



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.11.2021 Bulletin 2021/46

(51) Int Cl.:
D04H 1/68 (2012.01) **D21H 21/56 (2006.01)**
D21H 23/46 (2006.01) **D21H 23/52 (2006.01)**

(21) Application number: **21170038.0**

(22) Date of filing: **23.04.2021**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **PIETIKÄINEN, Reijo**
04400 Järvenpää (FI)
• **PITKÄNIEMI, Tapio**
04400 Järvenpää (FI)

(74) Representative: **Berggren Oy**
P.O. Box 16
Eteläinen Rautatiekatu 10A
00101 Helsinki (FI)

(30) Priority: **15.05.2020 FI 20205491**

(71) Applicant: **Valmet Technologies Oy**
02150 Espoo (FI)

(54) **METHOD AND SYSTEM FOR APPLYING A SUBSTANCE LAYER ONTO A MOVING FIBER WEB BY FOAM APPLICATION**

(57) The invention relates to a method for applying at least one substance layer in form of foam onto a moving fiber web (W) directly or indirectly by foam application through at least one opening of at least one nozzle opening (16) of a nozzle tip (15) of an application device (C10; C20; C30) as a foam flow (C). In the method an angle (A), in which the foam flow (C) through the nozzle opening (16) meets a target surface, is less than 90 degrees, advantageously 30-85 degrees, which target surface is in direct application the surface of the fiber web and in indirect application the surface of a roll, or of a belt or of a wire or of a felt or of like. The invention also relates to a system for applying a substance layer onto a moving fiber web (W) directly or indirectly by foam application comprising an application device (C10; C20; C30) comprising at least one nozzle tip (15) with at least one nozzle opening (16) for a foam flow (C). The system comprises means (17; 18; 19,20) configured to set/adjust an angle (A), in which the foam flow (C) through the nozzle opening (16) meets a target surface to less than 90 degrees, advantageously 30-85 degrees, which target surface is in direct application the surface of the fiber web and in indirect application the surface of a roll or of a belt or of a wire or of a felt or of like.

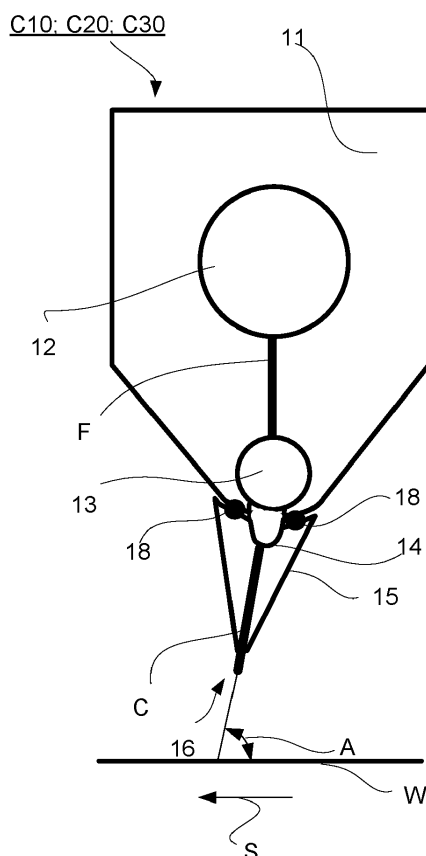


Fig. 2

Description

Technical field

[0001] The invention relates to a method and to a system for applying a substance layer onto a moving fiber web by foam application. More especially the invention relates to a method according to the preamble of claim 1 and to a system according to the preamble of claim 11.

Background

[0002] As known from the prior art fiber web making 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 wire 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 sections for finishing the fiber web, for example, a sizer, a calender, and a coating section. The production and treatment line also comprises at least one 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 paper and board webs.

[0003] In the production of fiber webs, for example of paper or board webs, various substances are added onto the fiber web in order to achieve the desired end-use properties of the fiber web. In particular, the strength and absorption properties of fiber webs can be improved by using sizing by applying sizing agents, such as starch or other glue chemicals, to the web at the wet or dry end of the web production line. In coating process a mixture of pigment and binder, usually starch, is applied onto the web usually as a single layer. In the coating process one or more layers of coating color, i.e. mixture of pigments, binders and other additives is added on the top of the web surface. The main purpose of the coating is to improve the appearance and printability of the web by providing a smooth, flat, and opaque surface.

[0004] In the coating of a fiber web typically a coating device - a coater - is used and in sizing a sizer is used. In connection with the coaters and the sizers different kinds of application technologies for application of the substance on the fiber web are employed, for example curtain technology or blade technology or film transfer technology or spray technology or jet technology. The different application technologies and methods have different operating characteristics and operation windows. In particular, different application methods set different requirements both for the physical properties and application amounts of the applied substance. The present invention relates to foam application technology, especially by a curtain or a jet type foam application device.

[0005] It is known from prior art to use foam application in a sizing or a coating process to add substance on a web, especially in connection of production of nonwoven

products. A foam coating system comprises typically a chemical dosing and a mixing device, a pumping device, a foaming device, a piping system, and an application unit. The foaming is based on powerful mixing for adding air into the liquid-based substance with a surfactant additive, resulting substantial increase in the specific volume and thus making the handling and application of the coating substance much easier at small dry coat weights. The application unit typically comprises a nozzle or nozzles for applying the foam onto the web.

[0006] The foam application method is a robust and simple application method and by it also substances comprising solid particles and/or coating color or sizing agent with high viscosity can be applied onto a moving fiber web. Typically, in the foam application a slot-appliator i.e. an application unit with a slot nozzle or slot nozzles, located close to the fiber web.

[0007] During foam application volume flow rate from the nozzle / nozzles varies due to air amount in the foam and due to mass flow of the foam. The foam mass flow, in turn, depends on the desired running speed and on the desired application amount of substance to be applied and to used dry content of substance that has been foamed. The air amount in the foam, e.g. foam density, depends on desired air content and targeted process effects such as foam penetration to the web. In the foam application, the foam density changes cause high volume flow variations. Thus, window for operation and running parameters of the foam volume flow from the nozzle opening is wide. The foam flow can be selected to be of curtain type or jet type, depending on the desired process conditions.

[0008] In from prior art known methods and systems the foam is applied onto the fiber web or onto another target surface, for example onto the surface of a wire or of a belt or of a felt or of a roll, by a vertical nozzle flow at a constant angle. This sometimes causes an effect called a back flow, so called curtain heel formation, during which flow direction of the applied substance as whole does not follow running direction of the fiber web or the target surface, onto to which the substance is applied but instead is at least part of the applied substance flows to upstream direction of the fiber web or the target surface, onto to which the substance is applied, and forms an accumulation of the substance in front of the foam curtain.

[0009] An object of the invention is to provide a method and system for applying a substance layer onto a moving fiber web, in particular onto a paper or a board web using foam application, in which the disadvantages of prior art are eliminated or at least minimized.

[0010] A particular object of the invention is to provide a method and system for applying a substance layer onto a moving fiber web, in particular onto a paper or a board web, using foam application, in which the disadvantages and problems of into opposite direction to the moving direction of the fiber web moving and accumulating foam, i.e. to back flow, are eliminated or at least minimized.

[0011] A particular object of the invention is to provide

an improved method and system for applying a substance layer onto a moving fiber web, in particular onto a paper or a board web, using foam application, in which the window of the running parameters of the foam application is widened.

Summary

[0012] In order to achieve the above objects and those that will come apparent later the method according to the invention is mainly characterized by the features of claim 1. The system according to the invention is mainly characterized by the features of claim 11. Advantageous aspects and features of the invention are presented in the dependent claims.

[0013] According to the invention in the method for applying at least one substance layer in form of foam onto a moving fiber web directly or indirectly by foam application through at least one opening of at least one nozzle opening of a nozzle tip of an application device as a foam flow, wherein an angle, in which the foam flow through the nozzle opening meets a target surface, is less than 90 degrees, advantageously 30-85 degrees, which target surface is in direct application the surface of the fiber web and in indirect application the surface of a roll or of a belt or of a wire or of a felt or of like.

[0014] In direct foam application the foam is applied directly onto the fiber web and in indirect foam application the foam is first applied onto a surface of a roll or of a belt or of a wire or of a felt or of like, and thereafter via the surface the foam is applied onto the fiber web.

[0015] According to an advantageous feature of the invention in the method the angle is adjustable.

[0016] According to an advantageous feature of the invention in the method the angle is set/adjusted by turning the application device.

[0017] According to an advantageous feature of the invention in the method the angle is set/adjusted by turning the nozzle tip of the application device.

[0018] According to an advantageous feature of the invention in the method the substance is applied onto the fiber web during a run of the fiber web on a roll and the angle is set/adjusted by moving the application device in respect of the roll or in the method the substance is applied onto the fiber web indirectly via a roll and that the angle is set by moving the application device in respect of the roll.

[0019] According to an advantageous feature of the invention in the method the substance is applied onto the fiber web during a run of the fiber web supported by a suction box.

[0020] According to an advantageous feature of the invention in the method running and operating parameters of the foam application are foam flow rate defined by volumetric flow rate or mass flow rate, foam air content or density, running speed of the fiber web and impact angle of the foam flow. Advantageously, the air content of the foam is typically 100-250 g/l, i.e. air content is ad-

vantageously 75-90%.

[0021] According to an advantageous feature of the invention at least one layer of the substance in form of foam is applied onto the fiber web one-sidedly or two-sidedly.

[0022] According to an advantageous feature of the invention the substance to be applied in form of foam is sizing or coating agent, which comprises: binder (e.g. starch, synthetic or bio-based polymer latexes, polyvinyl acetate PVA, polyvinyl alcohol PVOH, carboxy methyl cellulose CMC) or mixture of binders, and foaming agents. Additionally, advantageously the sizing or coating agent may comprise mineral fillers, pigments (e.g. GCC, PCC, kaolin, talc), micro-fibrillated cellulose MFC, nano-fibrillated cellulose NFC, highly refined cellulose.

[0023] According to an advantageous feature of the invention the foam flow is a curtain or a jet type flow.

[0024] According to an advantageous feature of the invention the system for applying a substance layer onto a moving fiber web by foam application directly or indirectly comprises an application device comprising at least one nozzle tip with at least one nozzle opening for a foam flow, wherein the system comprises means configured to set/adjust an angle, in which the foam flow through the nozzle opening meets a target surface, to less than 90 degrees, advantageously 30-85 degrees, which target surface is in direct application the surface of the fiber web and in indirect application the surface of a roll, or of a belt or of a wire or of a felt or of like.

[0025] According to an advantageous feature of the invention the means configured to set/adjust the angle, in which the foam flow meets the target surface, comprise a joint mechanism or a turning device. The joint mechanism / the turning device may be an adjustable or configured to be fixed to a selected angle.

[0026] According to an advantageous feature of the invention the means for setting/adjusting the angle, in which the foam flow meets the target surface, comprise moving rails or moving levers or arms.

[0027] According to an advantageous feature of the invention the nozzle opening is a substantially full width slot nozzle or a curtain- or a jet- nozzle opening.

[0028] According to an advantageous feature of the invention the foam flow is a curtain or a jet type flow.

[0029] According to an advantageous feature of the invention the nozzle opening is at a distance of 10 - 200 mm, advantageously 20 - 150 mm, more advantageously 30 - 100 mm, from the fiber web / from the target surface. By the distance not being too short the risks of nozzle tip contacting to the fiber web/ the target surface is avoided, even in cases the running of the fiber web is not smooth. Also by the distance not being too close possible problems relating to accumulation of dirt between the nozzle tip and the fiber web / the target surface etc. are minimized. Thus, also web break risks are minimized. Additionally, the tolerance and positioning demands are decreased. The distance not being too long provides improved controlling of the foam flow, as effects of gravity

causing changes in orientation of the foam flow are minimized. The greater the distance of the foam flow is, the more the gravity effects to the foam flow and might cause curving of the flow, which causes uncontrollable contact of the foam flow to the fiber web/the target surface. Thus the defined distance provides that the foam flow is not oriented too much towards perpendicular or backward contact angle in relation to the direction of the fiber web / the target surface but instead is forward inclined in the running direction of the fiber web/target surface. This also provides, that capability of avoidance of the back flow is improved, especially in cases where the flow amount of the foam is large and/or the running speed of the fiber web/the target surface is low. Also, disturbances in the foam flow are minimized as the effects of the boundary air layer to the foam flow are minimized. Further, space savings are achieved, which provides advantages in view of constructional details of the system.

[0030] According to an advantageous feature of the invention the system is located at least in one of the following locations: a wire section or a press section or a drying section or a sizing section or a coating section or a calendering section of a fiber web production line. In the fiber web production line, the sizing section, or the coating section or the calendering section can be located on- or off-line.

[0031] According to an advantageous feature of the invention the angle can be set/adjusted by altering the angle of the running direction of the fiber web / of the target surface.

[0032] According to an advantageous aspect of the invention the angle of the nozzle flow of the foam is less than 90 degrees, advantageously 30-85 degrees. Advantageously the angle of the nozzle flow is adjustable. Advantageously, the angle is set/adjusted by turning the application device to the desired angle or turning the nozzle tip of the application device to the desired angle. Additionally, the angle can be varied in case the application is provided onto the fiber web during its run supported by a roll or in case of indirect application via a roll by moving the application device horizontally above the roll, such that the foam flow meets the roll in a desired angle on the roll surface location.

[0033] In the method and the system according to the invention and its advantageous features the problem of back flow is avoided as the contact angle of the curtain to the passing fiber web is below 90 degrees, the sizing substance flows in the running direction downstream. Better curtain quality and evenness is achieved. Curtain running window is larger, enabling higher speeds and larger application amounts. The bulkiness of the fiber web is increased when the sizing agent is applied in form of foam. Also, the strength properties, especially ply-bond strength, of the fiber web are improved due to the uniform sizing agent distribution achieved by applying the sizing agent in form of foam. In addition, internal strength is improved due to application to the inner structure (i.e. between the plies) and due to good movability

and/or penetration of the sizing agent within the fiber web layer in thickness direction. Thus, grammage of the fiber web can be decreased as the critical strength properties are achieved by better effect of the sizing agents. Further, good retention is achieved due beneficial application to the inner structure and cost-savings are achieved as smaller amounts of sizing agent are needed as it is applied by foam and thus the sizing agent remains within the fiber web and does not flush away with following water removal steps. Additionally, good runnability properties of the fiber web are achieved as misting and other spreading as well as adherence to rolls and other components of the sizing agent is minimized due to foam application of the sizing agent causing good distribution and stability of the sizing agent.

[0034] By the invention is achieved a robust and simple application of a treatment substance, in which the substance is applied in form of foam, and in which the problems caused by the back flow are avoided and by which a wider window for the running parameters of the foam application are provided. Additionally, higher foam application amounts and higher running speeds can be achieved without deterioration of foam application quality and evenness.

Brief description of the drawings

[0035] In the following the invention is explained in detail with reference to the accompanying drawing to which the invention is not to be narrowly limited.

In figures 1A-1B is shown schematically an advantageous example of a system for applying a substance layer onto a moving fiber web by foam application according to the invention.

In figure 2 is shown schematically another advantageous example of a system for applying a substance layer onto a moving fiber web by foam application according to the invention.

In figure 3 is shown schematically yet another advantageous example of a system for applying a substance layer onto a moving fiber web by foam application according to the invention.

In figure 4 is shown schematically an advantageous example

Detailed description

[0036] During the course of the following description like numbers and signs will be used to identify like elements according to the different views which illustrate the invention and its advantageous examples. In the figures some repetitive reference signs have been omitted for clarity reasons.

[0037] In figures 1A-1B is shown example of a system

for applying a substance layer onto a moving fiber web W directly by foam application. The example is also applicable in indirect application, in which the target surface is a roll, a wire, a belt, a felt or like. The movement direction of the fiber web W is denoted in the figures by an arrow S. The system comprises an application device C10; C20; C30 for foam application. The application device C10; C20; C30 comprises a frame structure 11 with a nozzle tip 15, which nozzle tip 15 has a nozzle opening 16. The nozzle opening 16 is a slot nozzle opening. Inside the frame structure 11 are located chambers 12, 13 for the foam substance F to be applied onto the moving fiber web W in form of foam as a foam flow C through the nozzle opening 16. The application device C10; C20; C30 comprises means 17 for turning the application device C10; C20; C30 such that angle A, in which the foam flow C through the nozzle opening 16 meets the fiber web W, is set/adjusted. The application device C10; C20; C30 can also be mounted to a selected angle A fixedly. Advantageously, the angle A is less than 90 degrees, advantageously 30-85 degrees. The means 17 for turning the application device C10; C20; C30 can be for example a joint mechanism or a turning device. In the figures 1A and 1B are shown examples of two different angles A.

[0038] In figure 2 is shown another example of a system for applying a substance layer onto a moving fiber web W by direct application by foam application. The example is also applicable in indirect application, in which the target surface is a roll, a wire, a belt, a felt or like. The movement direction of the fiber web W is denoted in the figures by an arrow S. The system comprises an application device C10; C20; C30 for foam application. The application device C10; C20; C30 comprises a frame structure 11 with a nozzle tip 15, which nozzle tip 15 has a nozzle opening 16. The nozzle opening 16 is a slot nozzle opening. Inside the frame structure 11 are located chambers 12, 13 for the foam substance F to be applied onto the moving fiber web W in form of foam as a foam flow C through the nozzle opening 16. The application device C10; C20; C30 comprises means 18 for turning the nozzle tip 15 of application device C10; C20; C30 such that angle A, in which the foam flow C through the nozzle opening 16 meets the fiber web W, is set/adjusted. Advantageously, the angle A is less than 90 degrees, advantageously 30-85 degrees. The means 18 for turning the nozzle tip 15 of the application device C10; C20; C30 can be for example a joint mechanism or a flexible or turnable nozzle tip, or a nonsymmetric nozzle tip.

[0039] In figure 3 is shown another example of a system for applying a substance layer onto a moving fiber web W directly by foam application. The example is also applicable in indirect application, in which the target surface is a roll, a wire, a belt, a felt or like. In this example the substance is applied onto the moving fiber web W during its run on a roll 25. The movement direction of the fiber web W and the roll 25 is denoted in the figures by an arrow S. The system comprises an application device C10; C20; C30 for foam application. The application de-

vice C10; C20; C30 comprises a frame structure 11 with a nozzle tip 15, which nozzle tip 15 has a nozzle opening 16. The nozzle opening 16 is a slot nozzle opening. Inside the frame structure 11 are located chambers 12, 13 for the foam substance F to be applied onto the moving fiber web W in form of foam as a foam flow C through the nozzle opening 16. The application device C10; C20; C30 comprises means 19, 20 for moving and/or turning the application device C10; C20; C30 such that angle A, in which the foam flow C through the nozzle opening 16 meets the fiber web W, is set/adjusted. Advantageously, the angle A is less than 90 degrees, advantageously 30-85 degrees. The means 19, 20 for turning and/or moving the application device C10; C20; C30 can be for example moving rails or moving levers or arms. In this example as the application device C10; C20; C30 is moved the location, at which the foam flow C through the nozzle opening 16 meets the fiber web W on the roll 25 is changed and thus the angle A is different. By the dashed line is shown another example of the position of the application device C10; C20; C30.

[0040] In figure 4 is shown an example of a forming section for a multi-ply fiber web W, in this example for a two-ply fiber web W. The forming section comprises a headbox M10; M20 for each layer, from which the stock suspension is fed to the forming unit for each layer W beginning as single wire part comprising a wire 10 for the bottom layer of the multi-ply fiber web W and a wire 20 for the top layer W of the multi-ply fiber web W, each wire comprising rolls 12, 22 for guiding, tensioning and/or driving the wire 10; 20 as an endless loop. The headbox M10; M20 can be single layer or multilayer headbox. The stock suspension is first fed onto the wire 10; 20 and thereafter a fiber web layer W formed of the stock on the wire is guided past inside the loop of the wire 10; 20 located water removal means 11; 15; 21; 25. Inside of the loops of the lower and the upper wire 10; 20 at least one suction means 15; 25 are located. The run of the wire 10; 20 during this water removal on the single wire part is at least in the beginning substantially horizontal.

[0041] The top fiber web layer W of the multi-ply fiber web guided on the wire 20 is after the single-wire part guided as a downwards run towards the first wire 10 and the runs of the wire 10 for the bottom layer and the wire 20 for the top layer are united by a combining roll 23 to form a twin-wire part and the webs for the bottom layer and the top layer are guided into a gap formed between the wires 10; 20 forming the twin-wire part of the forming unit. Web layers W have been joined together by a combining roll 23 at the beginning of the twin-wire forming part. Combining roll 23 is situated in the top layer wire loop 20.

[0042] Application devices C10; C20; C30 are located at the angle on the horizontal runs of the lower and the upper wire loop 10; 20 for applying sizing agent advantageously in form of foam by the application device onto the fiber web layer W and to be in between at the layers W of the multi-ply fiber web W in forming section. The

angle is less than 90 degrees, advantageously 30-85 degrees. The application device C10; C20 is advantageously located opposite to a inside the wire loop 10, 20 located suction device 15, 25. Also, more than one application devices C10; C20; C30 can be used consecutively for one fiber web layer.

[0043] Thus, the sizing agent applied in form of foam by the application device C10; C20; C30 onto the layer of the web is guided in between the layers. Advantageously, after applying the sizing agent in form of foam by the application device C10; C20; C30 its conveyance and penetration into the web layer is assisted such that the sizing agent is forwarded deeper into the web layer on which the sizing agent is applied in form of foam by guiding the foam to desired direction. In the example of figure 4 the suction means 11 are provided inside the lower wire loop 10 also after the web layers W are joined by the combining roll 23 at the beginning of the twin-wire forming part in order to assist the conveyance and penetration of the sizing agent into the web layer.

[0044] After the joining of the layers the multi-ply fiber web W is guided on the wire 10 supporting the bottom side of the multi-ply fiber web as a single wire part during which run support foils 16 located inside the wire 10 loop. At this run is located another application device C30 for applying substance in form of foam onto the fiber web W is located at an angle. The angle is less than 90 degrees, advantageously 30-85 degrees. The support foils 16 do not deviate the run of the wire 10 only remove water from the bottom surface of the wire 10 and support the run of the wire 10 as the multi-ply fiber web is guided via suction roll 13 towards a pick-up roll 41 for transferring the multi-ply fiber web to a first press fabric 40 of a press section. The press section also comprises a second press fabric 50 with a roll 51. The press fabrics 40, 50 comprise rolls 42, 52 for guiding, tensioning, and/or driving the fabrics 40; 50 as an endless loop. In the press section the multi-ply fiber web is guided between the first press fabric 40 and the second press fabric 50 to a press nip formed between a first press roll 45 and a second press roll 55. Press nip even improves conveyance and penetration of the sizing agent. After the press section the fiber web W is guided to a drying section (not shown).

[0045] In the method at least one layer of the substance in form of foam is applied onto the fiber web one-sidedly or two-sidedly.

[0046] In the description in the foregoing, although some functions and elements have been described with reference to certain features and examples, those functions and elements may be performable by other features and examples whether described or not. Although features have been described with reference to certain embodiments or examples, those features may also be present in other embodiments or examples whether described or not.

[0047] Above only some advantageous examples of the inventions have been described to which examples the invention is not to be narrowly limited and many mod-

ifications and alterations are possible within the invention.

5 Claims

1. Method for applying at least one substance layer in form of foam onto a moving fiber web (W) directly or indirectly by foam application through at least one opening of at least one nozzle opening (16) of a nozzle tip (15) of an application device (C10; C20; C30) as a foam flow (C), **characterized in that** in the method an angle (A), in which the foam flow (C) through the nozzle opening (16) meets a target surface, is less than 90 degrees, advantageously 30-85 degrees, which target surface is in direct application the surface of the fiber web and in indirect application the surface of a roll or of a belt or of a wire or of a felt or of like.
2. Method according to claim 1, **characterized in that** in the method the nozzle opening (16), through which the at least one substance layer in form of foam is applied onto the moving fiber web (W) directly or indirectly by the foam application, is located at a distance of 10 - 200 mm, advantageously 20 -150 mm, more advantageously 30 -100 mm, from the fiber web / from the target surface.
3. Method according to claim 1 or 2, **characterized in that** in the method the angle (A) is adjustable.
4. Method according to any of claims 1 - 3, **characterized in that** in the method the angle (A) is set/adjusted by turning the application device (C10; C20; C30).
5. Method according to any of claims 1 - 3, **characterized in that** in the method the angle (A) is set/adjusted by turning the nozzle tip (15) of the application device (C10; C20; C30).
6. Method according to any of previous claims, **characterized in that** in the method the substance is applied onto the fiber web (W) during a run of the fiber web (W) on a roll (25) and that the angle (A) is set/adjusted by moving the application device (C10; C20; C30) in respect of the roll (25) or in the method the substance is applied onto the fiber web (W) indirectly via a roll (25) and that the angle (A) is set by moving the application device (C10; C20; C30) in respect of the roll (25).
7. Method according to any of previous claims, **characterized in that** in the method the substance is applied onto the fiber web during a run of the fiber web supported by a suction box.

8. Method according to any of previous claims, **characterized in that** in the method running and operating parameters of the foam application are foam flow rate defined by volumetric flow rate or mass flow rate, foam air content or density, running speed of the fiber web and impact angle of the foam flow, that the foam air content is advantageously 100-250 g/l, i.e. the air content is advantageously 75-90%. 5
9. Method according to any of previous claims, **characterized in that** at least one layer of the substance in form of foam is applied onto the fiber web one-sidedly or two-sidedly. 10
10. Method according to any of previous claims, **characterized in that** the substance to be applied in form of foam is sizing or coating agent, which comprises: binder (e.g. starch, synthetic or bio-based polymer latexes, polyvinyl acetate PVA, polyvinyl alcohol PVOH, carboxy methyl cellulose CMC) or mixture of binders, and foaming agents. 15 20
11. System for applying a substance layer onto a moving fiber web (W) directly or indirectly by foam application comprising an application device (C10; C20; C30) comprising at least one nozzle tip (15) with at least one nozzle opening (16) for a foam flow (C), **characterized in that** the system comprises means (17; 18; 19,20) configured to set/adjust an angle (A), in which the foam flow (C) through the nozzle opening (16) meets a target surface to less than 90 degrees, advantageously 30-85 degrees, which target surface is in direct application the surface of the fiber web and in indirect application the surface of a roll or of a belt or of a wire or of a felt or of like. 25 30 35
12. System according to claim 11, **characterized in that** the nozzle opening (16) is at a distance of 10 - 200 mm, advantageously 20 - 150 mm, more advantageously 30 - 100 mm, from the fiber web / from the target surface. 40
13. System according to claim 11 or 12, **characterized in that** the means (17; 18) for setting/adjusting the angle (A), in which the foam flow (C) meets the target surface, comprise a joint mechanism or a turning device. 45
14. System according to claim 11 or 12, **characterized in that** the means (19, 20) for setting/adjusting the angle (A), in which the foam flow (C) meets the fiber web (W), comprise moving rails or moving levers or arms. 50
15. System according to any of claims 11 - 14, **characterized in that** the system is located at least in one of the following locations: a wire section or a press section or a drying section or a sizing section or a coating section or a calendering section of a fiber web production line. 55

C10: C20: C30

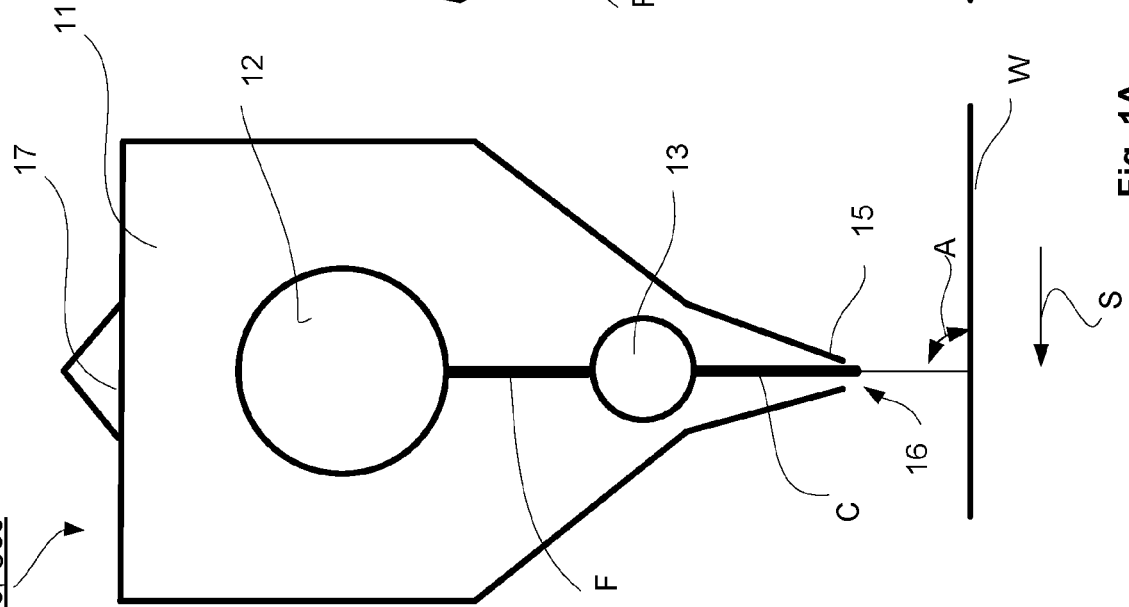


Fig. 1A

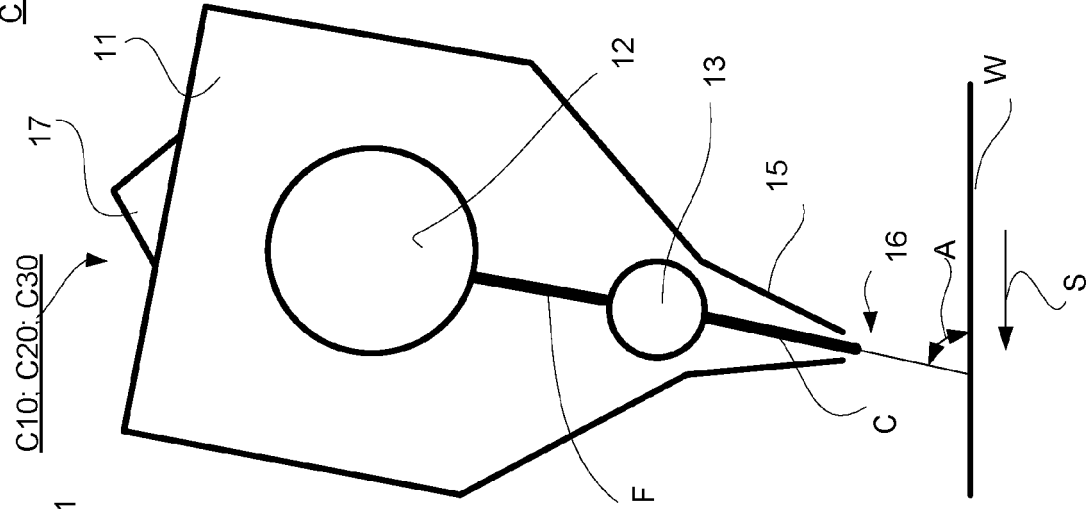


Fig. 1B

C10: C20: C30

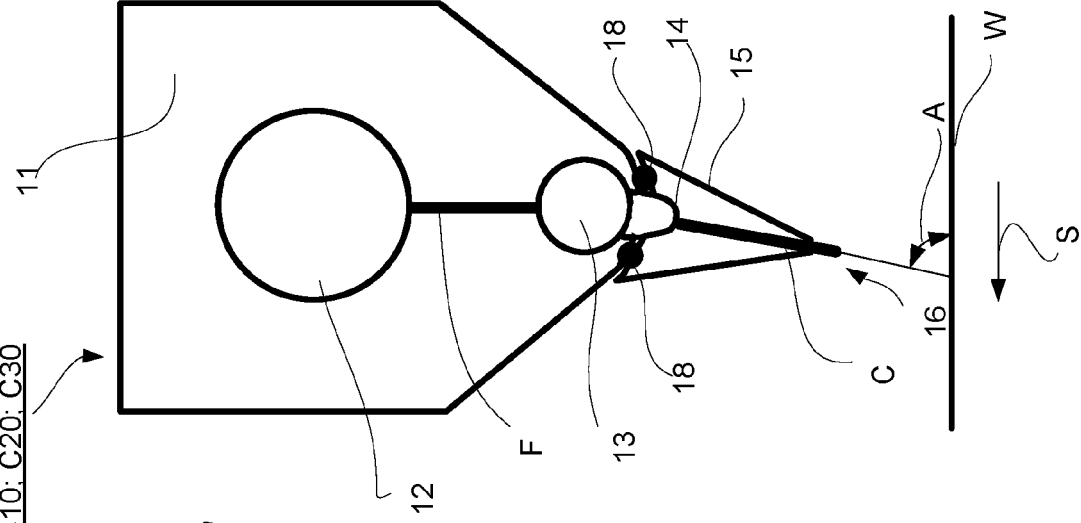


Fig. 2

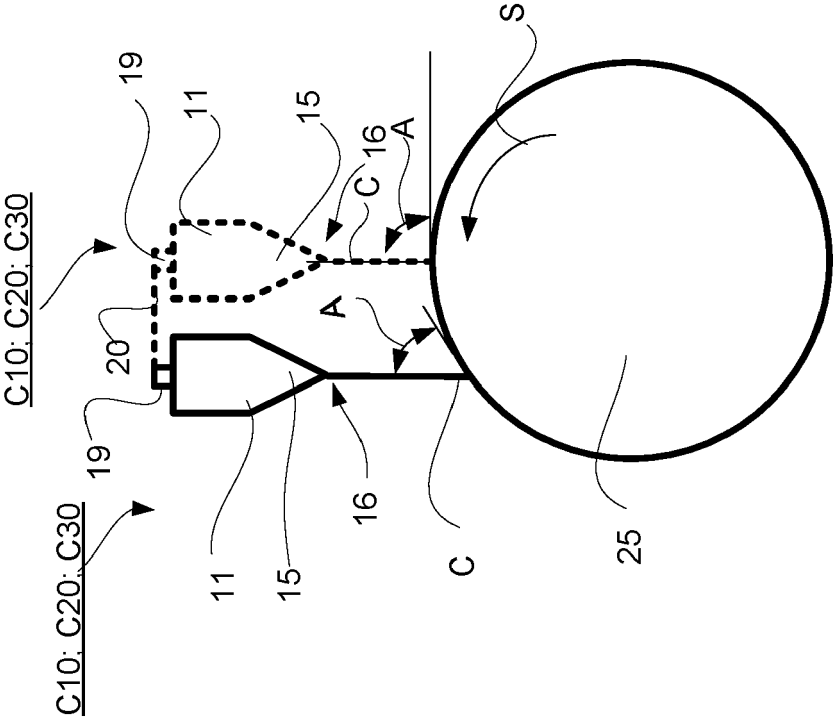


Fig. 3

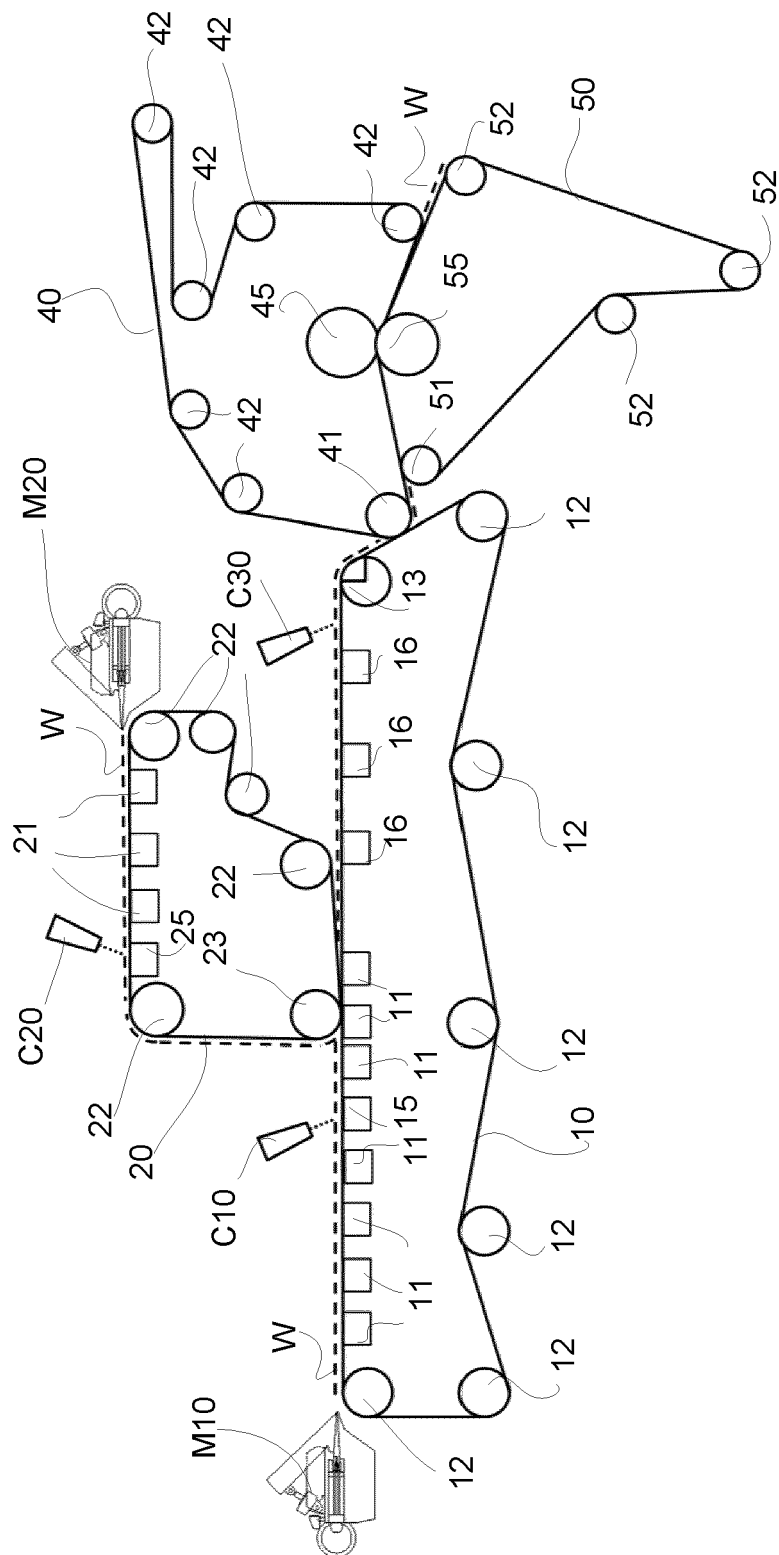


Fig. 4



EUROPEAN SEARCH REPORT

 Application Number
 EP 21 17 0038

5

10

15

20

25

30

35

40

45

50

55

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	DE 10 2017 128242 A1 (VALMET TECHNOLOGIES OY [FI]) 7 June 2018 (2018-06-07)	1-3,5,7,9-13,15	INV. D04H1/68 D21H21/56 D21H23/46 D21H23/52
Y	* paragraph [0009] - paragraph [0023] * * paragraph [0032] - paragraph [0039] * * claims 1-15; figures 1-5 *	4,6,8,14	
X	US 4 348 251 A (PAULS WALTER L ET AL) 7 September 1982 (1982-09-07) * figures 1, 2, 4 * * column 3, line 20 - line 28 * * column 4, line 45 - line 63 * * column 5, line 20 - column 6, line 4 *	1,11	
X	US 4 086 377 A (BARCHI HENRY J) 25 April 1978 (1978-04-25) * figures 2, 3; example 1 * * column 1, line 8 - line 16 * * column 5, line 10 - line 58 *	1,11	
X	US 4 463 583 A (KRUEGER MAX [DE] ET AL) 7 August 1984 (1984-08-07) * claims 1-15; figures 1,2 * * column 4, line 48 - line 64 * * column 5, line 36 - line 42 * * column 2, line 60 - column 3, line 17 *	1,3,5,11,13	
X	US 2004/055534 A1 (ZEIFFER DIETER FRIEDRICH [US] ET AL) 25 March 2004 (2004-03-25) * claims 1-24; figures 3-7 * * paragraph [0001] - paragraph [0021] *	1,11	
Y	EP 1 065 308 A2 (GASTON SYSTEMS INC [US]) 3 January 2001 (2001-01-03) * paragraph [0029] - paragraph [0040] * * claims 1-46; figures 4-7 *	4,6,14	TECHNICAL FIELDS SEARCHED (IPC) D04H D21H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 1 October 2021	Examiner Billet, Aina
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	

EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
EP 21 17 0038

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2013/160564 A1 (STORA ENSO OYJ [FI]) 31 October 2013 (2013-10-31) * paragraphs [0003], [0044] * -----	8	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 1 October 2021	Examiner Billet, Aina
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			

 1
EPO FORM 1503 03.82 (P04C01)

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

EP 21 17 0038

5

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.

01-10-2021

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102017128242 A1	07-06-2018	AT 519423 A2 DE 102017128242 A1	15-06-2018 07-06-2018
US 4348251 A	07-09-1982	NONE	
US 4086377 A	25-04-1978	CA 1089726 A US 4086377 A US 4089296 A	18-11-1980 25-04-1978 16-05-1978
US 4463583 A	07-08-1984	AU 545750 B2 CA 1178435 A DE 3131545 A1 GB 2103113 A US 4463583 A	01-08-1985 27-11-1984 24-02-1983 16-02-1983 07-08-1984
US 2004055534 A1	25-03-2004	EP 1400620 A2 US 2004055534 A1	24-03-2004 25-03-2004
EP 1065308 A2	03-01-2001	AT 259440 T BR 0003781 A CN 1291529 A DE 60008170 T2 EP 1065308 A2 KR 20010049686 A US 6395088 B1 US 2002108568 A1	15-02-2004 16-10-2001 18-04-2001 18-11-2004 03-01-2001 15-06-2001 28-05-2002 15-08-2002
WO 2013160564 A1	31-10-2013	BR 112014026790 A2 CA 2871555 A1 CN 104285006 A EP 2841651 A1 ES 2652512 T3 FI 124556 B JP 6310446 B2 JP 2015518096 A PL 2841651 T3 RU 2014146501 A US 2015096700 A1 US 2017335522 A1 WO 2013160564 A1	27-06-2017 31-10-2013 14-01-2015 04-03-2015 02-02-2018 15-10-2014 11-04-2018 25-06-2015 28-02-2018 20-06-2016 09-04-2015 23-11-2017 31-10-2013

EPO FORM P0459

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