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(54) **Method and arrangement for a fiber web production line**

(57) The invention relates to a method for applying a substance to generate at least one web layer of a fiber web, in which method a substance mixture or suspension or dispersion or solution is applied on a moving surface by at least one spraying and atomizing means. In the method the at least one web layer of fiber web is generated on to moving surface by providing an atomized substance spray comprising fiber particles by the at least one spraying and atomizing means to apply the substance mixture or suspension or dispersion or solution flow as a high viscosity and high consistency mixture or suspension or dispersion or solution, which has the consistency over 5 %. In the method the substance flow is sprayed and atomized by the at least one spraying and atomizing means comprising at least one rotary application means and fiber web is generated partly or completely by applying in contactless manner fibrous substance in form of mixture or suspension or dispersion or solution. The invention also relates to an arrangement for applying a substance to form at least one web layer of a fiber web, which arrangement comprises at least one spraying and atomizing means and moving surface. The arrangement comprises at least one rotary application means for spraying and atomizing the substance mixture or suspension or dispersion or solution with high viscosity and high consistency, in which the mixture or suspension or dispersion or solution comprises fibers or fibrous particles and has the consistency over 5 %.

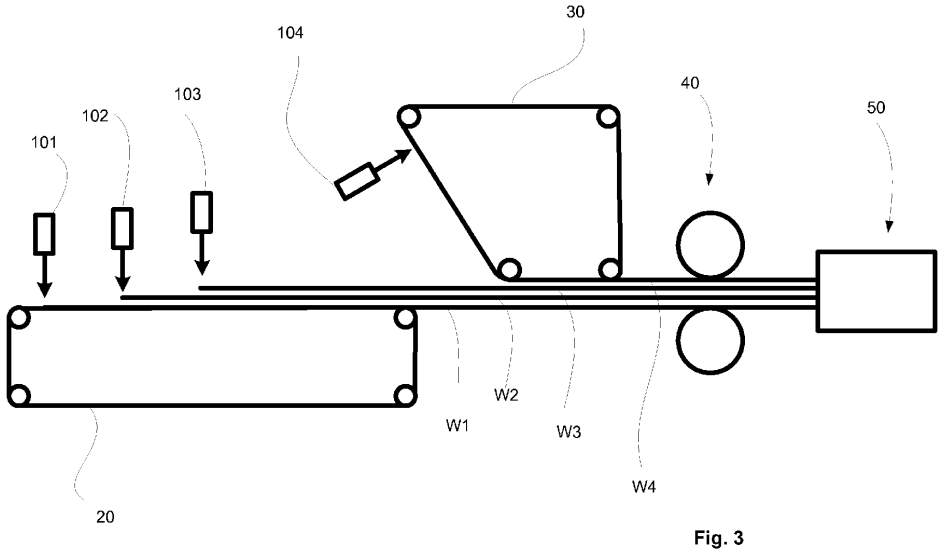

Fig. 3

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Description

[0001] The present invention relates to a method and an arrangement for a fiber web production line. Especially the invention relates to a method for applying a substance to generate at least one web layer of a fiber web. More especially the invention relates to a method according to the preamble of claim 1 and to an arrangement according to the preamble of claim 6.

[0002] As known from the prior art fiber web producing processes typically comprise an assembly formed by a number of apparatuses arranged consecutively in the process line. A typical production and treatment line comprises a head box, a forming section and a press section as well as a subsequent drying section and a reel-up. The production and treatment line can further comprise other devices and/or sections for finishing the fiber web, for example, a pre-calender, a sizer, a coating section, a final-calender. The production and treatment line also comprises at least one slitter-winder for forming customer rolls as well as a roll packaging apparatus. In this description and the following claims by fiber webs are meant for example a paper and board webs.

[0003] In atomization and spraying technology a term spray means a system of liquid droplets in gaseous phase i.e. a liquid-air mixture or dispersion, which is provided by atomization process. Further, the sprayed liquid may comprise a solution or mixture of several liquids or fluids. In addition, spray may contain solid particles, for example as a result of atomizing solid containing mixtures or suspensions or dispersions or solutions.

[0004] Spraying process comprises from two sub processes, namely the atomization process itself and the spray particle transfer process to the object surface. The atomization process i.e. disruption of liquid or solid phase into smaller particles or droplets is typically based on aerodynamic shear forces and friction between sprayed material and other medium, typically surrounding gas. Speed differences between the two mediums are created in various ways, like by hydraulic pressure in pressure nozzles and by pneumatic air pressure in air atomization nozzles. In the atomization processes, the sprayed liquid is influenced by cohesive forces resisting droplet formation. The disruptive forces, like shear forces or inertial forces created by the atomizer tend to break the continuous liquid phase, and as soon as disruptive forces are greater than the cohesive forces droplets are formed. The fluid viscosity and surface tension have an effect on the droplet formation and spray generation.

[0005] The other subprocess in the spraying, the spray particle transfer to the object surface, utilize typically means, like guiding air flows or assisting electrostatic charge fields, to control spray jet shape, movement and setting to the target surface.

[0006] Prior art known atomizers include for example a single fluid hydraulic pressure nozzle, a two-fluid gas atomizing nozzle, a centrifugal or rotary atomizer, an ultrasonic atomizer and an electro hydrodynamic atomizer. In hydrodynamic pressure atomization with single fluid nozzles the liquid is accelerated by liquid's own pressure, and the liquid's speed, kinetic energy and friction against surrounding medium are the driving mechanisms of atomization. In pneumatic or gas assisted atomization with two-fluid nozzles the atomizing gas flow is accelerated and injected adjacent to the atomized fluid. The mixing of air and gas can be either internal or external. The speed difference, friction and shear forces between the two mediums are main mechanisms of atomization. In centrifugal, or rotary, atomization the fluid is applied on a fast spinning disk or wheel, where fluid picks up momentum as the centrifugal force accelerates the fluid, and fluid flows towards the outer edge of the disk, where eventually the droplet formation and atomization takes place at as the fluid leaves the disk.

[0007] In fiber web production it is known to apply substances onto the fiber web in a spray form by fluid nozzles. For example water, chemicals, diluted solutions of starch, coating substances are applied onto or into the fiber web by nozzles. In order to provide a smooth and even applied layer the substance spray is atomized by utilizing hydrodynamic or pneumatic atomizing principle, typically using an array of several nozzles. Fluid nozzles are limited in flow rate to certain values and prone to wear and to spray quality deterioration, particularly if spraying substance containing solid hard particles, like coating pigments, fillers and other minerals. One problem related to nozzle sprays is thus the wear of nozzles, particularly when spraying mixtures or suspensions or dispersion or solutions containing hard solid particles, such as minerals. Typically, pulp mixture or suspension or dispersion or solution contains fillers, pigments and other hard inorganic particles like sand and other impurities coming for example from the recycling process.

[0008] Typically in fiber web production the fiber web is formed on a forming section after the head box, which feeds the fiber suspension to a moving wire. The task of the forming section is to remove water from the suspension fed by the headbox keeping a good formation. The consistency of fiber suspension fed onto the forming section is usually 1% and, after the forming section, the consistency of the web formed on the forming section is usually 18- 20 %. The higher feeding consistency usually makes the formation worse, which has a negative effect on web end properties. Thus, higher feeding consistencies than 1.5 % are avoided in the typical fiber web production.

[0009] In US patent 6237525 is disclosed an ultrasonic atomizer apparatus for coating fiber webs with a large area vibrating plate to provide increased atomizing power and atomized throughput flow rate.

[0010] In US patent 3475198 is disclosed a rotary atomizing process and dispensing equipment for applying liquid binders in manufacturing of nonwoven fiber webs. This known process is for treating a loose fiber structure in a web, in which the fibers should not be disturbed by air flows, and for applying high viscous liquid binders that

are hard to atomize, like starch and polyvinyl-acetate. In this known arrangement a rotary atomizer is used to avoid problems of nozzle clogging and to increase obtained flow rate with use of high voltage electrostatic field for improving spray particle transfer efficiency.

[0011] In patent application publication US 2001/0048976 is disclosed a method and device for spray application of coating medium in liquid, powdered or solid form into a moving web, for example a paper or board web, in which as spray device a single fluid nozzle, a two-fluid nozzle or a rotary disk applicator is used and the spray transfer is enhanced by electric forces created by charging device.

[0012] In US patent 3484275 is disclosed a method of applying coating to moving, for example paper web by electrostatic deposition, in which atomized coating is transferred under influence of electrostatic forces and atomizing can be done for example by a rotating disk.

[0013] In US patent 6866207 is disclosed a swirling gas atomizer for dispensing liquids and highly viscous or otherwise difficult to dispense solutions of liquids and solids to a mist with desired properties. An apparatus is disclosed for spraying of liquids and solution containing solid particles such as paper fibers and fillers for high consistency paper manufacturing, paper surface treatments, mixing of chemicals and chemical reactions. The apparatus allows web forming in the paper machines with consistencies reaching up to 15%. The atomizer comprises elongated tubing, an intake orifice disposed on one end of the tubing, a nozzle assembly affixed to the opposite end of the tubing, a first nozzle element extending from the nozzle assembly at an angle with respect to the axis of the tubing, a swirl wheel and cone former concentrically disposed with respect to the tubing and adopted to receive propellant gas from the first nozzle element, and the cone former comprising a swirl ledge angled inwardly with respect to the axis of the tubing.

[0014] In US patent 7217342 is disclosed a process that can utilize current paper manufacturing facilities by adding consecutive spray apparatuses that can make and/or enhance the manufacture of a multitude of specific paper product on-line, or improve the properties of already formed paper products with consequent spraying steps on-line or off-line. An apparatus is disclosed for paper making comprising a spray box, a paper web substrate moveable below the spray box, multiple nozzles mounted inside the spray box for cross-sectional profiling achieved by means of each nozzle spraying a controlled amount or suspended solids including fibers, minerals and chemicals onto the substrate, the spray box including a substrate entry point and a substrate exit point, the entry and exit points comprising respectively adjustable entry and exit gaps disposed above the substrate, aerosols emitting from the nozzles, means to remove the aerosols from the spray box, a device for smoothening the surface characteristics of the suspended solids having a distal end, the distal end being adjacent a point on one side of the substrate, a rolled disposed on the other side of the substrate and in abutment therewith, and the adjacent point being space laterally along the substrate from the location of the abutment.

[0015] The main problem in the known applications in spraying solid containing mixtures or suspensions or dispersions or solutions in practical paper and board production is the limited nozzle flow capacity. Currently, the best air atomizing nozzles producing acceptable spray quality have mass flow rate about 0.5 kg/minute (0.008 kg/s) per nozzle. For example, forming a 5 g/m^2 (dry) material layer in a fiber web with a speed of 1200 m/min require dry mass flow 0.1 kg/s per meter in width; applying same dry material amount in a mixture or suspension or dispersion or solution of 15 % consistency, the material flow is 0.67 kg/s per meter in width. This means that about 80 nozzles per meter in width are needed. This is the most optimistic case, in practice the realistic consistency is about 8 %; therefore the amount of nozzles will increase to 150 pcs / m. Of course, this amount of nozzles would be arranged in several rows, but still this leads to very complicated and large nozzle systems.

[0016] Another problem with the conventional nozzles is the limited operating range regarding the consistency and viscosity. The practice has shown that high viscosity liquid materials, like starch solutions can be sprayed typically up to viscosity of 50-100 cP by using low pressure air atomizers. The high pressure hydraulic nozzles can however spray higher viscosity and consistency substances, for example coating colors up to 60% consistency.

[0017] Yet another problem of the used spray nozzles is narrow coverage area. Typically, large number of spray nozzles need to be assembled dense array, effective division in machine cross direction being for example only 20-50 mm.

[0018] The high consistency fiber mixtures or suspensions or dispersions are difficult to pump and atomize, since the fibers tend to form a networked structures. If the flow speed is too low, plugging may result and fluidization is necessary before pumping or spraying.

[0019] Fiber containing mixtures or suspensions or dispersions or solutions have typically very high viscosity and they have shear thinning character. In measurements done (measured by the Brookfield viscometer at 100 rpm, using spindle no 2), typical viscosity has been found to be clearly over 100 cP, typically 500 - 10000 cP or even more, at consistency of 5 %.

[0020] Due to these above mentioned reasons, it has not been possible to apply fiber containing substances at high consistency, typically over 5%, or at high viscosity, typically 100 - 1000 cP or more. As mentioned above, spraying and atomizing applications in fiber web production are limited due to low flow rate (about 0.5 l/min per nozzle), usable consistency (typically below 5-8% for air atomizing nozzles) and viscosity (below about 100 cP). The substances applied by fluid nozzles have thus in practice been applied as low consistency mixtures or suspensions or dispersions or solutions of water.

[0021] In practice coating and sizing mixtures, suspensions or solutions have been applied by using contact applying methods. Disadvantage in these contact applying methods is high cost of the equipment needed and lower runnability of the fiber web.

[0022] An object of the present invention is to create a new method and a new arrangement for applying substances, which have high consistency, over 5 %, advantageously over 10%, in form of mixture or suspension or dispersion or solution, to generate at least one web layer of a fiber web.

[0023] Furthermore an object of the present invention is to provide method and arrangement for applying substances in fiber web production that is utilizable in generating of the fiber web.

[0024] In order to achieve the above objectives the method for applying a substance to generate at least one web layer of a fiber web is mainly characterized by the features of the characterizing part of claim 1. The arrangement for applying a substance to generate at least one web layer of a fiber web is in turn mainly characterized by the features of the characterizing part of claim 6. Further advantageous aspects and features of the invention are presented in the dependent claims.

[0025] In this description and the following claims by fiber and fiber containing material is meant substance comprising fibers, fiber-like materials of natural or synthetic origin, fine fractions of fibers, screened to suitable coarseness, nanocellulose in its various forms, NFC (nanofibrillated cellulose); MFC (microfibrillated cellulose), refined or beaten pulps, chemically or mechanically processed pulps. The fiber containing material may also comprise for example fillers, pigments and binders. It should also be noted that a layer of a fiber web in this description and the claims is used mainly in the meaning of the manufacturing sense of the fiber web and thus in the finished fiber web product a layer is not necessarily visible or separable and the layers may not have a distinct border as two layers may have combined layer structure in between of them.

[0026] According to the invention in the method for applying a substance to generate at least one web layer of a fiber web, a substance in form of mixture or suspension or dispersion or solution is applied on a moving surface by at least one spraying and atomizing means. In the method the at least one web layer of fiber web is generated on to moving surface by providing by the at least one spraying and atomizing means an atomized substance spray comprising fiber and/or fibrous particles to apply substance mixture or suspension or dispersion or solution flow as a high viscosity and high consistency mixture or suspension or dispersion or solution, which has the consistency over 5%, preferably over 10%, and the substance flow is sprayed and atomized by an applicator comprising at least one rotary application means and that fiber web is generated partly of completely by applying fiber containing substance in form of mixture or suspension or dispersion or solution by a contactless method.

[0027] According to the invention the arrangement for applying a substance to generate at least one web layer of a fiber web comprises at least one atomizing means and moving surface and at least one rotary application means as an applicator for spraying and atomizing the substance of mixture or suspension or dispersion or solution with high viscosity and high consistency, in which the substance contains fiber particles and/or fiber-like particles and has consistency over 5%, preferably over 10%.

[0028] In the method and the arrangement according to the invention the materials to be applied with a rotary atomizer are in the form of mixtures or suspensions or dispersions or solutions containing fiber and/or fibrous particles and organic or inorganic solid particles, in particular other fiber web raw material components.

[0029] In the method advantageously the at least one rotary application means is a rotary atomizer, which creates mist-like substance flow based on centrifugal forces and atomizing is provided by the rotational movement creating high speed to the substance. The centrifugal forces, and the atomization, can be provided in the rotary applicator by various rotating elements, such as rotor, disk, cup, bowl, blade wheel, vaned wheel, impeller, porous wheel or similar element.

[0030] In rotary disk atomizers the substance to be atomized is applied on a rotating disk or wheel or corresponding rotating element, which is rotated at high speed, which in turn accelerates the liquid and discharges spray at the disk edge. Droplet size in atomizing can be controlled by the rotational speed. The rotating elements may have various designs. Rotary bell cup atomizers comprise a rotary disk atomizer with bell shaped cup inside of which cup liquid to be atomized is supplied. When the cup is rotated centrifugal forces push liquid film along the cup surface towards the outer edge, where liquid is ejected as small droplets and spray is created. The spray can be additionally controlled by shaping air or by electrostatic assistance.

[0031] According to an advantageous feature as rotary application means a rotary disk atomizer or a rotary bell cup atomizer is used high viscosity fluid can be atomized and a high flow rate is provided. Also high consistency fluids can be atomized; the solid content can be up to 70 % and thus less water needs to be removed and dried and energy savings are achieved.

[0032] According to an advantageous feature rotary atomizer contains at least one rotating element, which is for example a flat disk, a bowl, a cup, an impeller, a vaned wheel or a porous wheel.

[0033] According to one advantageous feature of the invention, the substance to be applied to web contains at least two of the following materials: organic or inorganic fibers, organic or inorganic fillers, pigments and binders, solvent fluids (like water) and additional materials like chemicals needed in fiber web making.

[0034] According to one advantageous feature of the

invention, the fibers are the main component of the applied mixture, which is in the form of mixture or suspension or dispersion at 5 - 25 % consistency.

[0035] According to one advantageous feature of the invention, the substance applied contains fibers of following kind: short fibers, long fibers; nanosellulose fibers, nanofibrillated cellulose (NFC); microfibrillated cellulose (MFC); mechanical pulp or chemical pulp or combination of them, or recycled fibers.

[0036] In the method according to the invention high flow rate for spraying to substance to be applied is advantageously used. The flow rate is 0.5 - 1000 kg/min per applicator unit. In spraying thin surface layers the flow is advantageously 0.5-10 kg/min, in forming single web layers the flow is advantageously 10-100 kg/min and in forming thick main bulk layers or the whole web structure the flow is 100 - 1000 kg /min.

[0037] In connection with the invention advantageously uniformity and particle size of atomization is controlled by controlling the rotation speed of the rotating application means. In the method according to the invention the droplet size for the atomized fluid substance is about 20 - 200 μm, advantageously 30 - 100 μm. When applying fluid-like substances containing larger solid particles, like fiber mixtures or suspensions or dispersions, the solid phase particle size in the spray remains unchanged, but the fluid phase is atomized to smaller particles, typically to 20- 200 μm droplets.

[0038] Advantageously all layers of the fiber web are generated by rotary application means. In this case the fiber orientation of the fiber web is largely random and isotropic material properties are achieved. This is very beneficial regarding the dimensional stability, particularly by reducing the sheet curling and dimensional changes in CD and MD directions of paper sheets.

[0039] Advantageously when less than all layers are generated according to this advantageous aspect at least the one layer is generated according to this aspect by using rotary application means and other layers can advantageously be generated by conventional means like wet forming or alternatively, by air laid forming, or foam forming, by which a very porous web is achieved.

[0040] According to an advantageous feature the substance comprising fibers and possible additives is applied as a mixture or suspension or dispersion by the rotary application means on to a moving surface for example on to the forming wire or directly on the fiber web. According to an advantageous feature on the other side of the moving surface in relation to the rotary application means suction means, like vacuum box, can be provided.

[0041] When generating a web layer or layers of the fiber web in accordance with this advantageous aspect a fluffy and bulky fiber web is produced. When generating more than one web layer in accordance with advantageous aspects of the invention a layered structure of a fiber web with web layers of different properties can be provided by applying with successive rotary application means substances of different compositions.

[0042] Also, when generating all layers of the fiber web according to this aspect, the head-box is no longer needed in the fiber web production line.

[0043] According to an advantageous feature a high viscosity barrier layer is applied as water mixture or suspension or dispersion or solution of high solids content and high viscosity by the rotating application means on the fiber web. The barrier layer is a thin, dense polymer layer and it comprises for example polymers, like polyolefin or polyethylene, polypropylene, PVOH or PVA or special polymers or nanocellulose in various forms.

[0044] The application by the rotary application means can be direct i.e. the substance is applied directly on the fiber web or indirect i.e. the substance is first applied on a moving surface, for example wire, felt, belt, metal belt, or on a roll, from where the substance is later transferred to the fiber web.

[0045] According to an advantageous feature the applied substance is heated before applying it by the rotary application means, which results as better flattening, setting and faster drying of the applied layer.

[0046] According to an advantageous feature, substance is mixed with another substance in the applicator's rotor element, providing a local mixing process in the applicator. For example, a fast reactive chemical can be mixed as the last stage just before atomization and application on to the web. Rotary element works as a rotary mixer and a chemical reactor. The mixed substances are fed to the mixer through separate feed lines. Second mixed substance can be for example liquid, filler, fiber, chemical etc.

[0047] According to an advantageous feature of the invention, as soon as the applied substance is atomized and dispensed from the atomizer, applied substance starts drying due to water evaporation while still being airborne, and at least partly dries before the substance is laid at the fiber web. The evaporation is enhanced by the heating, and droplet size control.

[0048] According to one aspect of the invention, the substance is applied to the fiber web, which is a tissue web, a paper web or a board web, or specialty paper or specialty board product.

[0049] Furthermore the method and arrangement according to the invention is advantageously utilized for applying substances in the fiber web production in coating or sizing of fiber web by a layer of coating containing fibrous or fiber based materials. According to one advantageous feature of the invention, the coating color is the main component of the applied substance, which is in the form mixture or suspension or dispersion or solution at 5 - 70 % consistency. According to one aspect of the invention, the sizing agent is the main component of the applied substance, which is in the form liquid mixture or suspension or dispersion or solution of sizing agents at 5 - 30% consistency.

[0050] By the invention and its advantageous aspects and features several advantages are achieved. The invention provides for an effective means for applying a

substance of high consistency and high viscosity by spraying and atomizing. The amount to be sprayed can be controlled independently by infeed flow rate. The particle size of atomized spray can be controlled separately by the rotation speed of the rotary element. The arrangement construction needed for the method is simple, basically only pressurized air or gas and an inlet piping to the rotary application means are needed. The invention also provides for high consistency and viscosity forming possibilities with better retention and less circulation water. Also new types of fiber web products can be produced, for example replacing pigment coating by fiber containing coatings. Further advantages are achieved as the nozzles of advantageously used rotary atomizers are not sensitive to plugging or wearing, which results savings in downtime of machine, maintenance work and cost.

[0051] In the inventive method and arrangement the at least one spraying and atomizing means provides an advantageous atomizing system having higher throughput flow rate than conventional fluid nozzle technology, being over 0.5 kg/min per nozzle, favorably 0.5-10 kg/min, particularly favorable 10-100 kg/min and in extremely demanding applications 100-1000 kg/min per nozzle, enabling to spray materials at high flow rate to generate at least one web layer of the fiber web, making spray forming a realistic option, and additionally reducing the number of nozzles and saving assembly space. Furthermore the advantageous atomizing system atomizes high consistency and high viscosity substances, like liquids and liquid-solid systems, mixtures or suspensions or dispersions or solutions and the like, effectively to generate at least one web layer of the fiber web, the consistency of the said substances being over 5 %, advantageously over 15 % and even over 20 %, said materials being applied on to a moving surface, for example on to a fiber web machine fabric or on the fiber web. Particularly the invention provides for a new kind of manufacturing and finishing processes of fiber webs, as well as manufacturing completely new value added fiber products, produced efficiently in large volumes in web like manner. Generally by having an atomizer with ability to atomize high consistency and high viscosity mixtures or suspensions or dispersions or solutions, having high atomizing throughput flow rate, being installable in compact way in small space, having low feed line pressure, being insensitive to applicator clogging and dirt build-up and fouling and being easy to clean many advantages are achieved.

[0052] The invention is utilizable in fiber web production for different types of end products, for example for packaging boards with bulky or multi-layer structure or lamination or barrier layers, for liquid and household packaging boards with barrier layer or polymer coatings, high quality surface and lacquering, for beverage and food packaging boards with barrier layers and high strength, for cosmetic and luxury boards with lacquering, barrier layers, polymer coatings or lamination layers, for pharmaceutical and other special packaging boards with barrier layers or lamination, for decorative boards with special coatings or painting like effects and for graphical papers and boards. In particular, the invention is applicable in producing bulky paper, board or tissue webs.

[0053] The invention can also be utilized in finishing the fiber web, in which at least one web layer of the fiber web has been provided according to the invention such that a layer of coating or sizing substance is applied on to the fiber web by at least one rotary application means and provide the fiber web thus with a sizing or coating substance, preferably of high consistency and high viscosity. The coating substance comprises pigment, binders, fillers and solvent and is applied as water mixture or suspension or dispersion with high solids content and high viscosity. The sizing substance comprises starch or latex or other sizing agents and it is applied as water mixture or suspension or dispersion or solution. The sizing or coating substance can also be applied by several successive rotary means to create a layered sizing or coating on the fiber web.

[0054] The rotary application means is provided in location/-s of the fiber web production line depending on the desired purpose of the application and the application is advantageously done in forming section of the fiber web production line. In forming section is advantageously produced the main layers of the fiber web by the rotary application means and in pressing or drying section an additional layer can be applied. In the finishing section advantageously the fiber web is sized and/or coated by the rotary application means

[0055] In the following the invention is explained in more detail with reference to the accompanying drawing in which

In figure 1 is schematically shown one example of a rotary application means,

In figure 2 is schematically shown another example of a rotary application means,

In figure 3 is schematically shown an example of part of a fiber web production line with arrangements according to examples of the invention and

In figure 4 is schematically shown another example of part of a fiber web production line with arrangements according to examples of the invention.

[0056] In the following description by same references are referred to same or corresponding parts or part-components of the examples unless otherwise mentioned.

[0057] In figure 1 is schematically shown one example of a rotary application means 10, which is a rotary disk atomizer and comprises a disk 11 that is arranged rotatably on a shaft 12. The rotary disk atomizer further comprises an actuator 13 for providing the rotational movement of the disk 11. Substance to be applied is supplied on the rotating disk 11 by a fluid tube 15 or corresponding inlet channel. The control means 14 controls the rotation speed of the disk 11 by controlling the actuator 13 and the control means 16 controls the substance amount to be supplied on the disk 11. When the substance to be applied to generate the fiber web or to be applied on to

the fiber web has been supplied via the fluid tube 15 on the rotating disk 11, centrifugal forces spray and atomize the substance over the edge of the disk and to the desired moving surface, for example on to a forming wire or on the fiber web.

[0058] In figure 2 is schematically shown one example of a rotary application means 10, which is a rotary bell cup atomizer and comprises a bell cup 17 that is arranged rotatably on a shaft 12. The rotary disk atomizer further comprises an actuator 13 for providing the rotational movement of the bell cup 17. Substance to be applied is supplied to the bell cup 17 by a fluid tube 15 or corresponding inlet channel. The control means 14 controls the rotation speed of the bell cup 17 by controlling the actuator 13 and the control means 16 controls the substance amount to be supplied in to the bell cup 17. When the substance to be applied to generate the fiber web or to be applied on the fiber web has been supplied via the fluid tube 15 to the bell cup 17, centrifugal forces transfer the substance on the inner surface of the bell cup 17 towards the edge, and throw the substance over the edge, atomizing and spraying the substance to the desired moving surface, for example on to a forming wire or on the fiber web.

[0059] In figures 3 and 4 is schematically shown some locations of a fiber web production line where the arrangement according to the invention can be located and where the method according to the invention can be utilized.

[0060] In the example of figure 3 rotary atomizers 101, 102, 104, 104 each are located to atomize and spray fiber substance to generate respective web layers W1, W2, W3, W4 of the fiber web. The first rotary atomizer 101 is located such that it sprays the substance on to a moving wire 20 to generate first web layer W1 or the fiber web. The moving wire 20 can be for example a forming wire type of wire and it has been arranged as a continuous, moving loop guided by its guide rolls. The following rotary atomizers 102, 103 spray the fiber substance to generate next web layers W2, W3. The fourth rotary atomizer 104 is also as the first rotary atomizer 101, arranged to spray fiber substance on to a wire 30, which then transfers the respective web layer W3 on to the fiber web. In press section 40 the web layers W1, W2, W3, W4 are pressed to remove water and in dryer section 50 the fiber web is dried. Inside the wire 20, 40 loops vacuum devices can be arranged for suction to improve the stability of the web layer W1, W4 on the wire 20, 30 and also if needed to remove water.

[0061] In the example of figure 4 rotary atomizers 10 are located to atomize and spray fiber substance to generate web layers of a fiber web W. The first web layer is generated by a head-box 60 and the first rotary atomizer 10a is located such that it sprays the substance on to the moving fiber web W supported by a forming wire 20 to generate next web layer. The moving wire 20 can be for example a forming wire type of wire and it has been arranged as a continuous, moving loop guided by its guide rolls. The following rotary atomizer 10b spray the fiber substance to generate next web layer, which is also arranged to spray fiber substance on to a wire 30, which then transfers the respective web layer on to the fiber web W. Inside the wire 20, 40 loops vacuum devices can be arranged for suction to improve the stability of the web layer W1, W4 on the wire 20, 30 and remove water. In press section 40 the web layers are pressed to remove moisture and in dryer section 50 the fiber web is dried. Further web layers are generated after the dryer section 50 by further rotary atomizers 10c and 10d. In this example the first rotary atomizer following the dryer section 50 sprays the fiber substance directly on to the fiber web and the next rotary atomizer generates first the layer on to the wire 70, which transfers the layer on to the fiber web. The substance to be sprayed after the dryer section 50 can be for example a sizing or coating substance with fiber or fiber-like particles. Each rotary atomizer 10 comprises one or more atomizing and spraying units. In the example of this figure the rotary atomizers 10a and 10b, comprise several units. It should be understood that the process line layout, the locations and the number of rotary units are only examples of possible implementations.

Claims

1. Method for applying a substance to generate at least one web layer of a fiber web, in which method a substance mixture or suspension or dispersion or solution is applied on a moving surface by at least one spraying and atomizing means, **characterized in, that** in the method the at least one web layer of fiber web is generated on to moving surface by providing an atomized substance spray comprising fiber particles by the at least one spraying and atomizing means to apply the substance mixture or suspension or dispersion or solution flow as a high viscosity and high consistency mixture or suspension or dispersion or solution, which has the consistency over 5 %, that in the method the substance flow is sprayed and atomized by the at least one spraying and atomizing means comprising at least one rotary application means and that fiber web is generated partly or completely by applying in contactless manner fibrous substance in form of mixture or suspension or dispersion or solution.

2. Method according to claim 1, **characterized in, that** in the method by the rotating application means the substance flow is applied in mist-like form and the droplet size of the fluid component in the substance flow is 20- 200 μm.

3. Method according to claim 1 or 2, **characterized in, that** in the method the at least one rotary application means is a rotary atomizer, which creates the mist-like substance flow based on centrifugal forces and

atomizing is provided by the rotational movement creating high speed to the substance mixture or suspension or dispersion or solution.

4. Method according to claim 3, **characterized in, that** in the method high flow rate for spraying to substance to be applied is provided, which flow rate is 0.5 - 1000 kg/min and advantageously 0.5-100 kg/min per nozzle.

5. Method according to any of the previous claims, **characterized in, that** in the method the applied substance is heated before applying it by the rotary application means.

6. Arrangement for applying a substance to form at least one web layer of a fiber web, which arrangement comprises at least one spraying and atomizing means and moving surface, **characterized in that** the arrangement comprises at least one rotary application means for spraying and atomizing the substance mixture or suspension or dispersion or solution with high viscosity and high consistency, in which the mixture or suspension or dispersion or solution comprises fibers or fibrous particles and has the consistency over 5 %.

7. Arrangement according to claim 6, **characterized in that** the at least one rotary application means is a rotary atomizer, which creates the mist-like substance flow based on centrifugal forces and atomizing is provided by the rotational movement creating high speed to the substance.

8. Arrangement according to claim 6 or 7, **characterized in that** the rotary atomizer is a rotary wheel atomizer, a rotary disk atomizer or a rotary bell cup atomizer.

9. Arrangement according to any of claims 6 - 8, **characterized in that** the arrangement further comprises heating means located before the rotary application means for heating the substance mixture or suspension or dispersion or solution before its application.

10. Arrangement according to any of claims 6 - 9, **characterized in that** the rotary application means are located in the fiber web production line depending on the desired purpose of the application, advantageously in forming section of the fiber web production line.

11. Arrangement according to any of claims 6 - 10, **characterized in that** the moving surface is a fiber web.

12. Arrangement according to any of claims 6 - 10, **characterized in that** the moving surface is a forming wire, belt, felt or other moving fabric.

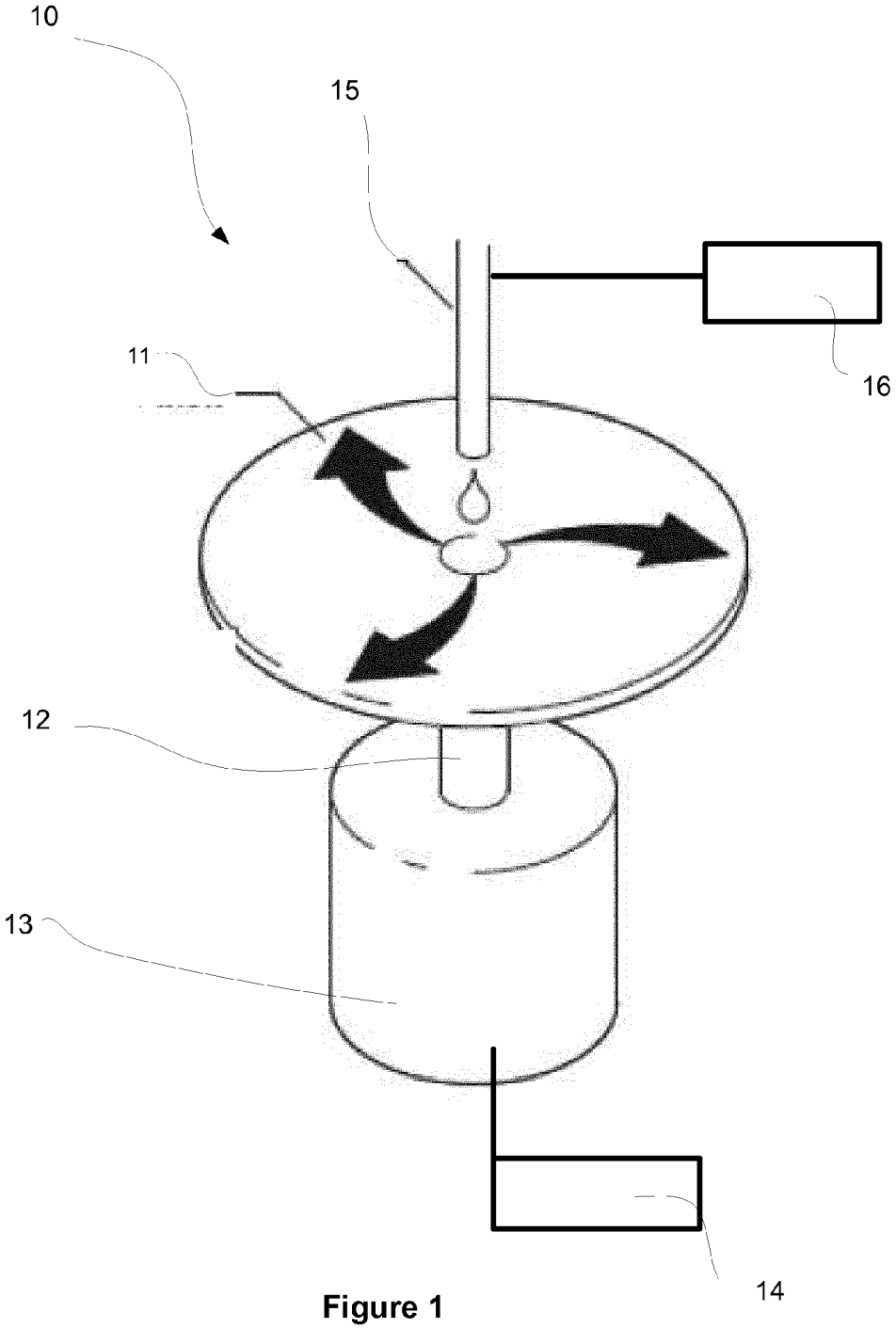

Figure 1

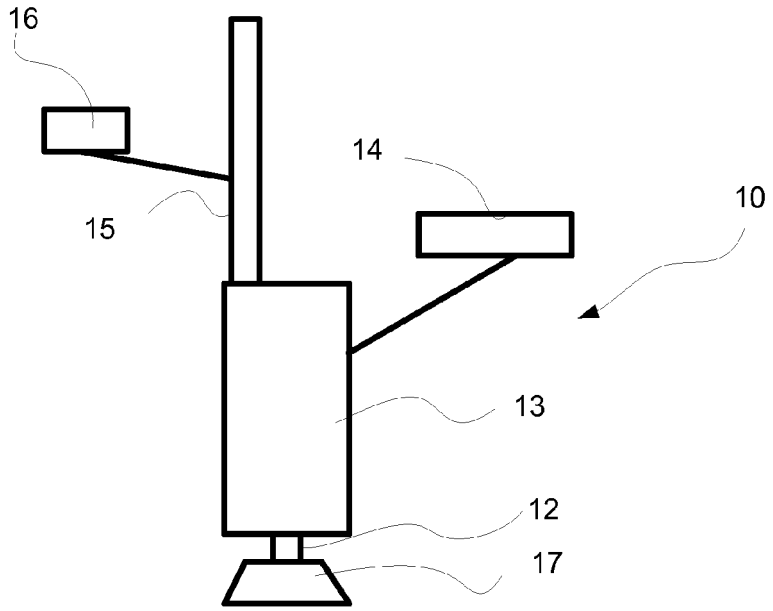

Fig. 2

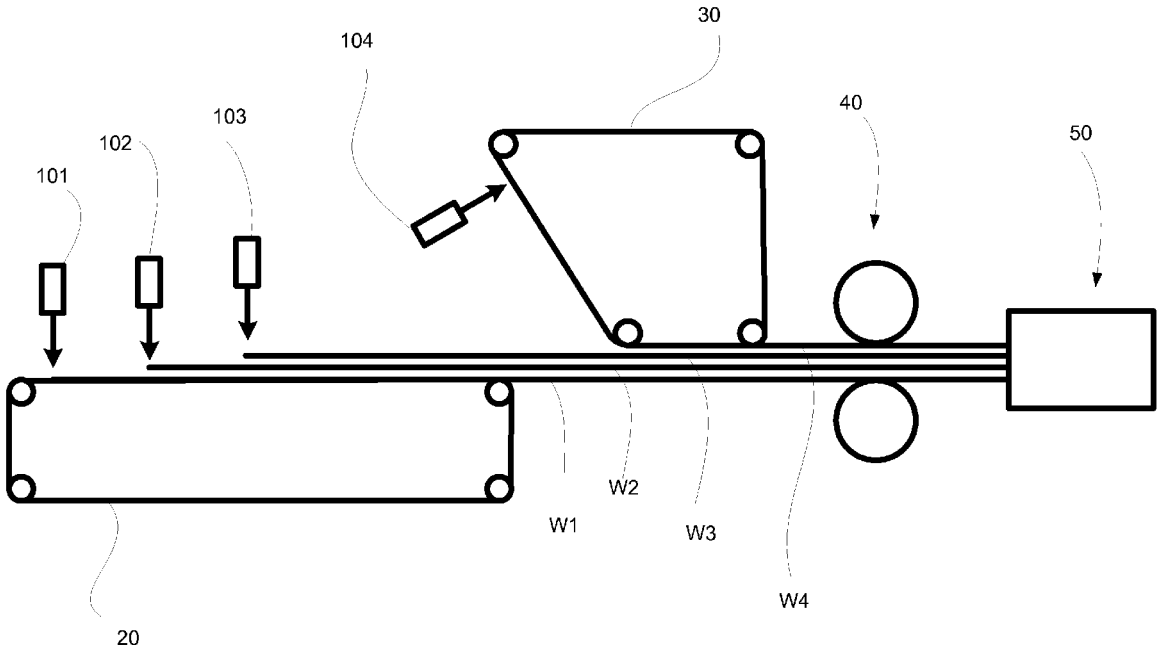

Fig. 3

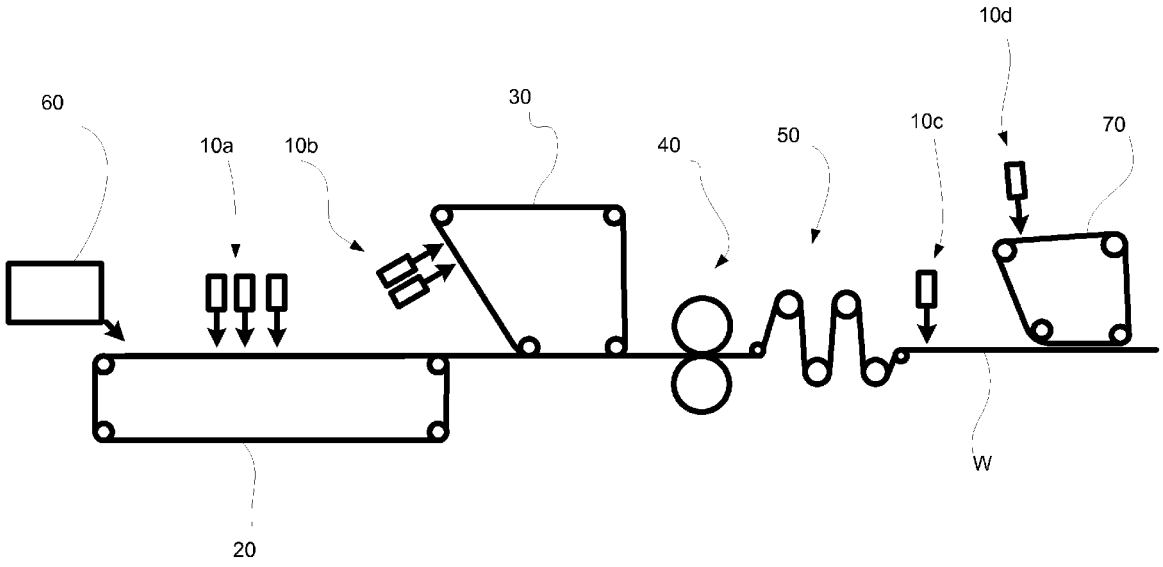

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 6967

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 270 806 A1 (HOGENKAMP RESEARCJ INC [US] HOGENKAMP RES INC [US]) 2 January 2003 (2003-01-02) * claims 1-3; figure 3 *	1,6-8,12	INV. D21H23/50 D21F1/02
X,D	EP 0 955 408 A2 (VOITH SULZER PAPIERTECH PATENT [DE]) 10 November 1999 (1999-11-10) * paragraph [0034]; claims 1-21; figure 3 *	6-8,11	
X,D	US 3 475 198 A (DRUM EDWARD W) 28 October 1969 (1969-10-28) * claims 1-11 *	6-8,11	
X	WO 00/37739 A1 (VALMET CORP [FI]; VAEHAEKUOPUS MIKA [FI]; NISSINEN VILHO [FI]) 29 June 2000 (2000-06-29) * claims 1-10; figures 1A,1B *	6-8,11	
A	DE 100 42 072 A1 (VOITH PAPER PATENT GMBH [DE]) 17 May 2001 (2001-05-17) * the whole document *	1-12	TECHNICAL FIELDS SEARCHED (IPC) D21H D21F
A,D	US 3 484 275 A (LEWICKI WALTER J JR) 16 December 1969 (1969-12-16) * the whole document *	1-12	
A	WO 97/13036 A1 (VALMET CORP [FI]; KOSKINEN JUKKA [FI]; KIRVESKARI ERKKI [FI]; NISSINEN) 10 April 1997 (1997-04-10) * the whole document *	1-12	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	1 July 2013	Karlsson, Lennart

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 15 6967

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-07-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1270806 A1	02-01-2003	DE 60103990 D1	29-07-2004
		DE 60103990 T2	14-07-2005
		EP 1270806 A1	02-01-2003
		US 2002195219 A1	26-12-2002
EP 0955408 A2	10-11-1999	DE 19820432 A1	11-11-1999
		EP 0955408 A2	10-11-1999
		JP H11333341 A	07-12-1999
		US 6248407 B1	19-06-2001
		US 6503325 B1	07-01-2003
		US 2001048976 A1	06-12-2001
US 3475198 A	28-10-1969	NONE	
WO 0037739 A1	29-06-2000	AU 3046800 A	12-07-2000
		CA 2358079 A1	29-06-2000
		EP 1244854 A1	02-10-2002
		JP 2002533199 A	08-10-2002
		US 6709516 B1	23-03-2004
		WO 0037739 A1	29-06-2000
DE 10042072 A1	17-05-2001	NONE	
US 3484275 A	16-12-1969	BE 681169 A	17-11-1966
		DE 1646093 A1	22-07-1971
		DK 123338 B	12-06-1972
		GB 1126539 A	05-09-1968
		LU 51122 A	18-07-1966
		NL 6606746 A	18-11-1966
		NO 119826 B	06-07-1970
		SE 303677 B	02-09-1968
		US 3484275 A	16-12-1969
WO 9713036 A1	10-04-1997	AT 215147 T	15-04-2002
		AT 220747 T	15-08-2002
		AU 7133496 A	28-04-1997
		AU 7133596 A	28-04-1997
		BR 9610747 A	13-07-1999
		BR 9610768 A	13-07-1999
		CA 2233855 A1	10-04-1997
		CA 2233900 A1	10-04-1997
		DE 69620210 D1	02-05-2002
		DE 69620210 T2	22-08-2002
		DE 69622418 D1	22-08-2002
		DE 69622418 T2	31-10-2002
		EP 0856084 A1	05-08-1998

EPO FORM P0459

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 15 6967

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-07-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		EP 0856085 A1	05-08-1998
		FI 954745 A	06-04-1997
		JP 4257748 B2	22-04-2009
		JP 4271726 B2	03-06-2009
		JP H11511379 A	05-10-1999
		JP H11513303 A	16-11-1999
		JP 2007169874 A	05-07-2007
		US 6063449 A	16-05-2000
		US 6106902 A	22-08-2000
		WO 9713035 A1	10-04-1997
		WO 9713036 A1	10-04-1997

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6237525 B **[0009]**
- US 3475198 A **[0010]**
- US 20010048976 A **[0011]**
- US 3484275 A **[0012]**
- US 6866207 B **[0013]**
- US 7217342 B **[0014]**