



(51) International Patent Classification:

B27N 3/14 (2006.01) B32B 21/02 (2006.01)
B27N 3/04 (2006.01) E04C 2/16 (2006.01)
B32B 5/16 (2006.01)

(21) International Application Number:

PCT/SE2020/050368

(22) International Filing Date:

08 April 2020 (08.04.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1950538-7 07 May 2019 (07.05.2019) SE

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,

(54) Title: APPARATUS AND METHOD FOR MANUFACTURING WOOD-BASED PANELS

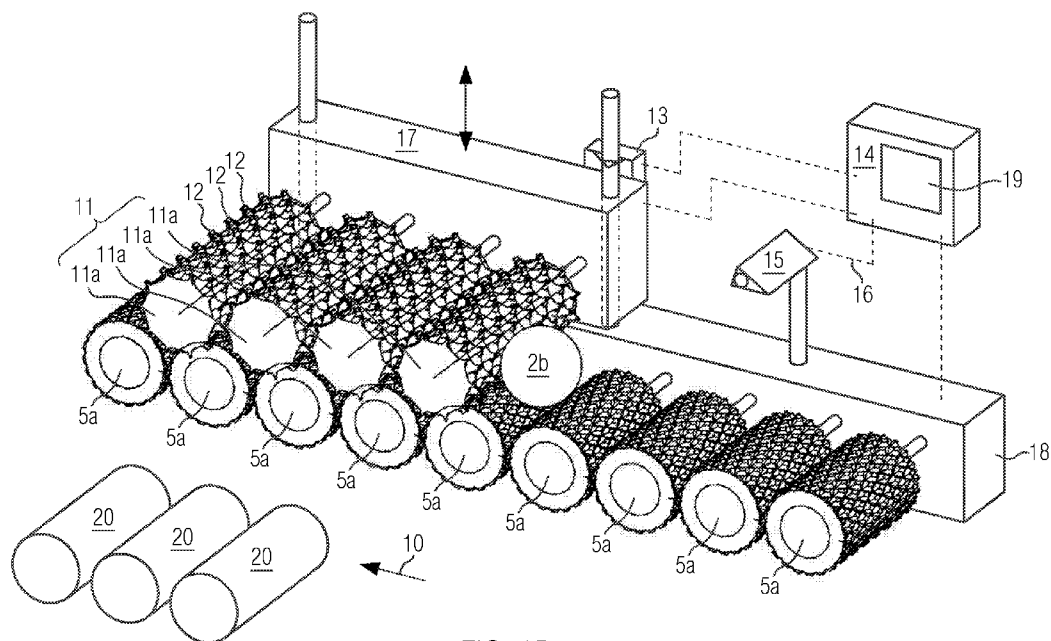


FIG. 1B

(57) Abstract: The invention provides an apparatus and a method for manufacturing wood-based panels. The apparatus comprises a roller array comprising at least one first roller configured such that when it engages with a wooden fibre agglomeration while being rotated, the wooden fibre agglomeration is at least partially broken down into smaller agglomerations and/or individual fibres, wherein the roller array is arranged in a transport path for material including wooden fibre agglomerations such that at least the first roller is engageable with the wooden fibre agglomerations while the material is transported along the transport path.



TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

Apparatus and method for manufacturing wood-based panels

BACKGROUND OF THE INVENTION

The invention relates to an apparatus and method for manufacturing wood-based panels.

Different techniques are known for manufacturing wood-based panels. One technique involves producing boards from wooden particles, so-called flakes, which are stacked in layers to form a mat, the mat then being pressed so as to form a so-called particle board. Typically, the flakes may have a size between 0.2 to 10 mm in their biggest dimension, e.g. length. Particles may be obtained by cutting wooden pieces of bigger dimension, typically from wood chips, using e.g. an attrition mill method (grinding) or using an impact mill method.

Boards made up mainly of such particles can be recycled relatively easily by using wooden particles derived from existing particle boards consisting only or mostly of wooden particles for manufacturing a new particle board. Flakes, even from recycled particle boards, do not tend to stick together when being moved forward or rotated in the board manufacturing process.

However, there are also other types of composite wood-based panels, e.g., medium or high density fibre (MDF/HDF) boards. They comprise wooden fibres and may optionally also comprise wooden particles. MDF/HDF boards have been widely used in many furniture and cabinet applications during the last 20 - 30 years. In view of this, increasing amounts of MDF/HDF-based material need to be recycled. In general, it is advantageous to recycle MDF/HDF-based furniture components back to boards and further to new furniture. However, there are so far no satisfying solutions for recycling the required amount of material.

Fibres, especially recycled fibres that may still carry some glue residue and/or new glue added in a process prior to the forming station, tend to stick together when being moved forward or rotated in the board manufacturing process, contrary to flakes. When the fibres stick together, they form fibre agglomerations, also called fibre lumps, for example rolls

and balls of fibres. Fibre agglomerations tend to have very low density and flotation speed in an air flow.

When assembling a mat of wooden material and pressing the mat to obtain a board, the presence of such low-density agglomerations in the mat is detrimental, as it leads to a board that has lower strength and density accuracy. The agglomerations make an accurate control of the transport of the material more difficult. In all mechanical transport units low density agglomerations inside the higher density material flow cause inaccurate density control.

Several processing steps, for example steps including rotating, transporting and/or sorting the wooden materials, that are generally required in the manufacturing process are impeded by the presence of fibre agglomerations.

As an example, in some manufacturing methods a drum dryer rotates the material flow from 10 min to 30 min at high temperatures (100 - 400 °C). The rotation may lead to formation of fibre agglomerations, which have a tendency to stick inside the dryer internals, thereby over drying and potentially catching on fire. Moreover, due to the low density and low floatation velocity they may end up in the electrostatic filter for exhaust air, for example, of the dryer and/or other components. In this case, the fibre agglomerations may block the channels and cause interruptions in the main production line and are a potential fire risk.

Another potential risk occurs when, during screening with a mechanical shaker screen or a wind sifter, the material flow rotates. Again, the rotation may lead to formation of fibre agglomerations, which may stick in conveyors and create a fire risk.

Another example of fibre agglomeration formation is the step of evening out the wooden material. In a forming bin the material is evened using rotating rake rolls to move material backwards and any lower density agglomeration will cause lower accuracy both along and across the board. A mechanical forming station comprises a forming head which scatters wooden particles through a roller array onto a conveyor belt. This forming head is fed from a forming bin, such as a supplying silo. In order to achieve an even scattering in the forming head, the particle flow is homogenized already in the forming bin, often by means of spike rollers. In case a forming head, which is used for forming the particle

board and is arranged after a forming bin, is made with rotating rolls of a typical surface pattern of the rotating rolls the agglomerations will stay on the roller bed for a very long time and the only way to remove them is to stop the production process.

The above issues have so far been addressed by either providing equipment specifically designed for processing fibre materials, i.e., different equipment than that used for wooden particles, or by using mixed raw or intake wood materials with flakes and fibres, but only allowing for a very small share of fibres.

Accordingly, recycling of MDF/HDF boards or mixed-type boards having fibres and particles cannot be efficiently integrated in a particle board manufacturing process.

SUMMARY OF THE INVENTION

In view of the foregoing, it is an object of the present invention to provide an improved apparatus and method for manufacturing wood-based panels that allows for integrating the recycling of MDF/HDF boards or mixed-type boards in the manufacturing process. In particular, it is an object of the invention to allow for efficient processing of wooden fibre agglomerations like fibre balls and fibre rolls. Specifically, an object of the invention is to allow for increasing the share of fibre-based recycled material in particle board production.

These objects are achieved with an apparatus and method according to independent claims. Preferred embodiments are specified in the dependent claims.

The invention provides a processing apparatus for manufacturing wood-based panels, particularly particle boards. The apparatus comprises a roller array comprising at least one first roller configured such that when it engages with a wooden fibre agglomeration while being rotated, the wooden fibre agglomeration is at least partially broken down into smaller agglomerations and/or individual fibres. The roller array is arranged in a transport path for material including wooden fibre agglomerations such that at least the first roller is engageable with the wooden fibre agglomerations while the material is transported along the transport path.

Providing a roller array with such a first roller in the transport path for the material including wooden fibre agglomerations allows for efficiently integrating the recycling of boards including wooden fibres, in particular integrating the processing of wooden fibre agglomerations, in the board manufacturing apparatus and method. Accordingly, the share of wooden fibres in the raw material is not particularly limited and an efficient recycling of any type of composite board, including MDF and mixed-type boards, is possible.

It should be noted that the terms “first roller”, “second roller” etc., unless specified otherwise, are not meant to be limiting in terms of the position or spatial arrangement of a roller within the roller array and/or the transport direction.

As an example, in known systems, during initial processing steps, fibre contents over 10 % possibly cause problems. However, during the forming process using rollers, even a small amount of fibres, e.g. less than 3%, start to build-up fibre agglomerations and may

cause problems. The claimed apparatus allows for a higher amount of fibres, e.g, up to 15%, even during a formation process using rollers.

The term “transport path” as used herein refers to the path along which wood material is transported during operation of the apparatus. It may extend from an infeed, through which raw material is introduced, to an assembly site, where the raw material is assembled to form a mat or stack of material that is to be pressed to form the wood-based panel.

The term "wood-based panel" as used herein refers to a board that comprises pressed wooden material. The term “particle board” as used herein refers to boards having wooden particles (flakes) and may also comprise wooden fibres, as described above.

The term “fibre agglomerations”, also referred to as fibre lumps, refers to a plurality of wooden fibres sticking/attaching to each other. For example, the fibres may stick to each other forming an agglomeration having a roll- or ball-like shape.

The term "roller“ as used herein refers to an element with a basic shape of a cylinder and being configured such that it can be supported/mounted rotatably about the cylinder axis. In the following, when reference is made to a roller being rotated, this refers to a rotation about the cylinder axis unless specified otherwise.

The material of the rollers of the roller array is not particularly limited. For example, the rollers of the roller array may be made of steel having a machined pattern on their surface. Rollers may be made of other material, e.g. Nylon, and may in particular be 3D printed.

The first roller engaging with a fibre agglomeration means that the roller and the fibre agglomeration contact each other and there is a force that presses the fibre agglomerations and the roller surface against each other. This force may be the gravitational force or a force actively applied to the roller. It may also be a counter force enacted by an additional element, e.g., another roller or a surface, the fibre agglomerations being sandwiched between the surface and the first roller.

A roller being engageable with the fibre agglomeration means that it is arranged, optionally in a movable manner, in a position in the transport path where it can engage with fibre agglomerations when they are transported along the transport path. It includes roller arrangements where the position or orientation of the roller may be adjusted based

on the type of raw material that is inserted to accommodate different compositions of the raw material and/or different sizes of fibre agglomerations.

The term "roller array" as used herein refers to a plurality of adjacent rollers that are rotatably mounted with their rotational axes parallel to each other. In particular, their rotational axes may be in the same plane. The surfaces of the rollers may be slightly spaced apart. In particular, in case the rollers also function as conveyor elements, which is described in more detail below, the spacing may be chosen in accordance with particle sizes of particles that are to fall through the gaps or not fall through them. As an example, the distance may be between 0,2 and 10 mm.

The roller array may comprise one to eight rollers, more preferably two to four rollers. The array may comprise an even number of rollers forming one or more pairs of rollers, each pair of rollers comprising a first roller and an adjacent second roller, which may have the same or a different configuration, e.g., size or surface texture, than the first roller.

The first roller may have a specific configuration, e.g., size or surface texture, so as to be able to at least partially break down the fibre agglomeration when it engages with the fibre agglomeration while being rotated. Exemplary configurations will be described in more detail below. The first roller, due to its property of breaking down fibre agglomerations, may also be referred to as a fibre-eating roller. An array having one or more such first rollers and arranged in the transport path of the material allows for efficiently processing fibre agglomerations without having to make major changes to a regular processing apparatus as currently used for manufacturing wood-based panels.

The roller array may have one or more rollers of said configuration, i.e., it may have more than one first roller. The arrangement of the first roller or first rollers is not particularly limited. A first roller may be arranged to be the outermost roller of the array or may be adjacent to the outermost roller of the array, but it may also be found in other positions within the array. In some configurations, first rollers and rollers of a different configuration may be arranged alternately, e.g., such that the first rollers do not engage with each other.

The circumferential surface of the above-described first roller may comprise spikes, particularly scoop-shaped spikes. That is, the circumferential surface, e.g., the cylinder surface, of the first roller has a specific profile pattern or texture configured such that the first roller is able to break down fibre agglomerations.

The spikes may have a height of 3-25 mm, in particular 5-15 mm, in particular 7-10 mm. The spikes may have a width of 10-35 mm, in particular 15-30 mm, in particular 20-25 mm. For each spike, the height of the spike is the difference between the distance of the point of the spike farthest from the cylinder axis and the distance of the lowest point of the valleys adjacent to the spike from the cylinder axes. The width of the spike corresponds to the maximum distance the spike, at its base, spans in a direction along the cylinder axis.

The spikes may be provided on the circumferential surface at a concentration of 10-100 spikes/dm², particularly 20-60 spikes/dm², particularly 30-50 spikes/dm², particularly 40-50 spikes/dm².

The term “scoop-shaped spike” refers to a spike having at least one concave surface side. In particular, two opposite sides of the spike’s surface of the spike may be configured so as to give the spikes a plano-concave or a convex-concave shape. However, the shape of the side opposite to the concave side is not particularly limited.

The circumferential surface of the rollers, in particular including the spikes, may be provided with anti-wear and anti-stick treatment, for example hard chromium, a high gloss surface or anti-stick coating.

The first roller may have an outer diameter of 60-100 mm, in particular 70-90 mm, in particular 80 mm, wherein the diameter is measured spike edge to spike edge. The spike edge is the point of the spike farthest from the cylinder axis. In case the spikes have different heights, the biggest of the values measured spike edge to spike edge is defined as the outer diameter of the roller. The second roller may have a diameter chosen among these diameter ranges as well. It may be different from or the same as the diameter of the first roller.

The apparatus may comprise driving means configured to rotate the first roller and an adjacent second roller of the roller array in opposite rotation directions and/or at different

rotation speeds, particularly, to rotate the first roller at a higher rotation speed than the second roller.

The apparatus may comprise driving means to have individual adjustable speed and rotation direction to first and second rollers, preferably to all rollers in the apparatus, preferably including any transporting or sorting rollers.

In general, when adjacent rollers are rotated in the same directions, this allows for moving the material along the transport path efficiently, whereas rollers rotating in opposite directions slows down the transport and increases mechanical stress on the transported material.

The first and an adjacent second roller may be rotated in opposite directions. As explained above, rotation in opposite directions slows down the material being transported, which allows for the first roller to engage with the material for a longer period of time. Moreover, it increases mechanical stress on fibre agglomerations, thus enhancing the efficiency of breaking down the fibre agglomerations.

Different rotation speeds may also be advantageous in terms of efficiency of breaking down the fibre agglomerations due to increased mechanical stress.

The driving means may be configured to rotate at least two adjacent rollers, in particular all except for the one or both of the outermost rollers or all of the rollers of the roller array in the same rotational direction. In particular, the driving means may be configured to rotate the outermost roller of the array on a downstream side of the array in an opposite direction than the other rollers. This slows down the material before it leaves the region wherein the first roller may engage with the material.

Accordingly, the material may be efficiently distributed along the array and slowed down to such an extent that the time of engaging the first roller with the agglomerations is long enough for the agglomerations to be sufficiently broken down.

The driving means may be configured to individually rotate the rollers. Alternatively, the rollers may be mechanically coupled and collectively rotated by the driving means. The apparatus may comprise a control device for controlling the driving means, in particular, for controlling the rotation speed and/or rotation direction.

As an example, the driving means may be configured to drive the first roller at a rotation speed of 25-500 rpm, in particular 50-200 rpm, in particular 75 to 100 rpm.

The roller array may comprise a plurality of pairs of the above-described first and second rollers arranged such that first and second rollers are alternately provided. In particular, in this configuration, the driving means may be configured to rotate the first rollers at a higher rotation speed than the second rollers, in particular, in the opposite rotation direction.

In other words, the rollers have alternately higher and lower rotation speeds. That is, every first roller operates at higher rotation speed and every second roller operates at a lower rotation speed. The roller rotating at a lower rotation speed functions as an anvil for the first roller rotating at a higher speed and breaking down the fibre agglomeration. Thus, the second roller provides the above-described force that presses the fibre agglomerations and the roller surface of the first roller together. The effect is particularly strong when the rollers rotate in opposite directions. In such a configuration the apparatus may additionally comprise rollers that only serve as conveyor elements and/or sorting elements.

Optionally, in particular during line stops, e.g. due to outside disturbances to the apparatus, the control system may adjust the speed of first and second rollers to provide optimal speed to transport the fibre agglomeration in contact with the second rollers.

In particular, the first roller may have the above-described spikes. As it rotates with the second roller functioning as an anvil, the spikes, for example in the manner of teeth chewing fibrous foods, break down the fibre agglomerations.

The apparatus may comprise a transport device with one or more conveyor elements, wherein the roller array is arranged over the conveyor elements such that at least the first roller is engageable with the wooden fibre agglomerations while the material is transported on the one or more conveyor elements.

That is, in some region of the transport path, the material may be sandwiched between the roller array and the conveyor elements. The conveyor elements may provide the above-mentioned force that presses the fibre agglomerations and the roller surface of the first roller against each other.

The transport device may comprise one or more belt conveyors and/or conveyor rollers as conveyor elements. The driving means may be configured to rotate some or all of the rollers of the roller array such that the rotational direction corresponds to the transport direction of the material. In case the conveyor elements comprise conveyor rollers, the driving means may be configured to rotate some or all of the rollers of the roller array in the same rotational direction as the conveyor rollers. In particular, all but the first roller or first rollers of the roller array may be rotated such that the rotational direction corresponds to the transport direction of the material. The first roller or first rollers may be rotated in the opposite direction.

The distance between and/or relative orientation of the roller array and the one or more conveyor elements, in particular, the position and/or orientation of the roller array may be a fixed setting.

Alternatively or in addition, the apparatus, in particular when the roller array is arranged over the conveyor elements, may comprise adjustment means configured to adjust the distance between and/or relative orientation of the roller array and the one or more conveyor elements, in particular, to adjust the position and/or orientation of the roller array.

In particular, adjustment means may be configured to adjust the distance between the roller array and the conveyor elements in a vertical direction. The adjustment may be performed by manually actuating the adjustment means or by automatically, e.g. using a motor or other driving element, actuating the adjustment means.

The adjustment means may particularly be configured to adjust the distance and/or relative orientation automatically, in particular, based on the size of the fibre agglomerations and/or the height of material flow to be processed.

The adjustment means may be configured to perform the automatic adjustment controlled by an internal or external control device, wherein the external control device may optionally be the same control device that is used for controlling the rotation of the rollers and/or may be part of the adjustment means.

The values for the size on which to base the automatic adjustment may be obtained from a storage medium where values for the size of agglomerations included in the present batch

are stored, e.g., after being input by a user. In particular, the above-described control device may obtain said values and use them to determine how to control the adjustment means.

Alternatively or in addition, the apparatus may comprise detection means configured to detect the size of fibre agglomerations, particularly upstream of the roller array, and may be configured to use the detected values of the size as basis for, particularly automatically, adjusting the distance and/or relative orientation based on the detected values of the size.

Alternatively or in addition to the above described configuration, the apparatus may comprise a transport device configured to transport the material on one or more conveyor elements, wherein at least one of the roller array's rollers, in particular the at least one first roller, is configured to serve as one of the conveyor elements.

In other words, the roller array is arranged, relative to other conveyor elements of the transport device, such that at least some of the rollers of the roller array and the remaining conveyor elements act as transport elements for transporting wooden material. In particular, all rollers of the roller array may serve as conveyor elements. Thus, compared to known transport devices having rollers as conveyor elements, some of the rollers are exchanged with a type of roller that is configured to break down fibre agglomerations, i.e., the first roller. The above-described arrangement means that an element breaking down fibre agglomerations is formed integrally with the transport device.

Optionally, an additional roller array as specified above may still be provided over the conveyor elements in a manner specified above.

The invention also provides a wood-based panel manufacturing method comprising steps for processing wooden fibre agglomerations, in particular using the apparatus according to one of the preceding claims. The method comprises transporting material including the wooden fibre agglomerations along a transport path and rotating rollers of a roller array provided in the transport path, such that at least one first roller of the roller array while being rotated engages with the wooden fibre agglomerations. The first roller is configured such that when it engages with one of the wooden fibre agglomerations while being rotated, the wooden fibre agglomeration is at least partially broken down into smaller agglomerations and/or individual fibres.

Features, feature combinations, definitions, and advantages described above in the context of the apparatus similarly apply in the context of the method.

The method may comprise rotating the first roller and an adjacent second roller of the roller array in opposite rotation directions and/or at different rotation speeds, particularly, rotating the first roller at a higher rotation speed than the second roller.

The material may be transported using one or more conveyor elements, particularly the above-described conveyor elements. The roller array may then be arranged over the conveyor elements such that at least the first roller, in particular several or all of the rollers of the roller array, engages with the wooden fibre agglomerations while the material is transported on the one or more conveyor elements.

The method may comprise adjusting the distance between and/or relative orientation of the roller array and the one or more conveyor elements, in particular the position and/or orientation of the roller array. The adjustment may particularly be performed automatically, in particular, based on the size of the fibre agglomerations.

The size of fibre agglomerations may be detected, for example upstream of the roller array, and used as basis for adjusting the distance and/or relative orientation.

Alternatively or in addition, the material may be transported on one or more conveyor elements and at least one of the roller array's rollers, in particular the at least one first roller, may be configured to serve as one of the conveyor elements.

Advantageous embodiments will now be described in combination with the enclosed figures.

BRIEF DESCRIPTION OF THE FIGURES

Figs. 1A and 1B schematically illustrate an apparatus for manufacturing wood-based panels according to a first embodiment of the present invention;

Figs. 2A and 2B schematically illustrate an apparatus for manufacturing wood-based panels according to a second embodiment of the present invention;

Figs. 3A and 3B schematically show an exemplary configuration of the first roller of the roller array; and

Figs. 4A and 4B illustrate exemplary rotation directions of rollers of the roller array.

DETAILED DESCRIPTION OF EMBODIMENTS

Figures 1A and 1B show a schematic representation of an apparatus 1a for manufacturing wood-based panels 2a according to a first embodiment. The apparatus comprises a chamber 3 and an infeed 4 for introducing raw wooden material into the chamber. The material may include including fibre agglomerations 2b and/or fibre agglomerations may be formed from fibres included in the infeed material while the material is transported and/or processed in the apparatus. Furthermore, the apparatus comprises a transport device 5, including conveyor elements 5a and 5b. The conveyor elements comprise rollers 5a and conveyor belt 5b in the example shown in Figure 1A. However, they may also comprise only conveyor belts or only rollers. Moreover, the apparatus comprises an assembly site 6, where the raw material is assembled to form a stack or mat of material that is to be pressed to form a wood-based panel. The apparatus may also have a pressing site 7 for pressing the stacked material to form a wood-based panel. Alternatively, the pressing may occur in a site outside of the apparatus, in which case the apparatus does not have such a site. Furthermore, the apparatus comprises an outfeed 8, through which the boards or assembled material mats may be transported out of the chamber. The transport elements transporting material through the outfeed may be arranged such that they have a transport surface that is inclined with respect to the horizontal direction, for example by -15 degrees to +15 degrees. The chamber may be a wind chamber having a blower 9 for blowing the material along the transport direction.

The transport path for material including wooden fibre agglomerations extends from the infeed, along a transport direction, which is indicated by arrow 10, towards the assembly site. Depending on the configuration of the layers of the board and which layer is currently formed, the transport direction of the board may also be in the opposite direction.

The apparatus according to this embodiment further comprises a roller array 11. The roller array comprises four first rollers 11a arranged adjacently to each other. There may be any other number of rollers. In particular, there may be any other number of second rollers having different configurations than the first rollers. In such a case, for example, at least one of the second roller may be arranged between each pair of first rollers.

As can be seen in the more detailed view of the roller array in Figure 1B, the first roller has a circumferential surface having spikes 12. An example for a possible surface texture or profile of the first roller will be described in more detail below in the context of Figures 3A and 3B.

Thus, the first roller is configured such that when it engages with a wooden fibre agglomeration while being rotated, the wooden fibre agglomeration is at least partially broken down into smaller agglomerations and/or individual fibres. That is, the spikes grind into the fibre agglomerations and break down the agglomeration.

As can be seen in the Figures 1A and 1B, the roller array is arranged in the transport path. It is arranged such that at least the first roller is engageable with the wooden fibre agglomerations while the material is transported along the transport path. In particular, in the embodiment shown in Figures 1A and 1B, the roller array is arranged over the conveyor elements 5a, i.e., the rollers that transport the wooden material. Alternatively, the roller array may be arranged over other types of conveyor elements, e.g., conveyor belts.

Such an arrangement is particularly advantageous when a surface layer of the board is to be formed. That is, the first rollers may, due to their shape that serves to break up agglomerations, allow for bigger particles to fall into the forming bed than is desired for the surface layer. In other words, in some cases the first rollers may be too coarse for being part of the sorting of particles that fall into the forming bed.

Figure 1B schematically indicates adjustment means 13, which are optionally provided. The adjustment means are configured to adjust the distance between and/or relative orientation of the roller array and the conveyor elements. In the present embodiment, as an example, they are configured to adjust the position of the roller array. In particular, the adjustment means are configured to move the roller array in a vertical direction, thereby increasing or decreasing the distance from the roller array. Additionally or alternatively, the adjustment means may be configured to move at least some of the conveyor elements to adjust their position and/or orientation.

Optionally, the adjustment means may also be configured to adjust the orientation of the roller array. For example, this configuration may be used for tilting the roller array, such that the angle between the roller array and the transport device may be changed.

The apparatus may optionally comprise a control device 14. The control device may be configured to control the rotation speed and/or direction of the rollers of the roller array, individually or collectively. In addition or alternatively, the control device may be configured to control the adjustment means such that the position and/or orientation of the array can be adjusted automatically. In particular, the adjustment means may be connected, via a data connection, to the control device. Data connections are indicated by broken lines 16. Alternatively, the adjustment means may comprise a control device for controlling an automatic adjustment.

The apparatus may optionally comprise detection means 15, which may for example be arranged upstream of the roller array. The detection means are configured to detect the size of fibre agglomerations transported towards the roller array. The apparatus may be configured to use the detected values of the size as basis for, particularly automatically, adjusting the distance and/or relative orientation based on the detected values of the size. In particular, the detection means may be connected, via a data connection, to the above-described control device for controlling automatic adjustment and provide the detected values to the control device using the data connection.

Figures 1A and 1B schematically show driving means 17 configured to rotate the rollers of the roller array. The rollers may each be driven by a separate driving element of the driving means, e.g., a motor. Alternatively, one or more of the rollers may be mechanically coupled, such that they are collectively driven by a common driving element, e.g. motor. Different rotation speeds, in such a case, may be achieved by suitable transmissions.

A control device, in particular the above described control device, may be provided to control the rotation speed and direction of the rollers by controlling the driving means accordingly.

The control device may be connected to, via a data connection, or part of a control device controlling driving means 18 driving the conveyor elements. The control device may be

configured such that a coordinated, particularly synchronized, control of the driving means of the roller array and the driving means of the conveyor elements is performed.

The control device may comprise or be connected to an interface 19 for receiving user input, for example for setting operation parameters during normal production and/or during idle run without material.

Optionally, a set of fractioning rollers 20 may be arranged below the conveyor elements to sort the wooden material into different sizes.

Figures 2A and 2B show schematic representations of an apparatus 1b for manufacturing wood-based panels according to a second embodiment.

Where the elements are the same as in the first embodiments, the same reference numerals will be used and a description thereof will be omitted. Regarding these elements, reference is made to the above description.

The main difference between the first and the second embodiment is that instead of roller array 11 arranged over the conveyor elements, a roller array 21 is employed. The roller array 21 is configured similarly to roller array 11 in that it comprises three first rollers 21a and three second rollers 21b alternately arranged adjacently to each other. There may be any other number of rollers. The driving means 17 are shown as having a plurality of separate motors 17a, each connected with one of the rollers.

However, the roller array in this case is not arranged over the conveyor elements. The roller array is instead integrated into the transport device and the rollers of the roller array are arranged and configured such that at least some of them serve as conveyor elements of the transport device. In the example shown in Figures 2A and 2B, this means that the rollers of the roller array are arranged on the same height as the other conveyor elements and in an extension thereof. That is, the outermost roller of the roller array towards an upstream side of the roller array is immediately adjacent to other conveyor elements. Alternatively, not shown here, the roller array may be arranged on a different level and material may fall from upstream conveyor elements onto the roller array, which processes the material and transports it further downstream.

Such an arrangement is particularly advantageous when a core layer of the board is to be formed. The particles used in the core may be coarser than in the surface layer, such that

even if the first rollers may allow for coarse particles to fall into the forming bed, this is not detrimental to the quality of the resulting board. In other words, in some cases the first rollers may be part of the sorting of particles that fall into the forming bed. In case the required particles are smaller than can be sorted by the first rollers, it is also possible to provide additional sorting rollers below the first rollers.

As can be seen in the more detailed view of the roller array in Figure 2B, the first roller has a circumferential surface having spikes 22. The spikes may be the same as or may be different from the above-described spikes depending on whether special requirements apply in view of their function as conveyor elements. An example for a possible surface texture or profile of the first roller will be described in more detail below in the context of Figures 3A and 3B.

In such a configuration, the driving means may be configured such that the first roller and an adjacent second roller are rotated in opposite rotation directions and/or at different rotation speeds. In particular, the first roller may be driven at a higher rotation speed and in an opposite direction than the second roller. Accordingly, the second roller serves as an anvil with respect to the first roller. Optionally, the roller array may comprise several pairs of adjacent first and second rollers.

In this arrangement, it is also possible that the apparatus comprises elements, for example other rollers, which do not have any particular limitations as to their surface texture, and/or plates arranged over the transport path so as to act as counter-force to the first rollers. This may allow for the first rollers to more efficiently engage with the agglomerations.

Figures 3A and 3B show an example of the circumferential surface of the first roller 11a or 21a. The roller comprises the spikes 12 or 22, which, in this example, are scoop-shaped. That is, each spike has a concave surface side. The concave surface side of each of the spikes may face in the same circumferential direction. In operation, a roller having such a surface may be arranged and driven such that the concave sides of the spikes form the leading edge. Other spike shapes are also possible.

It should be noted that an apparatus may also combine the first and second embodiments. That is, a first roller array may be provided over the conveyor elements as shown in

Figures 1A and 1B and a second roller array may at least partially serve as conveyor elements as show in Figures 2A and 2B.

The invention also provides a wood-based panel manufacturing method. The method comprises steps for processing wooden fibre agglomerations. For such a method, in particular, one of the above-described apparatuses may be used. However, an apparatus with a different configuration may also be used.

The method includes transporting material including the wooden fibre agglomerations, which may have been introduced through an infeed of a chamber of a manufacturing apparatus, along a transport path, for example a transport path as set out above.

Moreover, while transporting the material along the transport path, rollers of a roller array provided in the transport path are rotated, such that at least one first roller of the roller array while being rotated engages with the wooden fibre agglomerations, being transported along the transport path and pass the roller array.

The first roller is configured such that when it engages with one of the wooden fibre agglomerations while being rotated, the wooden fibre agglomeration is at least partially broken down into smaller agglomerations and/or individual fibres. A first roller as described above may be used.

The method may further comprise stacking wooden material after it has passed the roller array to form a mat and pressing the mat to form a wood-based panel, which may then be transported out of the chamber. Alternatively, the pressing may occur in a site outside of the apparatus.

Figures 4A and 4B show exemplary rotational directions of the rollers of the roller array that may be used in the method.

As an example, as shown in Figure 4A, the outermost roller 11a to the upstream side and an adjacent roller 11a' of the roller array may rotate in opposite rotation directions. As an example, the outermost roller may rotate in the same direction as the conveyor rollers 5a. In Figure 4A, the remaining rollers of the roller array all rotate in the same direction. However, some of these rollers may alternatively also rotate in the same direction as the outermost roller to the upstream side, in particular, the outermost roller to the downstream side.

This arrangement is particularly advantageous when, as shown in Figure 4A, the roller array is arranged over the conveyor elements similarly to the configuration in Figure 1B. In particular, this allows for efficiently grinding down the agglomerations without allowing too coarse particles to fall onto the forming bed. However, the arrangement can also be applied in a configuration similar to that of Figure 2B.

Figure 4B shows another possible combination of rollers and rotation directions. In this example, first rollers 21a and second rollers 21b are alternately provided. The first rollers each rotate in a first direction and the second rollers each rotate in the opposite direction. In this example, the first and second rollers may also rotate at different rotation speeds. In particular, the first rollers may rotate at a higher rotation speed than the second rollers. This is particularly advantageous when at least some rollers of the array also function as conveyor elements (e.g. as shown in Figures 2A and 2B), i.e., when the material is provided on top of the rollers when breaking down the fibre agglomerations. The second rollers will function as anvils in such a configuration. The first rollers may particularly be rotated such that they transport material in a transport direction, and the second rollers such that they slow down the material flow. As outlined in the context of Figures 2A and 2B, even in cases where the first rollers 21a, due to their shape, allow for coarse particles to fall through between them, it may still be acceptable for them to participate in the sorting process, for example when the coarser core layer is formed or when additional sorting rolls are provided on a lower layer.

The material may be transported using one or more conveyor elements and the roller array may be arranged over the conveyor elements, for example as shown in Figures 1A and 1B. The roller array may be arranged such that at least the first roller, in particular several or all of the rollers of the roller array, engages with the wooden fibre agglomerations while the material is transported on the one or more conveyor elements.

In this setup, the method may include adjusting, particularly automatically, the distance between and/or relative orientation of the roller array and the one or more conveyor elements, in particular the position and/or orientation of the roller array, in particular, based on the size of the fibre agglomerations.

When the position and/or orientation of the roller array and/or the conveyor elements is adjusted based on the size of the fibre agglomerations, the method may comprise a

detection step, wherein the size of fibre agglomerations is detected. This may particularly be done upstream of the roller array. The detected values may be used as basis for adjusting the distance and/or relative orientation.

In particular, in such a configuration the position and/or orientation may particularly be dynamically adjusted while transporting a stream of material along the transport path. That is, when a first portion of material has smaller fibre agglomerations than a second portion being fed after the first portion, the distance between the conveyor elements and the roller array may automatically be increased after the first portion has passed the roller array. The increasing of the distance may be gradual, in which case it may already start shortly before the first portion has passed the roller array.

In addition or alternatively, for example when using an apparatus as shown in Figures 2A and 2B, the material is transported on one or more conveyor elements and at least one of the roller array's rollers, in particular the at least one first roller is configured to serve as one of the conveyor elements. In such a configuration, the first roller or rollers engage with wooden material on top of the roller array and are broken down. They may then be moved forward or fall through gaps between the rollers to a site for further processing the material.

Although the previously discussed embodiments and examples of the present invention have been described separately, it is to be understood that some or all of the above-described features can also be combined in different ways. The above-discussed embodiments are not intended as limitations, but serve as examples, illustrating features and advantages of the invention.

CLAIMS

1. An apparatus for manufacturing wood-based panels, comprising:
a roller array comprising at least one first roller configured such that when it engages with a wooden fibre agglomeration while being rotated, the wooden fibre agglomeration is at least partially broken down into smaller agglomerations and/or individual fibres,
wherein the roller array is arranged in a transport path for material including wooden fibre agglomerations such that at least the first roller is engageable with the wooden fibre agglomerations while the material is transported along the transport path.
2. The apparatus according to claim 1, wherein the circumferential surface of the first roller comprises spikes, particularly scoop-shaped spikes, particularly spikes having a height of 3-25 mm, in particular 5-15 mm, in particular 7-10 mm.
3. The apparatus according to claims 1 or 2, comprising driving means configured to rotate the first roller and an adjacent second roller of the roller array in opposite rotation directions and/or at different rotation speeds, particularly, to rotate the first roller at a higher rotation speed than the second roller.
4. The apparatus according to claim 3, wherein the roller array comprises a plurality of pairs of first and second rollers arranged such that first and second rollers are alternately provided.
5. The apparatus according to any one of claims 1 to 4, comprising a transport device with on one or more conveyor elements, wherein the roller array is arranged over the conveyor elements such that at least the first roller is engageable with the wooden fibre agglomerations while the material is transported on the one or more conveyor elements.
6. The apparatus according to claim 5, comprising adjustment means configured to adjust the distance between and/or relative orientation of the roller array and the one or more conveyor elements, in particular, to adjust the position and/or orientation of the roller array.
7. The apparatus according to claim 6, the adjustment means being configured to adjust the distance and/or relative orientation automatically, in particular, based on the size of the fibre agglomerations and/or the height of material flow to be processed.

8. The apparatus according to claim 7, comprising detection means configured to detect the size of fibre agglomerations, particularly upstream of the roller array, the apparatus being configured to use the detected values of the size as basis for, particularly automatically, adjusting the distance and/or relative orientation based on the detected values of the size.

9. The apparatus according to claim 1, comprising a transport device configured to transport the material on one or more conveyor elements, wherein at least one of the roller array's rollers, in particular the at least one first roller, is configured to serve as one of the conveyor elements.

10. A wood-based panel manufacturing method comprising steps for processing wooden fibre agglomerations, in particular using the apparatus according to one of the preceding claims, comprising:

transporting material including the wooden fibre agglomerations along a transport path and rotating rollers of a roller array provided in the transport path, such that at least one first roller of the roller array while being rotated engages with the wooden fibre agglomerations,

the first roller being configured such that when it engages with one of the wooden fibre agglomerations while being rotated, the wooden fibre agglomeration is at least partially broken down into smaller agglomerations and/or individual fibres.

11. The method of claim 10, comprising rotating the first roller and an adjacent second roller of the roller array in opposite rotation directions and/or at different rotation speeds, particularly, rotating the first roller at a higher rotation speed than the second roller.

12. The method according to claim 10 or 11,

wherein the material is transported using one or more conveyor elements, wherein the roller array is arranged over the conveyor elements such that at least the first roller, in particular several or all of the rollers of the roller array, engages with the wooden fibre agglomerations while the material is transported on the one or more conveyor elements.

13. The method according to claim 12, comprising adjusting, particularly automatically, the vertical distance between and/or relative orientation of the roller array

and the one or more conveyor elements, in particular the position and/or orientation of the roller array, in particular, based on the size of the fibre agglomerations and/or the height of material flow to be processed.

14. The method according to claim 13, wherein the size of fibre agglomerations is detected, particularly upstream of the roller array, and used as basis for adjusting the distance and/or relative orientation.

15. The method according to claim 10 or 11, wherein the material is transported on one or more conveyor elements and at least one of the roller array's rollers, in particular the at least one first roller, is configured to serve as one of the conveyor elements.

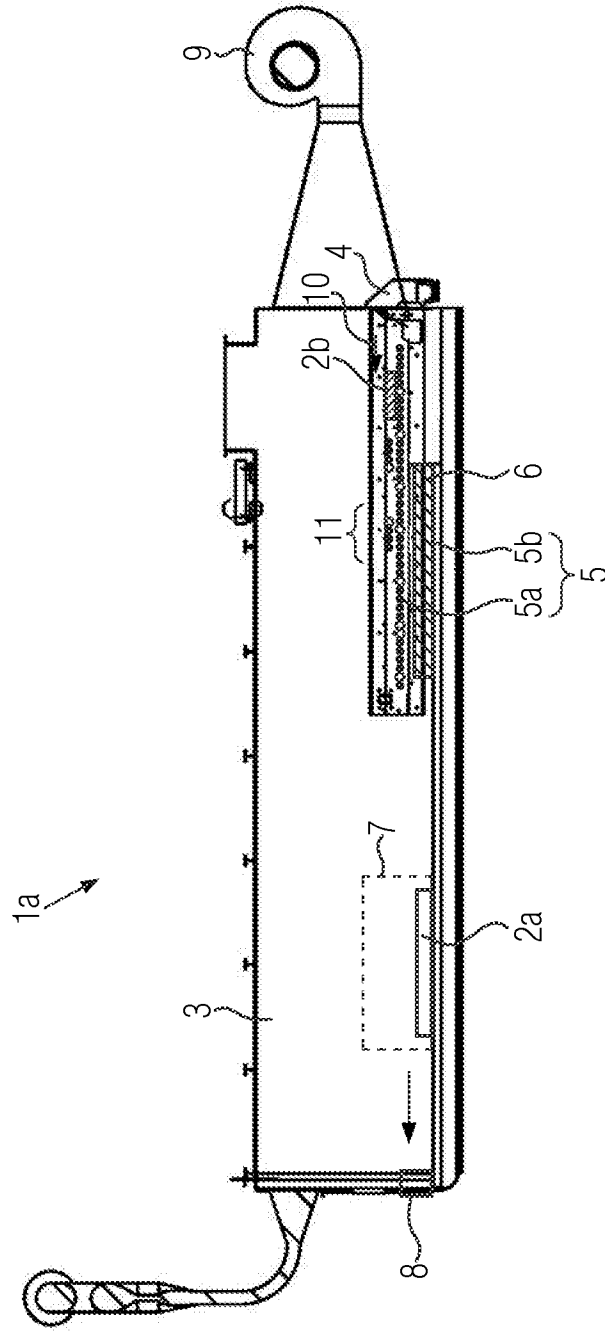


FIG. 1A

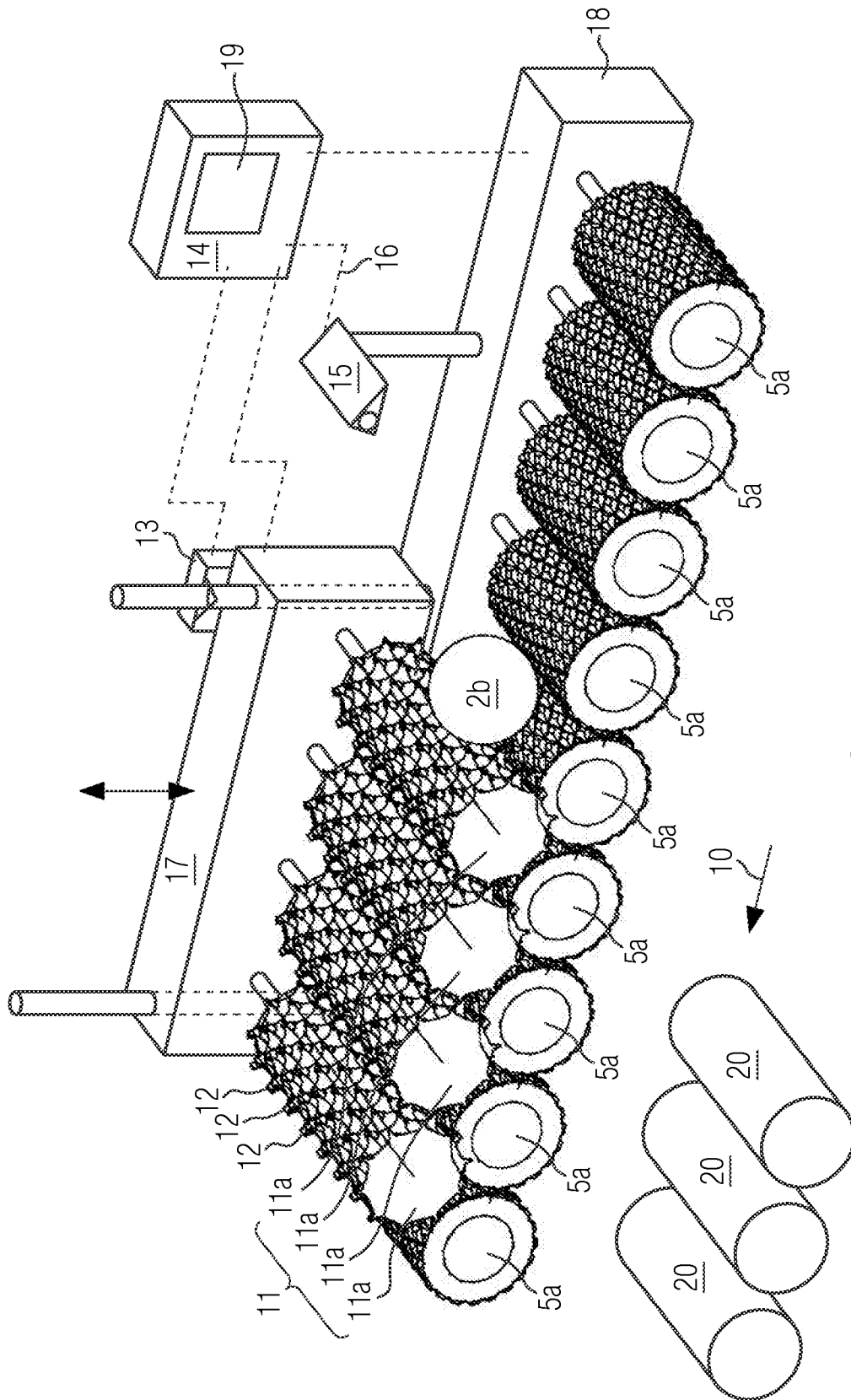


FIG. 1B

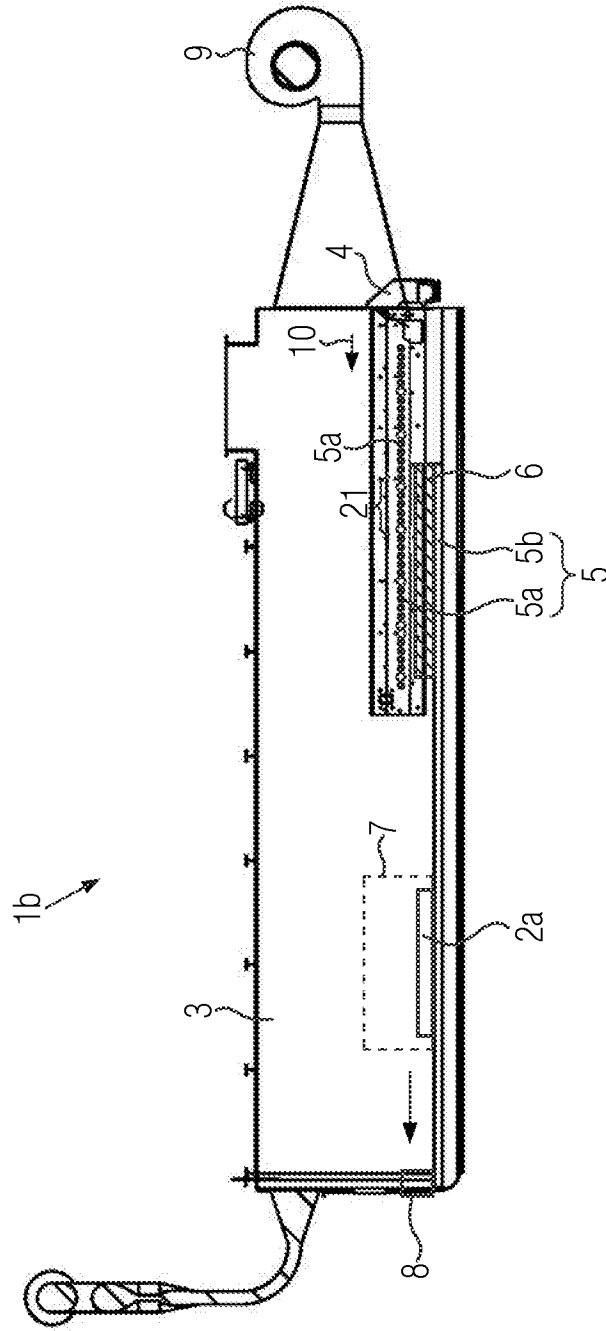


FIG. 2A

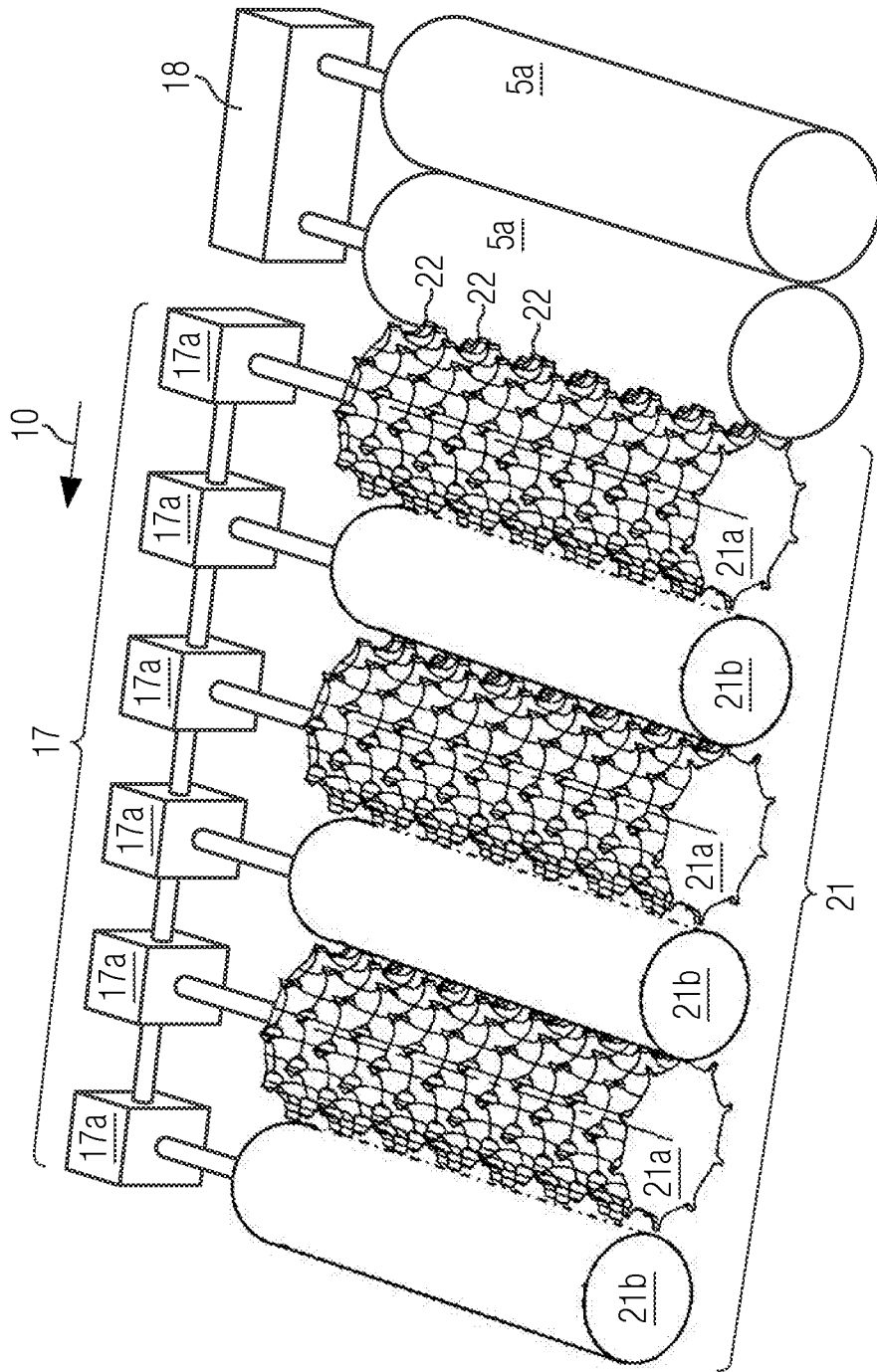


FIG. 2B

5/7

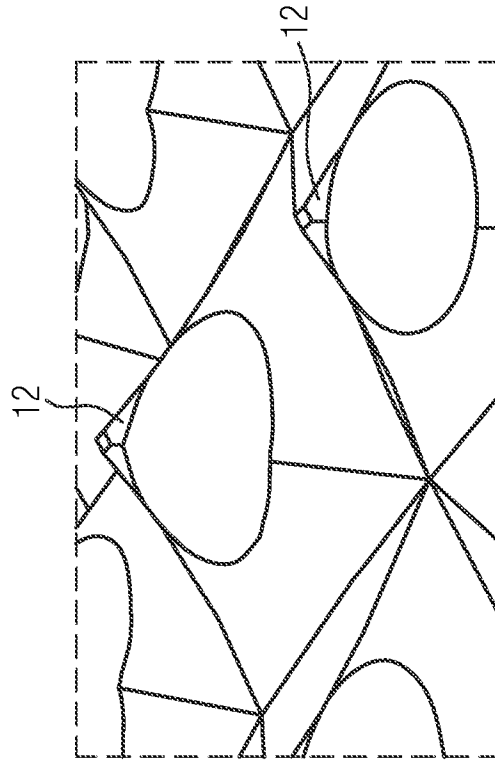


FIG. 3B

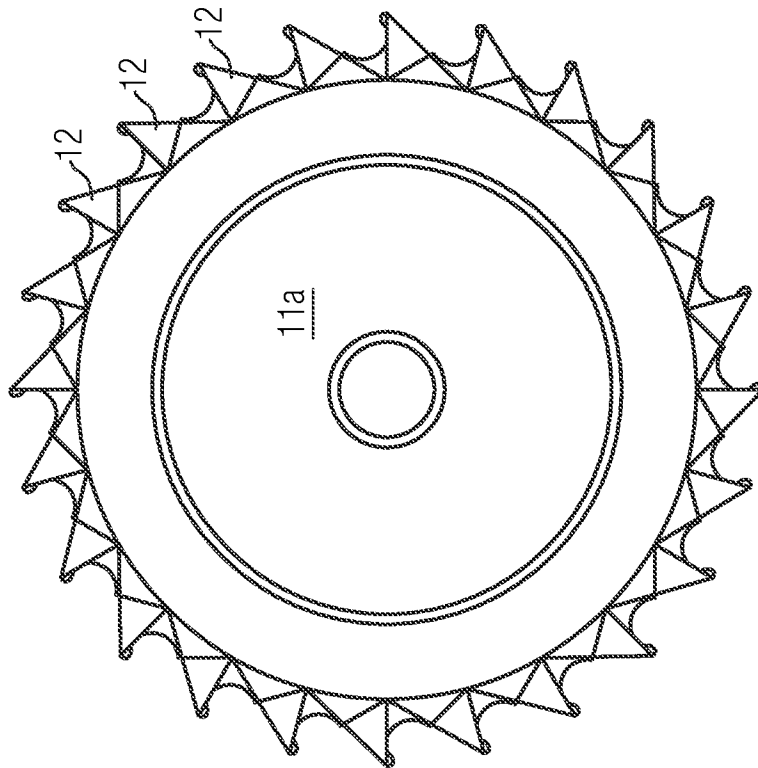


FIG. 3A

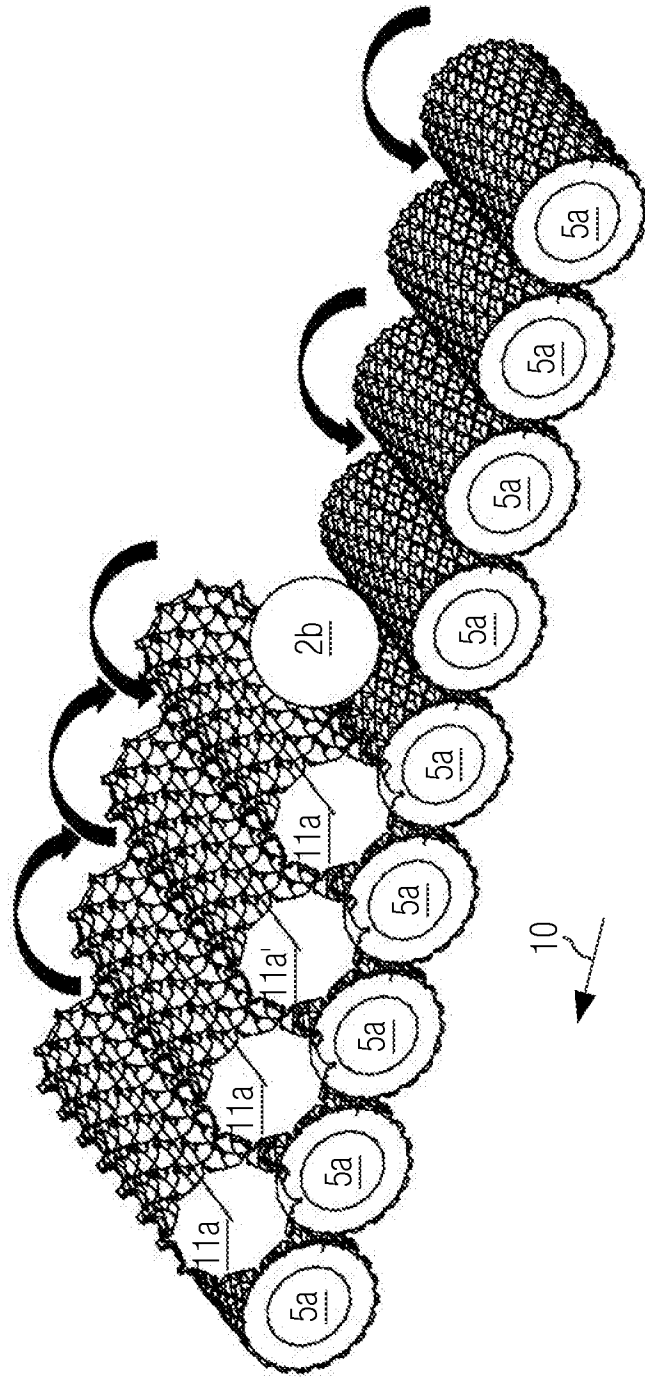


FIG. 4A

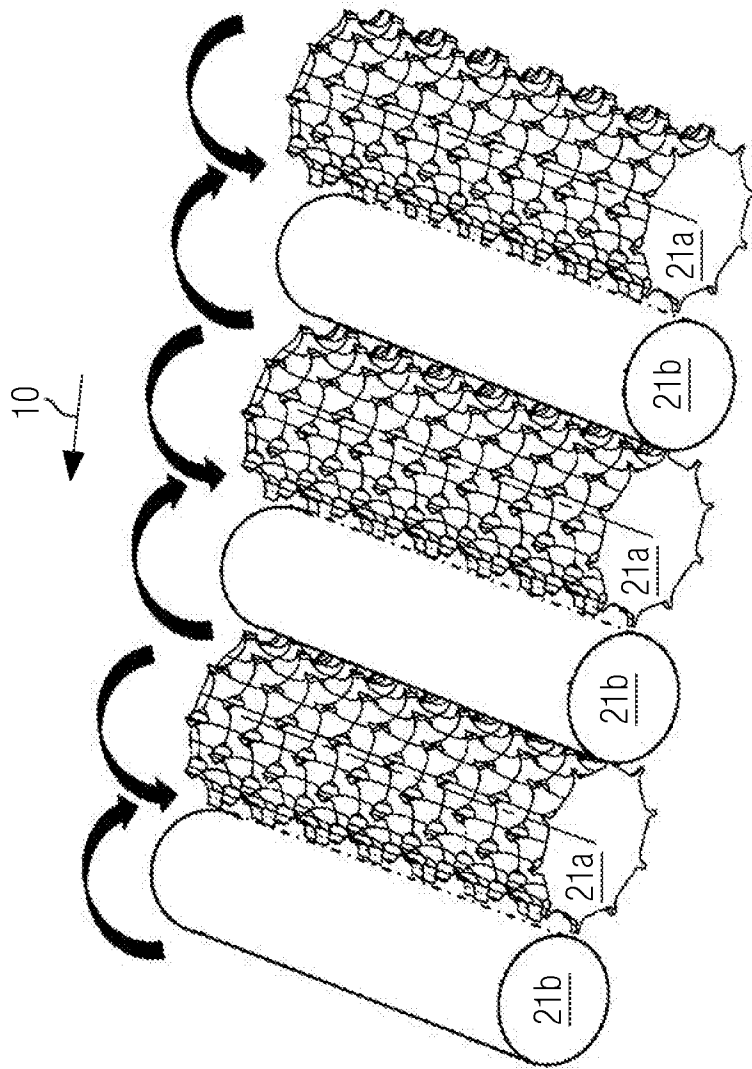


FIG. 4B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2020/050368

A. CLASSIFICATION OF SUBJECT MATTER		
IPC: see extra sheet		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC: B27N, B32B, B32N, D21J, E04C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE, DK, FI, NO classes as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPO-Internal, PAJ, WPI data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1938934 B1 (DIEFFENBACHER GMBH & CO KG ET AL), 2 July 2008 (2008-07-02); paragraphs [0001]-[0002], [0005], [0009]-[0010], [0017]-[0019]; figures 1-5; claims 1-3,6	1-4, 9-11, 15
A	--	5-8, 12-14
X	SE 1600039 A1 (GÅRAN LUNDGREN ET AL), 12 August 2017 (2017-08-12); pages 2, 5-6; figure 5; claims 7,9	1-2, 5-8, 10-14
A	--	3-4, 9, 15
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents:		
"A" document defining the general state of the art which is not considered to be of particular relevance		"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"D" document cited by the applicant in the international application		"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date		
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)		"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		"&" document member of the same patent family
Date of the actual completion of the international search	Date of mailing of the international search report	
29-05-2020	29-05-2020	
Name and mailing address of the ISA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Authorized officer Kristin Persson Telephone No. + 46 8 782 28 00	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2020/050368

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	--	3-8, 11-14
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A	US 6645593 B1 (ANDERSEN CARSTEN), 11 November 2003 (2003-11-11); column 3, line 49 - column 4, line 5; figure 2 -- -----	1-15

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International Patent Classification (IPC)

B27N 3/14 (2006.01)

B27N 3/04 (2006.01)

B32B 5/16 (2006.01)

B32B 21/02 (2006.01)

E04C 2/16 (2006.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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