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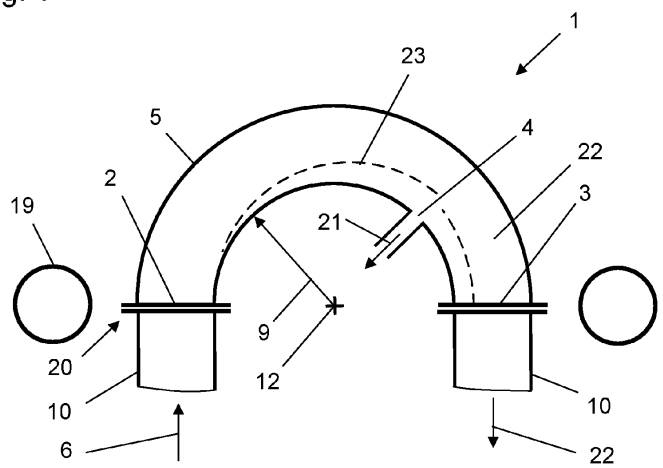
(54) **BLOW LINE AND METHOD FOR TRANSPORTING FIBERS SUSPENDED IN STEAM AS WELL AS AN STAGE OF EXPANSION SET FOR SAID BLOW LINE**

(57) The invention refers to a blow line and a method for transporting fibers in a duct, whereas the fibers are suspended in steam and are moving in the blow line (10) respectively the duct as a steam-fiber stream (6) with a higher pressure than the ambient pressure, said duct preferably arranged in a fiber processing plant, comprising at least one tube (5) with a bend (1) for guiding the steam-fiber stream (6) along a curve with a rotation angle (32) for separating steam (21) radially inward in the tube (5) from said steam-fiber stream (6) flowing radially outwards along the curve, said tube (5) comprising in direction of the flow an inlet (2) for the steam-fiber stream (6) before the curve of the bend (1) and an outlet (3) after the curve of the bend (1) for delivering a steam reduced steam-fiber stream (22). The invention is **characterized in** that an opening (4) for the separated steam (21) is arranged radially inwards in the wall of the tube (5), that the opening (4) is arranged in the direction of the flow with a determined distance (24) before the outlet (3) and that the opening (4) is within the curve of the bend (1) and/or along the rotation angle (32) of the curve (1005). Last but not least the invention refers to a stage of expansion for a blow line or similar applications.

Fig. 1



EP 4 464 483 A1

Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a blow line for transporting fibers in a duct, whereas the fibers are suspended in steam and are moving in the blow line respectively the duct as a steam-fiber stream with a higher pressure than the ambient pressure, said duct preferably arranged in a fiber processing plant, according to the preamble of claim 1.

[0002] The present invention further refers to a method for transporting fibers in said blowline according to claim 16 and an stage of expansion set for said blow line according to claim 17.

BACKGROUND OF THE INVENTION

[0003] EP 2 213 431 A2 discloses a bend, a blow line, and a fiberboard plant. In this known fiberboard plant, a refiner makes fibers out of wood chips by using high-pressure steam and rotating refiner discs. The high-pressure steam blows the fibers out into the blow line resulting in a steam-and-fibers stream which the blow line guides to the dryer. Depending on the size and design of the fiberboard plant, the blow line may have a length of up to 100 m. A gluing system might be part of the blow line and is used to inject atomized glue into the steam-and-fibers stream. The dryer is preferably a tube dryer, and the blow line extends into the tube of the tube dryer so that the outlet of the blow line empties into the dryer and ejects the steam-and-fibers stream into the hot, dry air in the tube.

[0004] Due to the moisture contained in the steam of the steam-and-fibers stream, the drying of the fibers is quite energy consuming.

[0005] EP 2 855 108 B1 discloses a bend for such a blow line, in which the fibers and the steam are separated a stripper or separator using an direction change of the steam-and-fibers stream in a part of the tube used as blow line. The direction change is mainly arranged by a curve or bend of the tube. At the end of the direction change the tube is splitting up into two separate tubes, whereas the separate tubes are arranged radially to the center of rotation of the curve of the tube and in doing so the radially inner tube is used for the steam and the radially outer tube is receiving the concentrated and squeezed steam-and-fiber-stream.

[0006] It so happens that the reduction of steam and the concentrated remaining steam-and-fiber-stream is helpful in saving energy as less steam has to be dried and removed from the steam-fiber-stream before it is possible to use the produced fibers in a dry process. Even in a wet-process less energy is necessary.

[0007] The mentioned innovations and systems have been accepted in the industry but still the performance can be improved and the energy consumption can be further reduced. Furthermore such bends or curves in high pressure usage underlay certain regulations and have to be checked regularly. The production and commissioning of such a high pressure system needs a close supervision and safety certificates.

SUMMARY OF THE INVENTION

[0008] It is an object of the present invention to reduce the energy consumption in a fiberboard plant or another fibers-processing plant, such as a pulp mill or a board mill. It is a further objective of the invention to provide a safe apparatus which is less costly than the mentioned systems before and can be maintained more efficiently. Furthermore a stage of expansion should be provided to enhance blow lines and their energy consumptions avoiding costly rearrangements in the plants. Last but not least a stage of expansion should be able to allow an operating company of a plant with a blow line to rearrange a blow line more easily especially by adding a bend according to the invention with the possibility for a separation of steam in the blow line. The pressure difference from the pipe of the blow line to the ambient pressure is usually more than three bars, mostly more than 5 to 10 bars. There might be blow lines with an even higher pressure for transporting the steam-fiber stream.

[0009] The object of the invention is solved by the solutions of claims 1, 16 and 17.

[0010] Regarding the blow line the invention emanates from an blow line for transporting fibers in a duct, whereas the fibers are suspended in steam and are moving in the blow line respectively the duct as a steam-fiber stream with a higher pressure than the ambient pressure, said duct preferably arranged in a fiber processing plant, comprising at least one tube with a bend for guiding the steam-fiber stream along a curve with a rotation angle for separating steam radially inward in the tube from said steam-fiber stream flowing radially outwards along the curve, said tube comprising in direction of the flow an inlet for the steam-fiber stream before the curve of the bend and an outlet after the curve of the bend for delivering a steam reduced steam-fiber stream.

[0011] The problem is solved for a blow line or a bend, preferably a steam/fiber separator, by an opening for the separated steam arranged radially inwards in the wall of the tube, by said opening arranged in the direction of the flow with a determined distance before the outlet and by an opening which is within the curve of the bend and/or along the rotation angle of the curve.

[0012] The bent section deflects the steam-and-fibers stream introduced through the inlet so that the fibers, due to their higher inertia and mass density in comparison with the steam, are concentrated on radially outward trajectories and thus are separated from a stream that is particularly more or less pure or purified, on radially inward trajectories. Thus, the opening in the wall of the tube allows for discharging the separated steam, and the outlet allows for injecting the concentrated, separated steam-and-fibers stream into following up pipes, ducts, cyclones, a dryer or a pulp chest. Since the separated steam-and-fibers stream is concentrated, namely contains less steam and thus less moisture in comparison with the steam-and-fibers stream introduced through the inlet, less energy will be required to dry the fibers in later process steps. The separated steam may be recycled as needed, and may for instance be guided back to a steam recycling means such as a pre-steaming bin and/or a refiner, and/or to a heat exchanger and/or to a condenser and/or to another steam consumer.

[0013] Accordingly to the invention it is preferred that a curve or tube is designed with a constant diameter or constant shape from the so called inlet to the outlet. If one side or parts of the tube are changing its trend it would be a indication that the bent or curve has ended, mostly arranged by a switch or separator, combined with a divider for the different parts of the stream.

[0014] The opening can be easily arranged in the hole by a bore drill or may be intentionally left open in a cast and the edges or the area alongside may be reinforced by certain means to secure the let out of the high pressurized steam out of the bend. It is not possible to arrange a valve directly after or at the opening to regulate the let out of the steam, therefore a closed loop controlled system is easier to be conducted and has a shorter reaction time. Vibrations of the pulsating blow-line are not coming up in the steam separating area as well as it usually happens in the systems of the state of the art.

[0015] Preferably the plane of the permeable diameter of said opening is essentially arranged parallel to the direction of the flow of the stream.

[0016] It is especially preferred to arrange the opening in direction of the flow in the last third of the curve of the bend or the rotation angle.

[0017] It might be advantageous to arrange an opening with a circular, oval, or elliptic geometry. Furthermore the opening can be arranged as a grove, preferably linear or bent.

[0018] In a further aspect there might be an advantage if the cross section of the bend is at least partially circular, oval, elliptic, trapezoidal or omega-shaped, wherein preferably the smallest or shortest length of the geometry is arranged radially inwards whereas the larger or longer length of the geometry is arranged radially outwards to enhance the separation by preparing the fibers more space radially outwards.

[0019] It is favored when at least the curve of the bend and/or at least a part of the cross section is arranged as cast and/or has been cast out of cast iron. So far the arrangement of such bends has been necessarily worked out with a lot of different parts, shapes and costly assembly and working time.

[0020] Additionally or alternatively in direction of the flow before and/or after the bend transition pieces and/or transition areas adjacent to the inlet or the outlet are arranged to connect the bend with the blow line or follow up transporting means, especially to adapt different cross sections and/or to adapt changes of the trajectory.

[0021] In a further aspect of the invention or its arrangement the bend is split or arranged along the direction of the flow in at least two parts, a shape and a cover, which are preferably connected with a positive mechanical engagement, like bolts. This is preferably useful in connection with a cast of the shape, especially as a one-piece-structure.

[0022] It might be advantageously if the cover in view of the cross section is perpendicular to the direction of the flow and is essentially planar whereas the shape is essentially arranging the permeable diameter for the steam-fiber stream. It might be possible to use non planar covers to optimize the shape of the permeable diameter of the bend.

[0023] Additionally it might be helpful when the geometry of the cross section of the shape is a trapezoid, an omega-shape or a hemicycle, whereas the connection of the shape with the cover is forming the tube.

[0024] Preferably by using a trapezoidal shape the opposite surface to the smallest edge of a trapezoidal shape is arranged by the cover and/or the opening is in the smallest edge.

[0025] It is especially an advantage if the the cover is arranged as an interchangeable wear and tear part. During maintenance and cleaning of the bend the cover can be removed and replaced by a new one.

[0026] In regard of the production of the bend and its manufacture it might be necessary to thicken the area of the opening of the tube, especially to receive a drill bore for the opening and/or a basic part as a connector for the transfer of the steam with other means.

[0027] In an most preferred embodiment a flange, a valve, a rinsing system for the opening and/or a replaceable sleeve for adjusting the diameter of the opening is arranged directly, in combination or adjacent to each other to regulate the let off of the steam. Said valve is preferably implemented as on/off-valve, a full bore valve and/or an 100% open valve.

[0028] Additionally or alternatively the tube and/or the bend is integrally molded excluding the areas to be covered by the cover and preferably including the flanges for the inlet, the outlet and/or the opening.

[0029] Additionally or alternatively a gluing system is arranged before or after the bend in the blow line.

[0030] In the following a solution for a method for transporting fibers in a duct of a blow line is described, whereas the

fibers are suspended in steam and are moving in the blow line respectively the duct as a steam-fiber stream in a higher pressure than the ambient pressure, said duct preferably arranged in a fiber processing plant, comprising at least one tube with a bend for guiding the steam-fiber stream along a curve with a rotation angle for separating steam radially inward in the tube from said steam-fiber stream flowing radially outwards along the curve, said tube comprising in direction of the flow an inlet for the steam-fiber stream before the curve of the bend and an outlet after the curve of the bend for delivering a steam reduced steam-fiber stream.

[0031] The problem is solved for such a method by the possibility to let out separated steam from the steam-fiber stream via an opening arranged radially inwards in the wall of the tube, said let out is arranged before the steam reduced steam-fiber stream is reaching the outlet and is conducted along the curve of the bend and/or along the rotation angle of the curve.

[0032] An advantageous stage of expansion for a blow line comprisis a bend with or without transition pieces to be connected onto a blow line in which fibers are suspended in steam and are moving in a duct of the blow line as a steam-fiber stream with a higher pressure than the ambient pressure, said duct preferably arranged in a fiber processing plant, said stage of expansion comprising at least one tube with a bend for guiding the steam-fiber stream along a curve with a rotation angle for separating steam radially inward in the tube from said steam-fiber stream flowing radially outwards along the curve, said tube comprising in direction of the flow an inlet for the steam-fiber stream before the curve of the bend and an outlet after the curve of the bend for delivering a steam reduced steam-fiber stream.

[0033] The stage of expansion is characterized in that an opening for the separated steam is arranged radially inwards in the wall of the tube, that the opening is arranged in the direction of the flow with a determined distance before the outlet and that the opening is within the curve of the bend and/or along the rotation angle of the curve.

[0034] Preferably such stage of expansion can be especially used as an installable in an existing blow line with a certain central axis by cutting out a determined part of the blow line and that by using at least one or two transition pieces and the bend the trajectory of the stream is at least partially different in reference to the central axis of the blow line.

[0035] The remarks about one of the aspects of the invention, especially about particular features of this aspect, also appropriately apply to the other aspects of the invention.

[0036] Further features of the invention. As such these features might be combined or used alone (every sentence) to enhance the invention at hand.

[0037] The bend may be arranged with a certain determined rotation angle or an angular dimension, preferably from at least 90° to at least 180°, and that the middle of the opening is arranged in the flow direction in the later area of the angular dimension. For example at least with an angle of 90% or less, preferably with 85% or less, especially with 75% or less of an rotating angle of the bend. Calculating such dimensioning values for an 180° bend would result in an angle for the opening of 162°, 153°, 135°. In reality this calculation might be rounded or is used as center of the opening.

[0038] Therefore it is preferably a main idea of the invention to have an opening in the wall of the tube, which is distanced to the end of the bend, hence distance to the outlet of the bend.

[0039] To describe the position of the opening for the steam with other words it might be necessary to obtain a better understanding about the difference to the state of the art:

The bend has a curve along a certain rotation angle, e.g. 180°. The inlet or the outlet can be defined either at the location of a flanges of the tube or between the starting and the end point of the curve, e.g 0° and 180° of the rotation angle as the 180° rotation angle is just an example. The centre of the rotating angle should be the central axis of rotation of the bend. The angle of rotation for the bend might be adapted out of several possibilities and is mainly depending on the available installation space or the local circumstances. If the location of the inlet and the outlet is determined along the bend the opening should be located by the parameters mentioned above and is in the most cases along the rotating angle more near to the outlet than to the inlet of the bend. It is of an advantage if the opening and the outlet are not aligning or adjacent to each other, therefore if the center of the opening is arranged by 160°, there is a different in length between the opening and the outlet of about 20° along the rotating angle. Calculating from the rim of the opening it should be less than 20° as the a few degrees of the rotation angle have to be deducted from the radius of the opening itself.

[0040] The invention states that an opening for the steam (outlet) is arranged in the wall of the tube. As such the smallest diameter of that opening might be adjacent to the tube. Said diameter is obtained as usual in a right angle to the walls or the mechanical elements for guiding the steam out of the tube.

[0041] Comparisons with the state of the art might be confusing as there are pipe switches known and used in the field. Such pipe switches usually manifest a dividing element in the flow, like a sword, separating steel sheet or a separating ridge. In such arrangements the outlets are regularly adjacent to each other and their diameters at the beginning of the continuative pipes or ducts are not parallel to the steam flow as according to the invention. That said the opening of the invention for receiving the steam from the separated steam-fiber stream is arranged in the direction of the flow with a determined distance before the outlet and specially within the curve of the bend and/or along the rotation angle of the curve.

[0042] It might be noticeable and reasonable to define the tube as a monolithic bend, at least along the curve, preferably and especially from flange to flange. This integrally approach might include transition areas between the flange and the

bend. Nevertheless, there might be a possibility that a cover is necessary to open up the bend for maintenance. Still along the direction of the flow there should be at least one monolithic body as a cast, even if there are openings or windows between the inlet and the outlet of the bend.

[0043] If there is a need of a cover for the tube to obtain a window, the cover might be arranged radially outwards of the bend. The cover might be curved along the tube, from the inlet to the outlet. The cover might be integrally or segmented. Preferably the cover is used as a wear part to be exchanged regularly.

[0044] As a special feature it might be sensible to arrange a fortification at the hull in the area of the intended opening or drill hole for the opening.

[0045] As a production method a bend is cast as a tube. This tube might be integrally formed as one piece. There might be an channel or an window arranged, especially radially outwards, along the direction of the flow for maintenance. This channel or window might be closable with a cover. Preferably the cover is designed integrally as well. Such cover might be especially used as expendable part and might wear down due to the abrasive effect of the fibers moving along this cover because of the bend. This cover, especially formed along the bend, might be bolted along its borders to the one-piece cast of the tube.

[0046] It also might be useful to arrange the flanges, inlet, outlet, opening, as integrally molded parts of the tube or the bend. It is also possible to use inlet for these parts which are molded in the cast of the bend.

[0047] Along the bend the cover might be arranged from flange (inlet) to flange (outlet). If between the curve of the bend and the inlet and/or outlet linear parts of the tube are arranged the cover is at least arranged along the curve of the tube/bend. There might be segmented or several covers along the curve. There might be a distance (along the flow of the stream) with a closed circumference of the tube between covers. The cover might only be arranged partly along the curve.

[0048] After the cast of the tube the opening can be drilled, preferably at an enhanced hull part of the tube. Afterwards, preferably after some preparations at the tube wall, a flange for connecting further pipes or machine elements can be welded onto the wall of the tube, whereas the flange might have a protrusion which is aligned with the opening in the wall of the tube and especially is used to define the measurement of the opening for the exiting steam. There might be at least a partly protrusion into the tube. It should be stated, that such protrusion is preferably arranged in flow direction at the end of the opening and is used as a (small) barrier for the steam to help the steam entering the opening. The difference in view of the state of the art is that there is no need of a complicated arrangement of two pipes with a so called sword-part or divisor in-between. The opening in the hull is surprisingly enough to give the steam near the wall of the tube an opportunity to leave the tube via the opening.

[0049] The center and/or the balance point of the opening, hence the theoretical tangent line to the hull of the tube through it should be parallel to the flow direction of the stream, especially to the flow direction of the stream along a theoretical centerline or centerplane of the tube along the direction of the flow. The diameter of the drill bore or the flange might be arranged accordingly hence perpendicular to the exit flow of the steam through the opening. As such the tangent might be arranged parallel to the flow direction of the stream in the tube. The tangent preferably defines the plane of the bore and/or the flange welded onto the opening of the tube. It might be in the range of the invention to have an angular plane of about 5°, 10° or up to 15° to support the steam flow into the opening. It might be beneficial to have a chamfer on the wall of the tube or an intrusion of the flange at the entry of the opening on the side of the stream, especially at the rim before the opening in view of the direction of the flow.

[0050] The welded flange onto the opening or the wall of the tube might be integrally arranged or might consist out of a welded basic part on which a further part or the flange is mounted to obtain an impermeable flange or connector for further mechanical elements.

[0051] Further mechanical elements arranged at the flange or at the opening might be a valve and/or a sleeve and/or a connection for a rinsing system.

[0052] The most preferred but not limiting arrangements might be:

- opening, welded basic part, sleeve, flange;
- opening, flange, valve or
- opening, flange, rinsing system, valve.

[0053] Of course similar or comparable arrangements should be in the scope of the invention. After such arrangement a line or pipe for the steam is arranged.

[0054] Especially the arrangement of a high pressure rinsing system before a closable valve is advantageous for cleaning the opening in regard of caking. For such cleaning the valve will be shut and the rinsing system injects a fluid, preferably steam, water or hot air into the opening hence the blow line and washes away any obstacles or caking. Preferably the rinsing system is able to overrule the pressure of the blow line.

[0055] As material for the tube a pressure vessel approved material should be used, preferably austenitic stainless steel. The walls of the tube should be at least 10 mm, preferably 12 mm, most preferably at least 15 mm thick. The area

around the opening to be drilled should be more than this. The opening can be cast and might be preferably re-drilled.

[0056] In a favorable arrangement the bend consists out of two main parts, the cover and the tube with a certain shape, whereas these parts are connected with bolts. Therefore the shape of the tube needs bore holes or screw threads to secure the cover onto the shape of the tube. Preferably the connection of the cover onto the tube or shape is arranged similar to a flange with a plain surface and drill holes in it. There might be a seal necessary to arrange the necessary impermeableness. The opening as well as the inlet and the outlet should have flanges for the connectivity with other mechanical parts, especially of or in a plant for producing fiber boards or a refiner for the production of fibers, maybe in a paper plant.

[0057] In a very advantageous arrangement the valve is almost directly connected with the opening of the tube, therefore the regulation or the control system is short distanced and easy to handle. Furthermore along the short distance between the opening from the tube to the valve an oscillation is easily prevented. Usually a blow line is fed by a high pressure valve of an refiner which tends to feed the blow line in a sputtering manner, which might cause the oscillations in a pipe between a separation switch and a valve later on.

[0058] Helpful or an improvement to be added would be an protrusion at the cover to smoothen the inner diameter or surface for the steam-fiber stream. As such the tube and/or the bend might have arranged a window to be covered by the cover. Preferably at the cover for such a window in the tube and/or the bend an external protrusion is arranged to be inserted in the window frame or its hole as to avoid hindrances or turbulences especially in the direction of the flow at the end of such a window. There might be at least a ramp as a protrusion to guide the stream. The protrusion might be formed as part of the cover and with it in one-piece. Alternatively the protrusion might be a wear plate to be exchangeable upon maintenance to save costs and is arranged with a form closure or similar means onto the cover. Therefore it might be not necessary to exchange the cover every time when the plate is worn out.

[0059] The shape of the bend with a cross section in the form of a trapezoid, a half circle or like an omega-form have been found as a significant feature to improve the invention. It has also been found out surprisingly, that these shapes work well in older state of the art with bends and aligned or adjacent outlets for steam and the remaining steam-fiber stream.

DETAILED DESCRIPTION OF THE INVENTION

[0060] In the following, preferred embodiments and examples of the invention will exemplarily be explained in more detail with respect to the appending drawings. The particular features resulting thereof are not restricted to the particular embodiments and examples, but may be combined with one or more particular features described or mentioned above and/or with one or more particular features of other embodiments or examples. The details shown in the drawings are only of explanatory nature and shall not be construed in any restrictive manner. The reference signs contained in the claims shall in no way restrict the scope of the present invention, but shall only refer to the embodiments and examples shown in the drawings.

[0061] In the following, the invention will be described in more detail by the aid of some preferred embodiments with reference to the attached and schematic drawings, wherein:

Fig. 1 presents a schematic and sectional view lengthwise to the moving direction of an steam-fiber stream through a bend according to the invention, whereat the bend is connected with a blow line;

Fig. 2 presents a perpendicular view according to Fig. 1;

Fig. 3 presents a schematic view on possible arrangements of the bend or an stage of expansion according to the invention in a blow line with the use of transition pieces in-between the blow line and the bend to adapt the trajectories;

Fig. 4 presents a schematic view of another transition piece for adapting the cross section;

Fig. 5 presents an example for the connection of a bend with a special trapezoidal cross section to a blow line with a circular pipe using transition pieces according to Fig. 4;

Fig. 6 presents a cross section of a bend respectively a tube of a bend with a trapezoidal shape and a cover on the opposite edge of the radially inwards opening;

Fig. 7 presents a cross section of a bend with a hemicycle shape and a cover for the open side to form a tube;

Fig. 8 presents a schematic and sectional view lengthwise to the moving direction of an steam-fiber stream through a bend according to the invention comparatively to Fig. 1 with a monolithic structure of the bend and integrated

transition areas at the inlet and the outlet;

Fig. 9 presents a sectional view regarding the opening with an thickened area around the opening and the arrangement of connectors for further pipes.

[0062] Fig. 1 presents a schematic and sectional view lengthwise to the moving direction of an steam-fiber stream through a bend according to the invention, whereat the tube 5 of the bend 1 is connected with a blow line 10 at the inlet 2 and the outlet 3 with flanges 20. The curve of the bend 1 shows an axis of rotation 12 with an radius 9 to the radial inner wall of the tube 5. Near the inlet 2 and the outlet 3 are circles for reflecting the cross section of the tube 5 and/or the blow line 10. The steam-fiber stream 6 is entering the bend 1 from the blow line 10 via the inlet 2. After beginning of the curve along the axis or rotation 12 the fibers are starting to shift their location radially outwards to the wall of the tube. The separation line 23 is a theoretical line for showing this physical effect, whereat the radially inner area is mostly filled with steam 21 without fibers. When the stream 6 moves along the opening 4 steam 21 is removed from the tube 5 and the steam reduced stream 22 of fibers with a certain amount of steam is moving back into the continuation of the blow line 10, usually into a dryer or a pulp chest.

[0063] Fig. 2 presents a perpendicular view according to Fig. 1 wherein the location of the opening 4 radially inwards of the curve of the tube 5 is shown more clearly.

[0064] Fig. 3 presents a schematic view on possible arrangements of the bend 1 or an stage of expansion 25 according to the invention in a blow line 10 with the use of transition pieces 7 in-between the blow line and the bend to adapt the trajectories. On the left side a usually blow line 10 with a linear central axis 11 (shown exemplary below), is optimized with a stage of expansion 25 and a tube 5 according to the invention. To be able to integrate such a tube 5 into an existing blow line the already constructed blow line 10 has been cut open and two trajectory changing transition pieces 7 have been installed, wherein the tube 5 with the bend 1 is arranged in between the transition pieces. After the let off of steam in the tube 5 the stream follows the same central axis in the blow line without further ado. This arrangement is comparable to arrange a looping into an existing rail.

[0065] On the right side a bend 1 or tube 5 has been installed into a blow line 10 and the opportunity has been used to change the trajectory of the blow line 10 after the inserted tube 5 and the transition piece 7. As such not only the energetically enhancement of a blow line is possible but a rearrangement of the blow line in a plant is available as well.

[0066] Fig. 4 presents a schematic view of another transition piece 8 for adapting the cross section between the blow line 10 (not shown) and a stage of expansion 25 (not shown) or a tube 5 of the bend 1. The flange 20 or the diameter on the left side is circular whereas the right side of the cross section of the diameter of the transition piece 8 is trapezoidal 17.

[0067] Fig. 5 presents an example for the connection of a bend 1 with a special trapezoidal cross section to a blow line 10 with a circular pipe using transition pieces 8 connected via flanges 20 according to Fig. 4. Starting on the left the cross section of the blow line 10 is circular, after the first flange 20 the cross section changes into a trapezoid 17. This geometry is continued along the curve of the tube 5 until the next flange 20 is arranged with an following transition piece 8 to return the shape of the cross section into a circular one.

[0068] Fig. 6 presents a cross section of a bend 1 respectively a tube 5 of a bend 1 with a trapezoidal 17 shape and a cover 14 on the opposite side of the radially inwards arranged short edge and the necessary opening (not shown). It is to say that such cover is closing a window, wherein the window has a window frame 35, as the window ends at a determined area of the bend 1 with the shape 15. The cover 14 is fastened with bolts 16 onto the shape 15 and therefore closes or shuts down the window.

[0069] Fig. 7 presents a cross section of a bend with a hemi circle 18 as shape 15 for the cross section and corresponding cover to be connected via flange like areas and bolts 16. The cover 14 presents a protrusion 34, which dives into the window frame 35 and therefore smoothens the inner diameter to avoid turbulences or built ups by the fibers.

[0070] Fig. 8 presents a schematic and sectional view lengthwise to the moving direction of an steam-fiber stream 6 through a bend 1 according to the invention comparatively to Fig. 1 with a monolithic structure of the bend 1 or the tube 5 and integrated transition areas 8* at the inlet 2 and the outlet 3 of the bend 1. Radially outwards the cover 14 is arranged and connected to the tube 5 with bolts 16. The theoretical central axis 11 of the tube 5or the stream 6 is shown inside of the tube 5. The curve of the bend 1 is arranged along a axis of rotation 12 whereupon the rotation angle 32 is 180°. Before and after the rotation angle 32 linear transition areas 8* are arranged. The missing flanges should show the intention to prepare a monolithic structure or cast out of the transition areas 8* and the rotation angle 32. Along the rotation angle 32 the distance 32 along an angle is shown to explain the distance of the opening 4 to the inlet, which might be understood as the beginning of the curve. It is also shown that the opening 4 has a certain distance to the outlet 3 of the curve or bend 1 of the tube 5. As the shapes of the tube 5 are shown as trapezoids 17, a cover 14 is arranged radially outwards and is connected with the monolithic tube 5 via bolts 14.

[0071] Fig. 9 presents a sectional view regarding the opening 4 with an thickened area around the opening 4 and the arrangement of connectors for further transporting pipes of the steam 22. A thickening is arranged on the hull of the tube 5, which should be the radially inner wall of the tube 5, as visible the the shape of the curve. Open by casting or opened

up by a drill an opening is arranged in the thickening 26, shown in black. After or during the molding a basic part 27 is arranged. It can be welded onto the tube 5 as well. The basic part 27 is optional, if the cast is strong or thick enough to handle bolts or welding to arrange a flange 29 with an pipe. Usually for the imperviousness of the connection and the tube 5 a basic part 27 is recommended. Into the opening 4 a sleeve 28 can be arranged to define the diameter 30 of the opening. The sleeve 28 can be interchangeable to prepare different openings 31 for different uses of the blow line or the bent 1.

List of Reference Signs:

1	bend	19	cross section
2	inlet	20	flange
3	outlet	21	steam
4	opening	22	stream (steam reduced)
5	tube	23	separation line
6	steam-fiber-stream	24	distance (3 to 4)
7	transition piece (trajectory)	25	stage of expansion
8	transition piece (cross section)	26	thickening
9	radius	27	basic part (welded)
10	blow line	28	sleeve
11	central axis of 10	29	flange with pipe
12	axis of rotation of 1	30	diameter
14	cover (radial outward)	31	opening
15	shape (radial inward)	32	rotation angle
16	bolt	33	distance (2 to 4)
17	trapezoid	34	protrusion at 14
18	hemicycle	35	window frame

Claims

1. Blow line for transporting fibers in a duct, whereas the fibers are suspended in steam and are moving in the blow line (10) respectively the duct as a steam-fiber stream (6) with a higher pressure than the ambient pressure, said duct preferably arranged in a fiber processing plant, comprising at least one tube (5) with a bend (1) for guiding the steam-fiber stream (6) along a curve with a rotation angle (32) for separating steam (21) radially inward in the tube (5) from said steam-fiber stream (6) flowing radially outwards along the curve, said tube (5) comprising in direction of the flow an inlet (2) for the steam-fiber stream (6) before the curve of the bend (1) and an outlet (3) after the curve of the bend (1) for delivering a steam reduced steam-fiber stream (22), **characterized in**

   that an opening (4) for the separated steam (21) is arranged radially inwards in the wall of the tube (5),
   that the opening (4) is arranged in the direction of the flow with a determined distance (24) before the outlet (3) and
   that the opening (4) is within the curve of the bend (1) and/or along the rotation angle (32) of the curve.

2. Blow line according to claim 1, **characterized in that** the plane of the permeable diameter of said opening (4) is essentially arranged parallel to the direction of the flow of the stream (6).

3. Blow line according to any of the preceding claims, **characterized in that** the opening (4) is arranged in direction of the flow in the last third of the curve of the bend (1) or the rotation angle (32).

4. Blow line according to any of the preceding claims, **characterized in that** the opening (4) is circular, oval, elliptic or a grove, preferably linear or bent.

5. Blow line according to any of the preceding claims, **characterized in that** the cross section of the bend (1) is at least partially circular, oval, elliptic, trapezoidal or omega-shaped, wherein preferably the smallest or shortest length of the geometry is arranged radially inwards whereas the larger or longer length of the geometry is arranged radially outwards to enhance the separation by preparing the fibers more space radially outwards.

6. Blow line according to any of the preceding claims, **characterized in that** at least the curve of the bend (1) and/or

at least a part of the cross section is arranged as cast and/or has been cast out of cast iron.

7. Blow line according to any of the preceding claims, **characterized in that** in direction of the flow before and/or after the bend (1) transition pieces (7, 8) and/or transition areas (8*) adjacent to the inlet (2) or the outlet (3) are arranged to connect the bend (1) with the blow line (10) or follow up transporting means, especially to adapt different cross sections and/or to adapt changes of the trajectory.

8. Blow line according to any of the preceding claims, **characterized in that** the bend (1) is split or arranged along the direction of the flow in at least two parts, a shape (15) and a cover (16), which are preferably connected with a positive mechanical engagement, like bolts (16).

9. Blow line according to claim 8 , **characterized in that** the cover (16) in view of the cross section perpendicular to the direction of the flow is essentially planar whereas the shape (15) is essentially arranging the permeable diameter for the steam-fiber stream.

10. Blow line according to any of the preceding claims 8 or 9, **characterized in that** the geometry of the cross section of the shape (15) is a trapezoid, an omega-shape or a hemicycle, whereas the connection of the shape with the cover is forming the tube and whereas preferably by a trapezoidal shape the opposite surface to the smallest edge of a trapezoidal shape is arranged by the cover and/or the opening is in the smallest edge.

11. Blow line according to any of the preceding claims 8 or 10, **characterized in that** the cover (16) is arranged as an interchangeable wear and tear part.

12. Blow line according to any of the preceding claims, **characterized in that** the area of the opening (4) of the tube (5) is thickened, especially to receive a bore for the opening (4) and/or a basic part as a connector for the transfer of the steam (21) with other means.

13. Blow line according to any of the preceding claims, **characterized in that** at the opening (4) a flange (29), a valve, a rinsing system for the opening and/or a replaceable sleeve for adjusting the diameter (30) of the opening is arranged, said valve is preferably implemented as on/off-valve, a full bore valve and/or an 100% open valve.

14. Blow line according to any of the preceding claims, **characterized in that** the tube (5) and/or the bend (1) is integrally moulded and preferably including the flanges for the inlet, the outlet and/or the area of the opening.

15. Blow line according to any of the preceding claims, **characterized in that** the tube (5) and/or the bend (1) have arranged a window to be covered by the cover (14) and that preferably at the cover (14) for such a window in the tube (5) and/or the bend (1) is arranged with an external protrusion (34) to be inserted in the window frame (35) as to avoid hindrances or turbulences especially in the direction of the flow at the end of such a window.

16. Method for transporting fibers in a duct of a blow line, whereas the fibers are suspended in steam and are moving in the blow line (10) respectively the duct as a steam-fiber stream (6) in a higher pressure than the ambient pressure, said duct preferably arranged in a fiber processing plant, comprising at least one tube (5) with a bend (1) for guiding the steam-fiber stream (6) along a curve with a rotation angle (32) for separating steam (21) radially inward in the tube (5) from said steam-fiber stream (6) flowing radially outwards along the curve, said tube (5) comprising in direction of the flow an inlet (2) for the steam-fiber stream (6) before the curve of the bend (1) and an outlet (3) after the curve of the bend (1) for delivering a steam reduced steam-fiber stream (22), **characterized in that** the separated steam (21) from the steam-fiber stream (6) is let out of the bend (1) via an opening (4) arranged radially inwards in the wall of the tube (4), said let out is arranged before the steam reduced steam-fiber stream (6) is reaching the outlet (3) and is conducted along the curve of the bend (1) and/or along the rotation angle (32) of the curve.

17. Stage of expansion for a blow line comprising a bend with or without transition pieces to be connected onto a blow line in which fibers are suspended in steam and are moving in a duct of the blow line (10) as a steam-fiber stream (6) with a higher pressure than the ambient pressure, said duct preferably arranged in a fiber processing plant, said stage of expansion comprising at least one tube (5) with a bend (1) for guiding the steam-fiber stream (6) along a curve with a rotation angle (32) for separating steam (21) radially inward in the tube (5) from said steam-fiber stream (6) flowing radially outwards along the curve, said tube (5) comprising in direction of the flow an inlet (2) for the steam-fiber stream (6) before the curve of the bend (1) and an outlet (3) after the curve of the bend (1) for delivering

a steam reduced steam-fiber stream (22), **characterized in that** an opening (4) for the separated steam (21) is arranged radially inwards in the wall of the tube (5),

that the opening (4) is arranged in the direction of the flow with a determined distance (24) before the outlet (3) and that the opening (4) is within the curve of the bend (1) and/or along the rotation angle (32) of the curve.

18. Stage of expansion for the preceding claim, **characterized in that** the stage of expansion is installable in an existing blow line with a certain central axis (11) by cutting out a determined part of the blow line (10) and that by using at least two transition pieces (7) and the bend (1) the trajectory of the stream is at least partially different in reference to the central axis (11) of the blow line (10).

Fig. 1

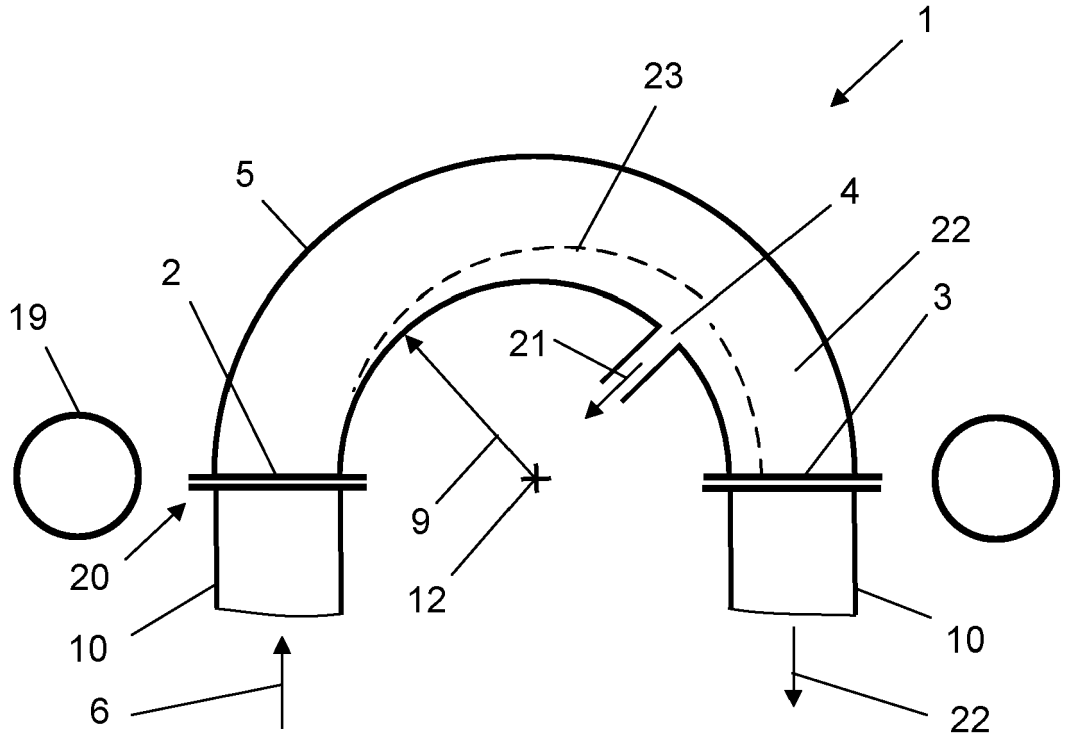


Fig. 2

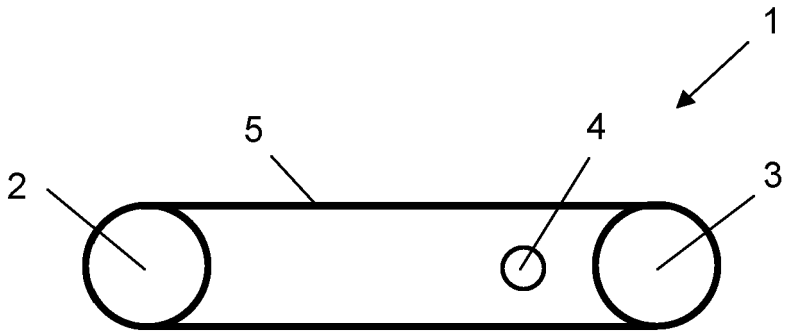


Fig. 3

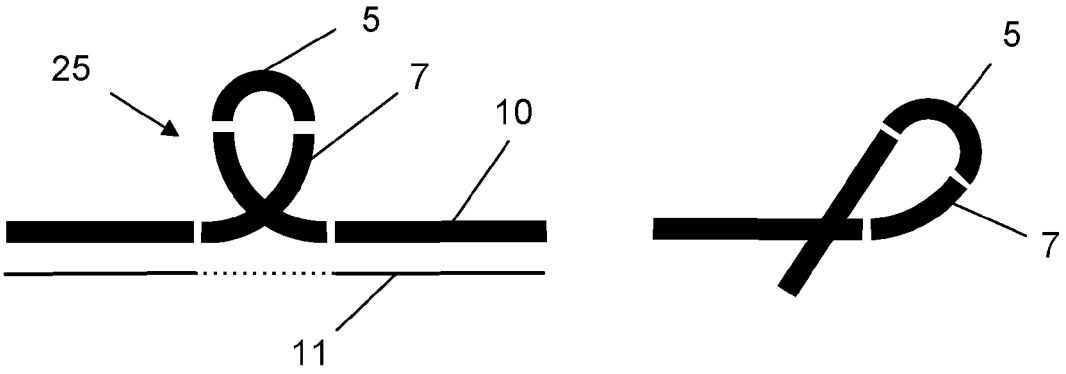


Fig. 4

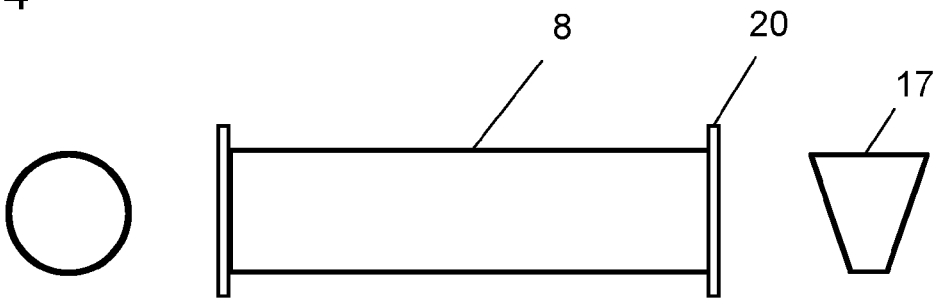


Fig. 5

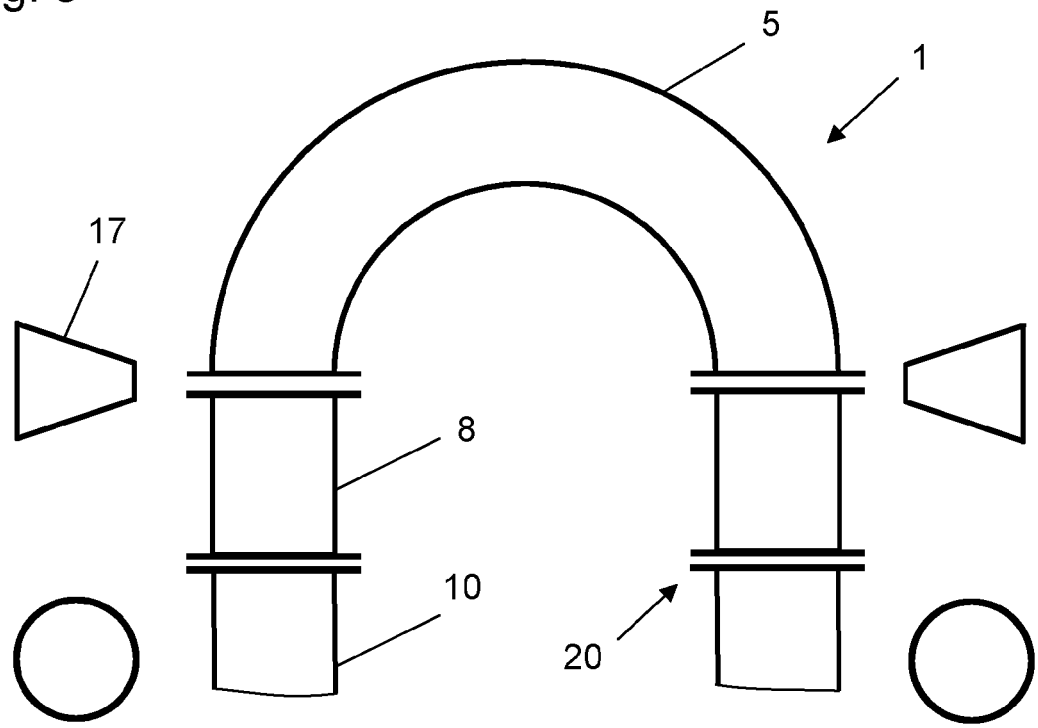


Fig. 6

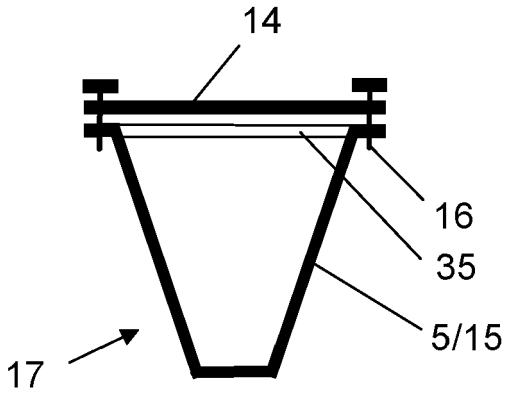


Fig. 7

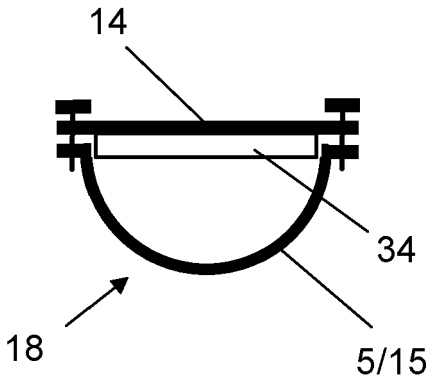


Fig. 8

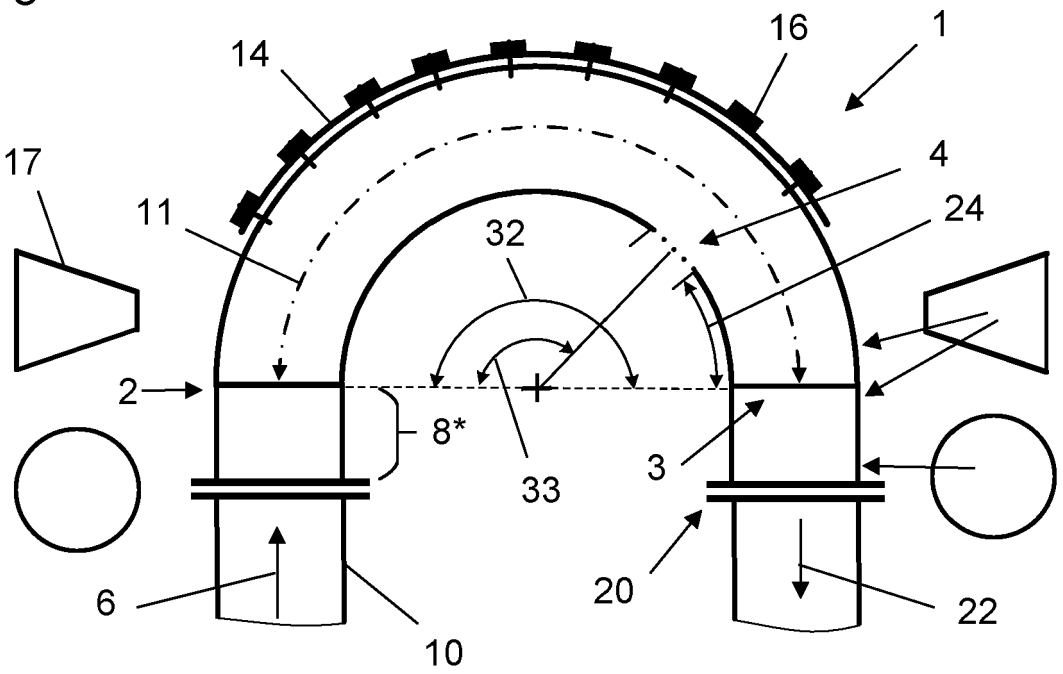
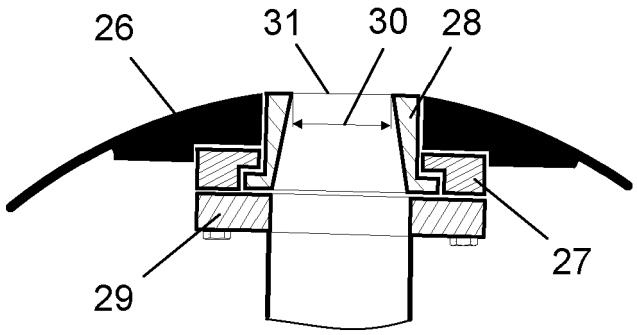


Fig. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 3495

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,D	EP 2 855 108 B1 (SUNDS FIBERTECH AB [SE]) 18 March 2020 (2020-03-18)	1-8, 10-18	INV. B27N1/02 B01F23/50 B01F23/57
A	* paragraphs [0044], [0050], [0051], [0053] - [0059], [0062], [0064], [0066], [0070], [0072]; claims 1,2,4,7,8,10; figures 1-7 *	9	ADD. B27N3/04 B27N3/18 B05B7/14

TECHNICAL FIELDS SEARCHED (IPC)

B27N
B65D
B01F
B05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 January 2024	Baran, Norbert

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03-01-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2855108 B1	18-03-2020	BR 112014028851 A2	29-05-2018
		CA 2872839 A1	05-12-2013
		CN 104349877 A	11-02-2015
		EP 2855108 A1	08-04-2015
		ES 2798102 T3	09-12-2020
		PL 2855108 T3	21-09-2020
		US 2016069021 A1	10-03-2016
		WO 2013178287 A1	05-12-2013

EPO FORM P0459

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Patent documents cited in the description

- EP 2213431 A2 **[0003]**
- EP 2855108 B1 **[0005]**