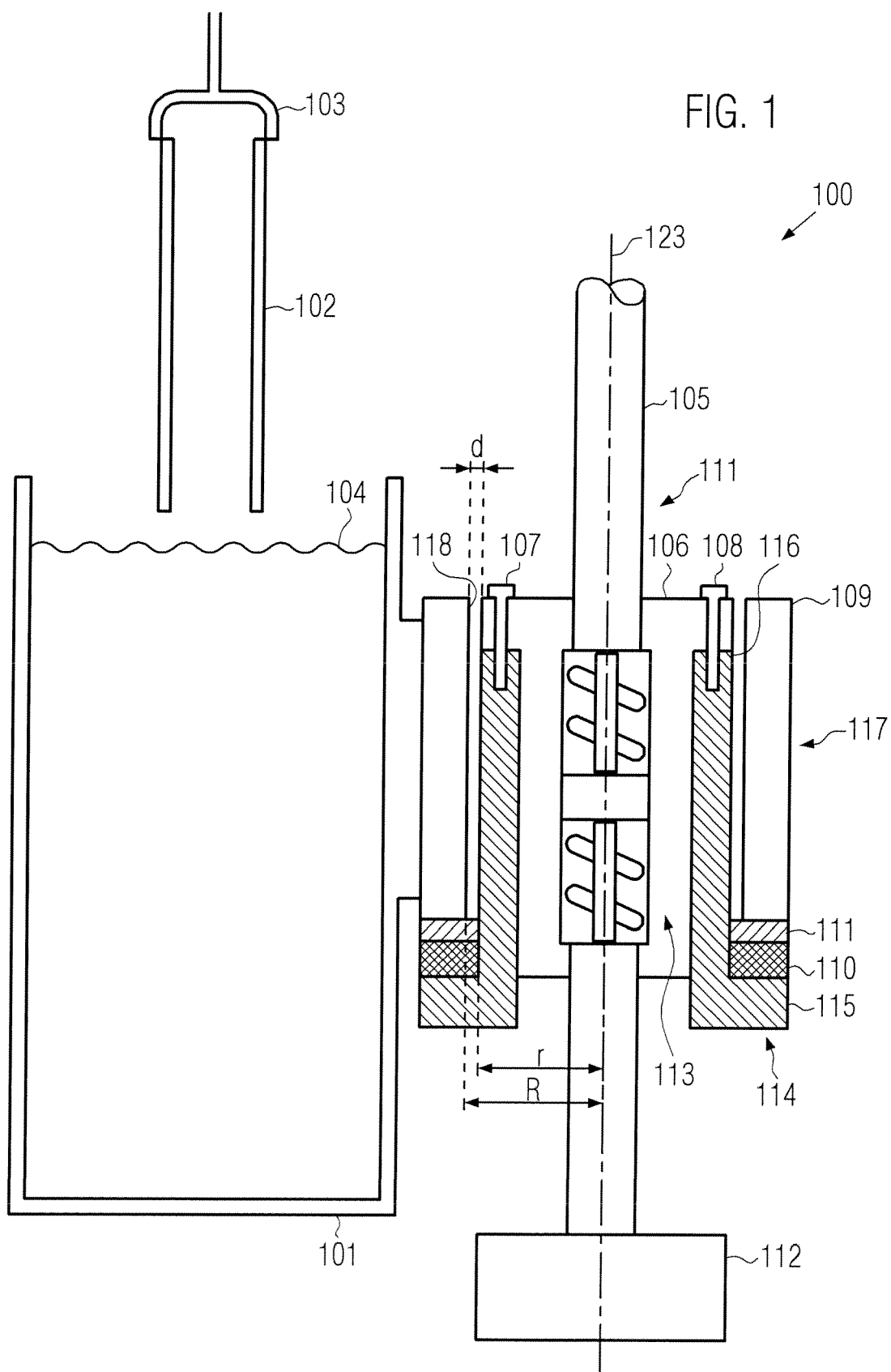
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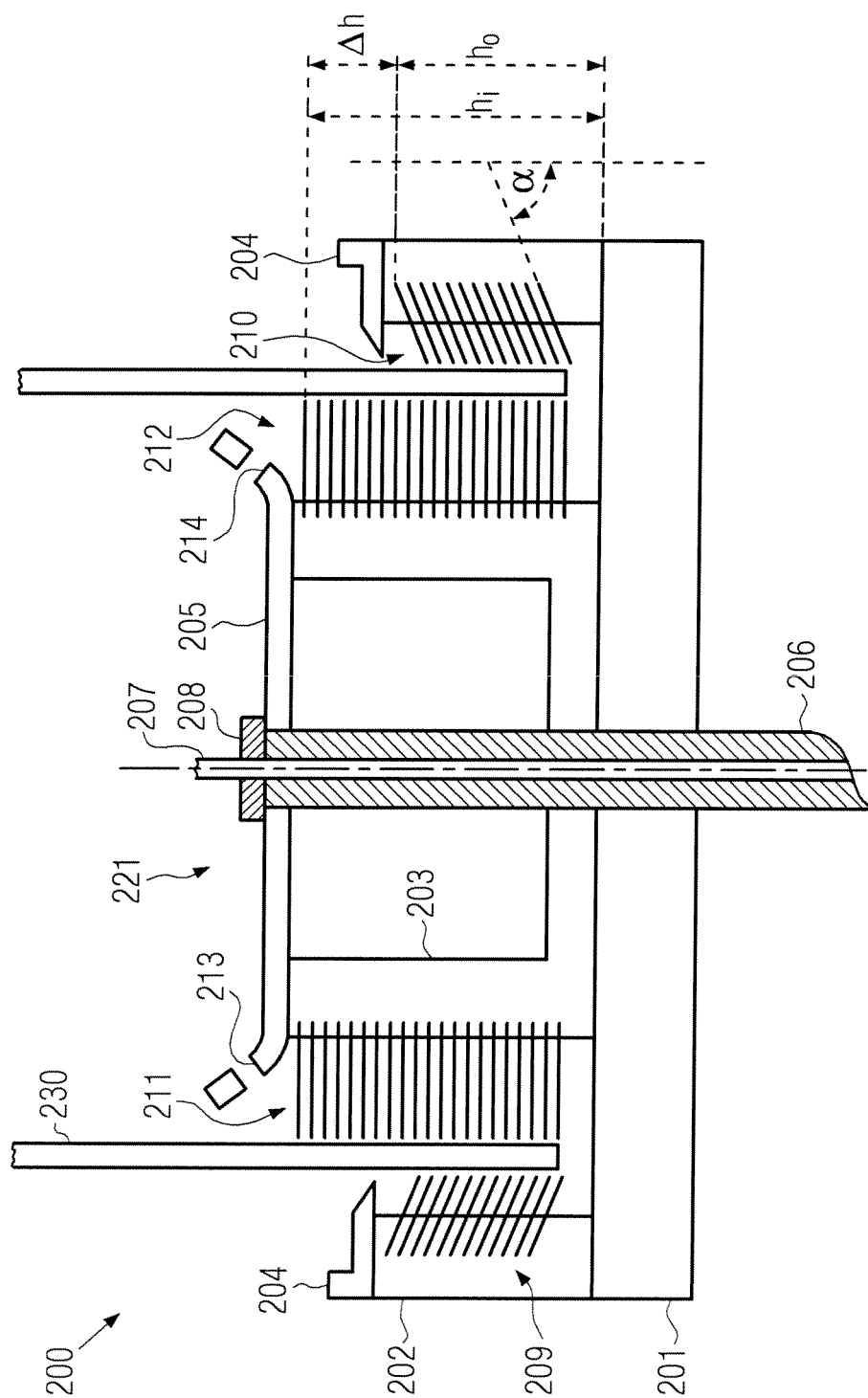


FIG. 2a

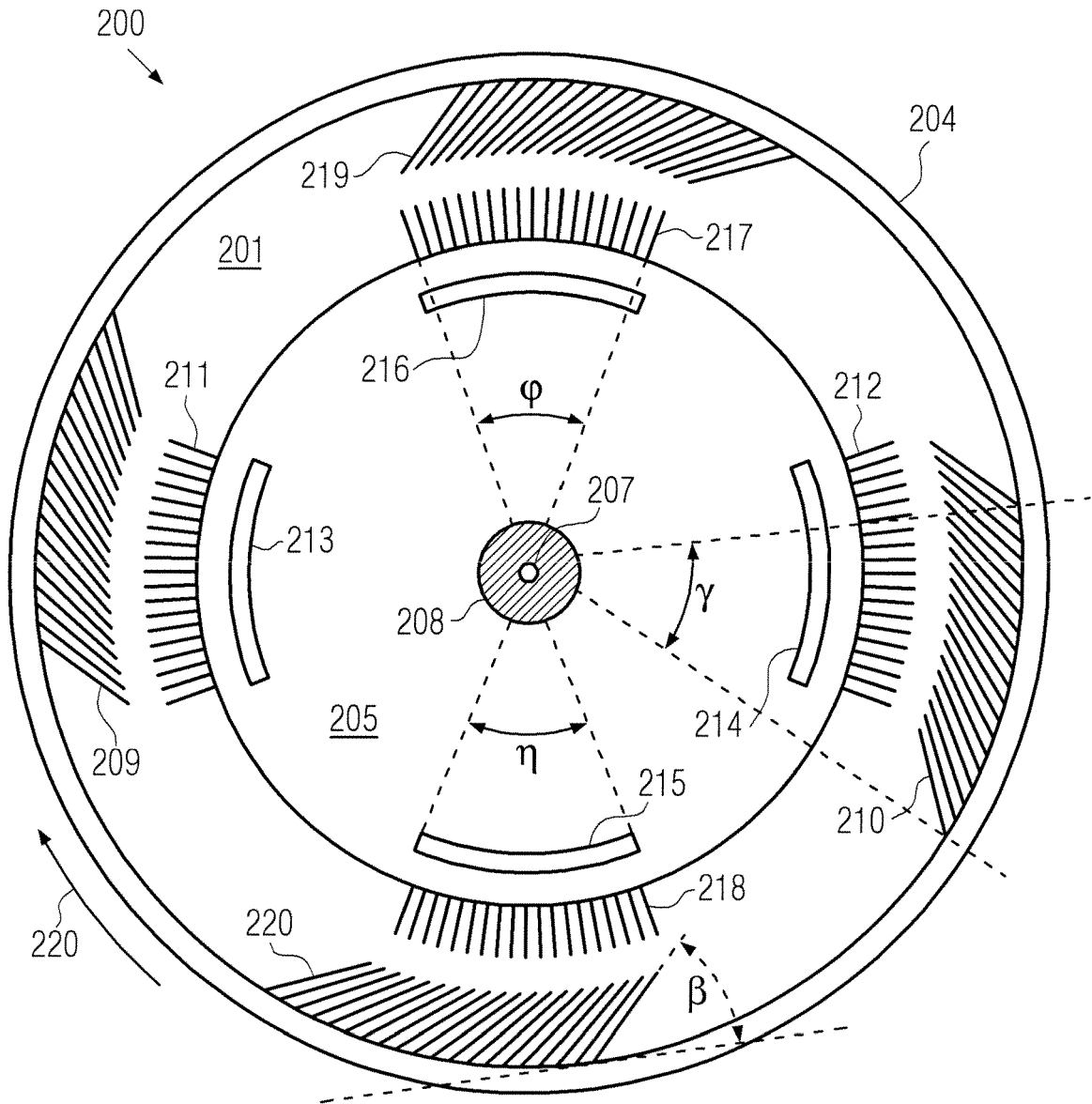


FIG. 2b



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 10 2865

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 5 185 187 A (YASHIKI ET AL) 9 February 1993 (1993-02-09) * column 3, line 30 - column 3, line 61; claim 4; figures *	1-3	B05C3/09 B05D1/18 B05C7/06 B05C9/04 B08B9/02
A	EP 0 458 393 A (AGFA-GEVAERT NAAMLOZE VENNOOTSCHAP) 27 November 1991 (1991-11-27) * column 1, line 48 - column 2, line 7 *	1-3	A46B13/00 A46B13/02
A	GB 419 074 A (WILLIAM DENIS WALKER SINCLAIR; WINSOR AND NEWTON, LIMITED) 6 November 1934 (1934-11-06) * page 1, line 15 - page 1, line 55; figures *	1-3	
A	US 2004/200018 A1 (KADINGER KELLY K ET AL) 14 October 2004 (2004-10-14) * paragraph [0005] - paragraph [0014]; figures *	4-10	
A	GB 438 602 A (THE HOBART MANUFACTURING COMPANY) 18 November 1935 (1935-11-18) * page 1, line 102 - page 3, line 110; figures *	4-10	TECHNICAL FIELDS SEARCHED (IPC) B05C B05D B08B A46B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 December 2005	Examiner Krysta, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3

Independent claim 1 refers to a dip coating apparatus comprising a spindle/nut mechanism for vertical movement of the coating tank or the component to be coated wherein a damping element is provided between the spindle nut and said tank or component.

2. claims: 4-10

Independent claims 4 and 8 refer to an apparatus/method for wiping an edge of a cylindrical component by rotating first and second brushes, the first brushes being offset relative to the second brushes.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 10 2865

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-12-2005

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