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(54) **STRUCTURING FABRIC WITH SUBLAYER-BEADS AND METHOD OF PRODUCING THE SAME**

(57) The invention concerns a structuring fabric for use in a machine to produce a structured fiber web, preferably a structured tissue fiber web, the structuring fabric having a machine direction, a cross machine direction and a thickness direction, wherein the structuring fabric comprises a woven base fabric, the woven base fabric having a web facing side and a machine side, wherein the structuring fabric further comprises a plurality of structuring-beads of polymeric material on the web facing side of the woven base fabric, the structuring-beads being suitable to provide a visible structure to the fiber web that is produced on the structuring fabric, and wherein the structuring-beads are resting on an upper foundation surface of corresponding sublayer-beads of polymeric material, the sublayer-beads thereby providing a foundation for the structuring-beads. The invention furthermore refers to a manufacturing process for such a structuring fabric.

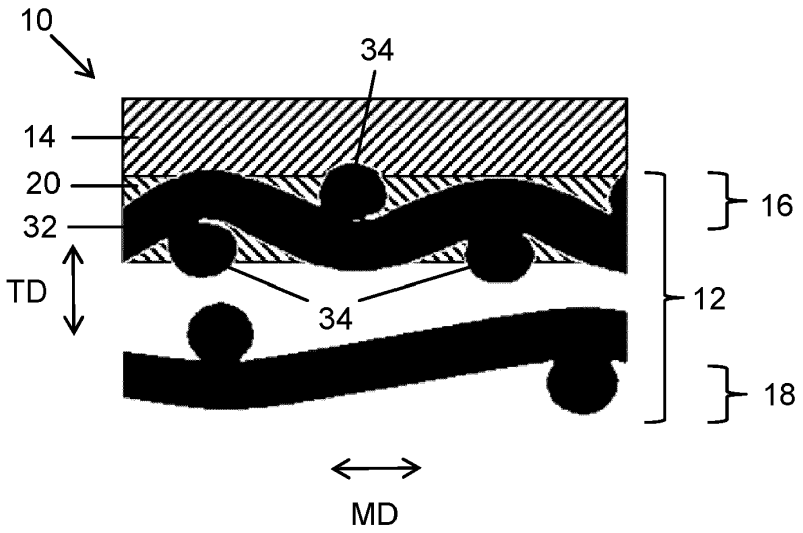


Fig. 2

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## Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

**[0001]** The invention concerns a structuring fabric for use in a machine to produce a structured fiber web, preferably a structured tissue fiber web, the structuring fabric having a machine direction, a cross machine direction and a thickness direction, wherein the structuring fabric comprises a woven base fabric, the woven base fabric having a web facing side and a machine side, and wherein the structuring fabric further comprises a plurality of structuring-beads of polymeric material on the web facing side of the woven base fabric, the structuring-beads being suitable to provide a visible structure to the fiber web that is produced on the structuring fabric. Furthermore, the invention concerns a method of producing such a structuring fabric.

2. Discussion of Background Information

**[0002]** Such structuring fabrics, sometimes also called "structured fabrics" or "molding fabrics", are already known. They are often used in the production of bulky tissue webs. The structuring-beads need to be of a certain minimum dimension to be suitable of imparting a visible structure into the fiber web produced thereon. For example, the structuring-beads can have a substantially square cross-section of 0.5 mm x 0.5 mm. The smallest dimension of the structuring-beads should be at least 0.25 mm.

**[0003]** WO 00/75424 A1 discloses such a fabric for making strong, soft, absorbent paper products. The content of WO 00/75424 A1 is incorporated herein by reference. This document teaches to extrude a fluid resinous material onto a reinforcing element, such as a woven fabric, according to a desired predetermined pattern and then solidifying the patterned resinous material. After solidification the resinous material is attached to the reinforcing element.

**[0004]** A portion of such a structuring fabric 10 known from the prior art is shown in a cross-sectional view along the machine direction MD in figure 1. A problem that can be observed with such a structuring fabric 10 is that the bonding of the extruded structuring-beads 14 to the woven base fabric 12 is sometimes insufficient. Especially if the structuring fabric 10 is circulated at high speeds in a corresponding web making machine and/or if high forces are applied to the structuring fabric 10, such as in a press nip, it can happen that the structuring-beads 14 peel away from the woven base fabric 12. The reason for this seems to be that the extruded structuring-beads 14 have only a very limited contact area with the web facing side 16 of the woven base fabric 12. In other words, the extruded structuring-bead 14 hardly penetrates the volume of the woven base fabric 12 in thickness direction TD from its upper, web facing side 16 towards its lower, machine side 18. Instead, it has only local contact to individual yarn knuckles on the web facing side 16 of the woven fabric 12.

**[0005]** Attempts to increase the contacting area by reducing the viscosity of the resinous material that form the structuring-beads were not successful because the lower viscosity adversely affects the dimensional stability of the structuring-beads. For obtaining a well visible pattern within the fiber web that is produced on the structuring fabric, the structuring-beads should have a substantially rectangular cross-section, wherein the sidewalls of the structuring-beads should be substantial perpendicular to the web facing surface of the woven fabric. However, this is difficult to achieve if the viscosity of the resinous material is reduced. The same is true if the still soft structuring-beads are forced into the woven base fabric e.g. by a calendaring device as proposed in WO 00/75424 A1.

**[0006]** Thus, it is an object of the present invention to provide an improved structuring fabric with a strong bonding of the structuring-beads to the web facing side of the woven base fabric, wherein at the same time the dimensional stability of the structuring-beads should not be adversely affected. It is another object of the present invention to provide a manufacturing process for such a structuring fabric.

SUMMARY OF THE INVENTION

**[0007]** The above-mentioned objects are achieved by a structuring fabric according to independent claim 1 and by a manufacturing process for such a structuring fabric according to independent claim 9, respectively. Advantageous embodiments are the subject-matter of the dependent claims.

**[0008]** In particular, the problem is solved by the generic structuring fabric as described at the beginning wherein the structuring-beads are resting on an upper foundation surface of corresponding sublayer-beads of polymeric material, the sublayer-beads thereby providing a foundation for the structuring-beads.

**[0009]** By providing sublayer-beads below the structuring beads it is possible to significantly improve the strength of the bonding of the structuring-beads to the web facing side of the woven base fabric, without adversely affecting the cross-sectional shape of the structuring-beads. The sublayer-beads can protrude deeper into the volume of the woven base fabric to have a larger contact area with the yarns of the woven base fabric, while providing a good foundation for the structuring-beads that rest thereon. The polymeric material of the sublayer-beads could be for example silicone, in particular a two-component silicone.

**[0010]** Preferably, the form of the upper foundation surface of the sublayer-beads substantially corresponds to the form of a lower surface of the corresponding structuring-beads that rest thereon. In other words, the dimensional extensions of the sublayer-beads within the plane

of the web facing side of the woven base fabric can be substantially the same as the dimensional extensions of the structuring-beads. That way, the structuring-beads can be fully supported by the sublayer-beads while at the same time the sublayer-beads do not or do hardly reduce permeability of the structuring fabric.

**[0011]** Furthermore, to provide a very good foundation for the structuring-beads it is preferred that the upper foundation surface of the sublayer-beads is substantially flat. At least the upper foundation surface of the sublayer-beads shall be significantly smoother compared to the web facing surface of the woven base fabric, which is characterized by a plurality of individual yarn knuckles.

**[0012]** The woven base fabric can be a single layer weave or can comprise serval layers. Preferably, the layer defining the web facing side of the woven base fabric has a plain weave pattern. In a plain weave pattern, the warp and weft yarns cross at right angles, aligned so they form a simple criss-cross pattern. Each weft yarns crosses the warp yarns by going over one, then under the next, and so on. The next weft yarn goes under the warp yarns that its neighbor went over, and vice versa. With such a weave pattern, irregularities on the web facing side of the woven base structure can already be kept small.

**[0013]** In thickness direction of the structured fabric, the sublayer-beads can be provided substantially within the volume of the woven base fabric. This maximizes their contact area with the yarns of the woven base fabric.

**[0014]** No matter if the woven base fabric is a single-layer woven fabric or a multi-layer woven fabric, it comprises an upper layer, that defines the web facing side of the woven base fabric. The upper layer is formed from upper cross-machine direction yarns that are interwoven with upper machine direction yarns. Preferably, the sublayer-beads extend so deeply into the woven base fabric that they create a form-fit connection with at least some of the upper cross-machine direction yarns at their deepest points, that is where these upper cross-machine direction yarns pass under the upper machine direction yarns. In other words, the sublayer beads preferably surround the upper cross-machine direction yarns at their deepest points by more than half of their diameter to create such a form-fit connection. This leads to a very strong hold of the sublayer-beads within the woven base fabric. At the same time, it is preferred that the sub-layer beads do not extend deeper than the thickness of the upper layer into the woven base fabric, so as not to reduce the void volume of the woven base fabric too much.

**[0015]** As mentioned above, to provide a well visible pattern into the fiber web produced on the structuring fabric, it is preferred that structuring-beads have a substantially rectangular cross-sectional shape. In particular, the structuring-beads may have a substantially square cross-sectional shape. The term "substantially" shall mean here that the sidewalls of the structuring beads do not necessarily have to be exactly flat and/or that the corners of the substantially rectangular cross-sectional shape are not allowed to be slightly rounded.

**[0016]** As shown and described in WO 00/75424 A1 the structuring-beads can form continuous lines on the web facing surface of the woven fabric, wherein preferably the continuous lines substantially extend in machine direction of the structuring fabric. The term "substantially in machine direction" means in this context that their main extension is in machine direction and not in cross machine direction of the structuring fabric. However, the structuring-beads do not have to extend precisely as straight lines in machine direction. For example, the structuring beads may have a wavy configuration or may form a zig-zag pattern. They also may have in total a small inclination angle with respect to the machine direction of the structuring fabric. Preferably, the structuring beads do not cross each other. Instead, they can extend substantially parallel to each other. If the structuring-beads form continuous lines on the web facing surface of the woven fabric, this implies that they can not be formed by extruding the resinous material through a rotary screen. Instead, a method called "nozzle extrusion deposition" is preferably applied.

**[0017]** Of course, it is possible to use a polymeric material for forming the sublayer-beads that differs from the polymeric material for forming the structuring-beads. For example, the polymeric material for forming the sublayer-beads may have a lower viscosity than the polymeric material for forming the structuring-beads. A lower viscosity can be beneficial to enhance the penetration of the material into the volume of the woven base fabric. However, for the sake of simplicity and to achieve a very good bonding between the two beads, it is often preferred that the polymeric material of the structuring-beads is the same as the polymeric material of the sublayer-beads. A good bonding can be achieved especially achieved if the two beads are applied in a so-called "wet-in-wet" method.

**[0018]** Another aspect of the present invention refers to a method of producing a structuring fabric of the present invention as described above, comprising the following steps:

a) extruding a sublayer-bead of polymeric material through a first extrusion nozzle onto a web facing surface of a woven base fabric, wherein the sublayer-bead comprises an upper foundation surface,
b) extruding a structuring-bead of polymeric material through a second extrusion nozzle onto the top of the upper foundation surface of the sublayer-bead.

**[0019]** The term "onto" in step a) might be read as "into" since the polymeric material forming the sublayer-bead shall at least partly, preferably completely, penetrate into the woven base fabric.

**[0020]** The nozzles may be stationary while the woven base fabric is moved in machine direction of the structuring fabric to be produced. This will result in a pattern of straight lines extending in machine direction. If the pattern shall be a zig-zag configuration or a wavy configu-

ration, the nozzles may be movable in cross machine direction during the manufacturing process. An example is illustrated in figure 4 of WO 00/75424 A1.

**[0021]** To guaranty that the structuring bead is precisely located on top of the corresponding sublayer-bead, the first extrusion nozzle and the second extrusion nozzle are preferably integrally formed in one extrusion die. Furthermore, it is advantageous if the distance between the two different nozzles is kept small. With respect to the moving direction of the woven base fabric during the production process of the structured fabric, the two nozzles are preferably located one behind the other so that first the sublayer-bead is applied onto the web facing side of the woven base fabric and then, on top of the sublayer-bead, the structuring bead is applied.

**[0022]** In a further preferred embodiment, a plurality of pairs of first extrusion nozzles and second extrusion nozzles are integrally formed in one extrusion die.

**[0023]** Preferably, the first extrusion nozzle is formed in a first surface of an extrusion die which first surface is substantially parallel to the web facing surface of the woven fabric during the extrusion process, wherein the second extrusion nozzle is formed in a second surface of an or the extrusion die which second surface is inclined with respect to the web facing surface of the woven fabric during the extrusion process. This allows to ensure that the resinous material extruded through the first extrusion nozzle to form the sublayer-bead will penetrate deeper the volume of the woven base fabric.

**[0024]** Furthermore, the distance of the first extrusion nozzle to the web facing surface of the woven fabric is preferably larger than the distance of the second extrusion nozzle to the web facing surface of the woven fabric during the extrusion process.

**[0025]** To achieve a strong bonding between the sublayer-bead and the structuring-bead the structuring-bead can be extruded in step b) at a time when the sublayer-bead has not been cured yet, at least not completely. This is sometimes called "wet-in-wet" method. Even though the two beads may be formed from the same polymeric material, such as silicone, and may be cured substantially at the same time, it is still possible to clearly recognize, at least in a laboratory, the border between the two beads in the final product.

**[0026]** It has been found out that good results are achievable if the first nozzle is substantially rectangular shaped, whereas the second nozzle is substantially star-shaped. The star-shaped nozzle can lead to a structuring-bead having a substantially rectangular, in particular substantially square, formed cross-section.

**[0027]** Furthermore, it has been found out that it is beneficial if the width of the first, substantially rectangular shaped nozzle is substantially the same as the smallest width of the second, substantially star-shaped nozzle and/or the length of the first, substantially rectangular shaped nozzle is substantially half the length of the second, substantially star-shaped nozzle. The term "width" of the first nozzle refers to its extension in cross machine direction of the structuring fabric during the production process, whereas the term "length" of the first nozzle refers to its extension in machine direction of the structuring fabric during the production process.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0028]** In the following the present invention is explained in more detail with the aid of an exemplary embodiment illustrated in the following schematic figures:

- Figures 2 shows a cross-sectional view of a portion of a structuring fabric according to the present invention;
- Figures 3 shows a die with several pairs of first and second nozzles to extrude sublayer-beads and corresponding structuring beads on top thereof; and
- Figures 4 shows the manufacturing process for producing the structuring fabric according to the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

**[0029]** Figure 2 shows in cross-section a portion of a structuring fabric 10 according to the present invention. This figure resembles figure 1 showing a corresponding portion of a structuring fabric known from the prior art, as described above. Therefore, the same reference signs are used for the same features, and it is referred to the description of figure 1 above regarding these features. In the following, only the differences between the embodiments of figure 1 and figure 2 will be explained.

**[0030]** In contrast to the prior-art embodiment of figure 1, in the embodiment of figure 2 according to the present invention, the structuring-bead 14 does not only have a limited local contact with the yarn knuckles that characterize the web facing side 16 of the woven base fabric 12 but the structuring-bead 14 rests with its lower surface on an upper foundation surface of a sublayer-bead 20. The sublayer-bead 20 is formed preferably completely within the volume of the woven base layer 12, thus having a strong bond to the woven base layer 12. Its upper foundation surface, i.e. its surface that is facing away from the machine side 18 of the woven base layer 12, is substantially flat, thereby providing a very good foundation for the structuring bead 14 resting thereon. In thickness direction TD of the structuring fabric 10, the dimension of the sublayer-bead 20 may be smaller than the dimension of the structuring-bead 14. In the present embodiment, the woven base fabric 12 is formed as a multi-layer woven fabric but it could also be a single-layer woven fabric. The upper layer, that defines the web facing side 16 of the woven base fabric 12 is preferably a plain weave. The upper layer is formed by upper machine direction yarns 32 interwoven with upper cross-machine direction yarns 34. The sublayer-bead 20 extends so deep into the woven base fabric 12 as to create a form-

fit connection with the upper cross-machine direction yarns 34 where these upper cross-machine direction yarns 34 pass under the machine direction yarns 34. In other words, the polymeric material of the sublayer-bead 20 surrounds more than half of the diameter of the upper cross-machine direction yarns 34 at their lowest points. At the same time, the sublayer-bead 20 does not extend deeper into the woven base fabric 12 than the thickness of the upper layer. In thickness direction, the sublayer-bead 20 is almost as thick as the structuring-bead 14 resting thereon.

**[0031]** In the present embodiment, the knuckles on the web facing side 16 of the woven fabric only slightly project above the substantially flat upper foundation surface of the sublayer-bead 20. The sublayer-bead 20 and the structuring-bead 14 are preferably formed from the same polymeric material, such as a two component silicone. This results in a strong bond between the two beads, especially if the structuring-bead 14 is applied on top of the sublayer-bead 20 at a time when the material of the sublayer-bead 20 has not been cured yet.

**[0032]** Figure 3 shows an extrusion die 22 adapted to simultaneously apply several structuring-beads 14 and corresponding sublayer-beads 20 onto the web facing side 16 of the woven base fabric 12. More precisely, the extrusion die 22 comprises five pairs of first nozzles 24 and second nozzles 26, to extrude five pairs of sublayer-beads 20 and structuring-beads 14, respectively. For the sake of clarity, two pairs of first nozzles 24 and second nozzles 26 are shown in an enlarged view on the bottom of figure 3. The first nozzles 24 for extruding the sublayer-beads 20 have a substantially rectangular form, whereas the second nozzles 26 for extruding the structuring-beads 14 have a substantially star-shaped form. The term "star-shaped form" in this context refers to a form that resembles a square, wherein the lateral edges of the square are not straight but curved toward the center of the star-shaped form. The smallest distance between two opposite curved lateral edges is designated here with letter "A". This smallest distance A is preferably between 0.3 mm and 1.0 mm, more preferably between 0,6 mm and 0,8 mm. The first, substantially rectangular shaped nozzle 24 has a width that substantially corresponds to the smallest distance A of the second, substantially star-shaped nozzle 26. The length of the first, substantially rectangular shaped nozzle 24 is significantly smaller than its width. It may be only half the width, i.e. half the smallest distance A of the second, substantially star-shaped nozzle 26.

**[0033]** The pitch of two directly neighboring pairs of first nozzles 24 and second nozzles 26 is "B". The pitch B is measured as the distance from the center of one second nozzle 26 to the center of one of its directly neighboring second nozzles 26. The pitch B is preferably between 2 and 6 times the smallest distance A between two opposite curved lateral edges of the first, substantially rectangular shaped nozzle 24.

**[0034]** The first nozzles 24 are provided within a first surface 28, whereas the second nozzles 26 are provided within a second surface 30. The first surface 28 and the second surface 30 do not lie within the same plane. In other words, the second surface 30 is inclined with respect to the first surface 28. As shown in figure 4, during the manufacturing process of the structuring fabric 10 according to the present invention, the first surface 28 of the extrusion die 22 is placed close and substantially parallel to the web facing side 16 of the woven base fabric 12. This allows resinous material extruded through the first nozzles 24 to easily penetrate the volume of the woven base fabric 12, so as to form sublayer-beads when the woven base fabric 12 is carried in moving direction v, preferably corresponding to the machine direction MD of the structuring fabric 10, below the extrusion die 22.

**[0035]** The resinous material extruded through the second nozzles 26 formed in the second surface 30 of the extrusion die 22 then forms the structuring-beads 14 that rest upon the upper foundation surface of the corresponding sublayer-beads 20. The inclination of the second surface 30 with respect to the first surface 28 and, thus, with respect to the web facing side 16 of the woven base fabric, helps to form substantially square shaped structuring-beads 14.

**[0036]** During the manufacturing process of the structuring fabric 10, the extrusion die 22 may be stationary while the woven base fabric 12 moves in moving direction v, so as to form a pattern of structuring-beads 14 that extend in parallel straight lines. However, if it is preferred to provide the structuring fabric 10 with another pattern of structuring-beads 14, such as a zig-zag pattern or a wavy pattern, the extrusion die 22 may be moved, e.g. back and forth, orthogonally to the moving direction v during the manufacturing process, i.e. orthogonally to the image plane of figure 4.

Reference signs:

**[0037]**

| | |
|---|---|
| 10 | structuring fabric |
| 12 | woven base fabric |
| 14 | structuring-bead |
| 16 | web facing side |
| 18 | machine side |
| 20 | sublayer-bead |
| 22 | extrusion die |
| 24 | first nozzle |
| 26 | second nozzle |
| 28 | first surface |
| 30 | second surface |
| 32 | upper machine direction yarns |
| 34 | upper cross-machine direction yarns |
| A | smallest distance between two opposite curved lateral edges |
| B | pitch of two directly neighboring pairs of first and second nozzles |

MD machine direction
TD thickness direction
v moving direction

## Claims

1. A structuring fabric for use in a machine to produce a structured fiber web, preferably a structured tissue fiber web, the structuring fabric having a machine direction, a cross machine direction and a thickness direction,

   wherein the structuring fabric comprises a woven base fabric, the woven base fabric having a web facing side and a machine side,
   wherein the structuring fabric further comprises a plurality of structuring-beads of polymeric material on the web facing side of the woven base fabric, the structuring-beads being suitable to provide a visible structure to the fiber web that is produced on the structuring fabric,
   **characterized in that** the structuring-beads are resting on an upper foundation surface of corresponding sublayer-beads of polymeric material, the sublayer-beads thereby providing a foundation for the structuring-beads.

2. The structuring fabric according to claim 1, **characterized in that** the form of the upper foundation surface of the sublayer-beads substantially corresponds to the form of a lower surface of the corresponding structuring beads that rest thereon.

3. The structuring fabric according to claim 1, **characterized in that** the upper foundation surface of the sublayer-beads is substantially flat.

4. The structuring fabric according to claim 1, **characterized in that** in thickness direction of the structured fabric, the sublayer-beads are provided substantially within the volume of the woven base fabric.

5. The structuring fabric according to claim 1, **characterized in that** the woven base fabric comprises an upper layer defining the web facing side of the woven base fabric, wherein the upper layer is formed from upper cross-machine direction yarns that are interwoven with upper machine direction yarns, and wherein the sublayer-beads extend so deeply into the woven base fabric that they create a form-fit connection with at least some of the upper cross-machine direction yarns at their deepest points.

6. The structuring fabric according to claim 1, **characterized in that** the structuring-beads have a substantially rectangular, preferably substantially square, cross-sectional shape.

7. The structuring fabric according to claim 1, **characterized in that** the structuring-beads form continuous lines on the web facing surface of the woven fabric, wherein preferably the continuous lines substantially extend in machine direction of the structuring fabric.

8. The structuring fabric according to claim 1, **characterized in that** the structuring-beads form straight lines on the web facing surface of the woven fabric or the structuring-beads have a wavy configuration.

9. The structuring fabric according to claim 1, **characterized in that** the polymeric material of the structuring-beads is the same as the polymeric material of the sublayer-beads.

10. A method of producing a structuring fabric according to any of the preceding claims, comprising the following steps:

    a) extruding a sublayer-bead of polymeric material through a first extrusion nozzle onto a web facing surface of a woven base fabric, wherein the sublayer-bead comprises an upper foundation surface,
    b) extruding a structuring-bead of polymeric material through a second extrusion nozzle onto the top of the upper foundation surface of the sublayer-bead.

11. The production method according to claim 10, **characterized in that** the first extrusion nozzle and the second extrusion nozzle are integrally formed in one extrusion die.

12. The production method according to claim 10, **characterized in that** the first extrusion nozzle is formed in a first surface of an extrusion die which first surface is substantially parallel to the web facing surface of the woven fabric during the extrusion process, wherein the second extrusion nozzle is formed in a second surface of an or the extrusion die which second surface is inclined with respect to the web facing surface of the woven fabric during the extrusion process.

13. The production method according to claim 10, **characterized in that** the distance of the first extrusion nozzle to the web facing surface of the woven fabric is larger than the distance of the second extrusion nozzle ot the web facing surface of the woven fabric during the extrusion process.

**14.** The production method according to claim 10, **characterized in that** the structuring-bead is extruded in step b) at a time when the sublayer-bead has not been cured yet.

**15.** The production method according to claim 10, **characterized in that** the first nozzle is substantially rectangular shaped, whereas the second nozzle is substantially star-shaped.

**16.** The production method according to claim 15, **characterized in that** the width of the first, substantially rectangular shaped nozzle is substantially the same as the smallest width of the second, substantially star-shaped nozzle and/or the length of the first, substantially rectangular shaped nozzle is substantially half the length of the second, substantially star-shaped nozzle.

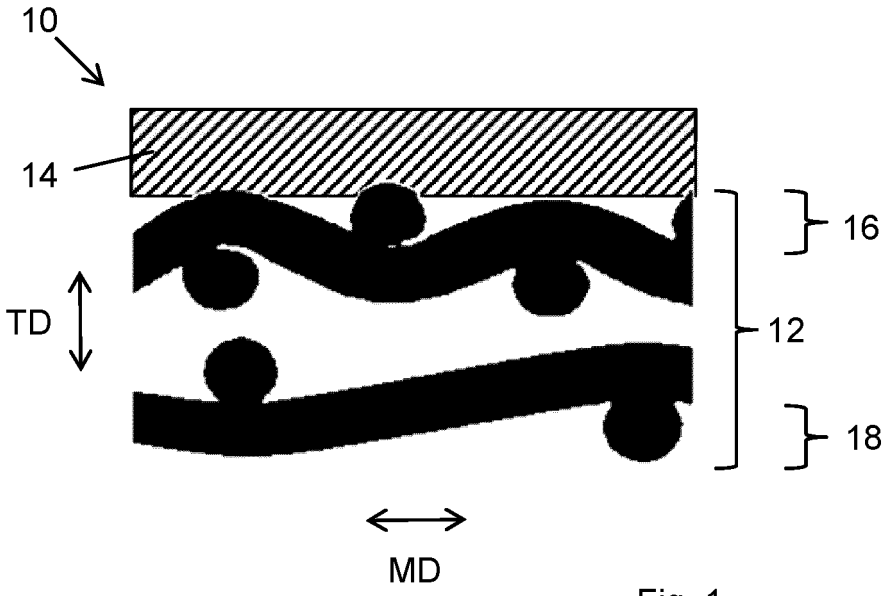


Fig. 1
(prior art)

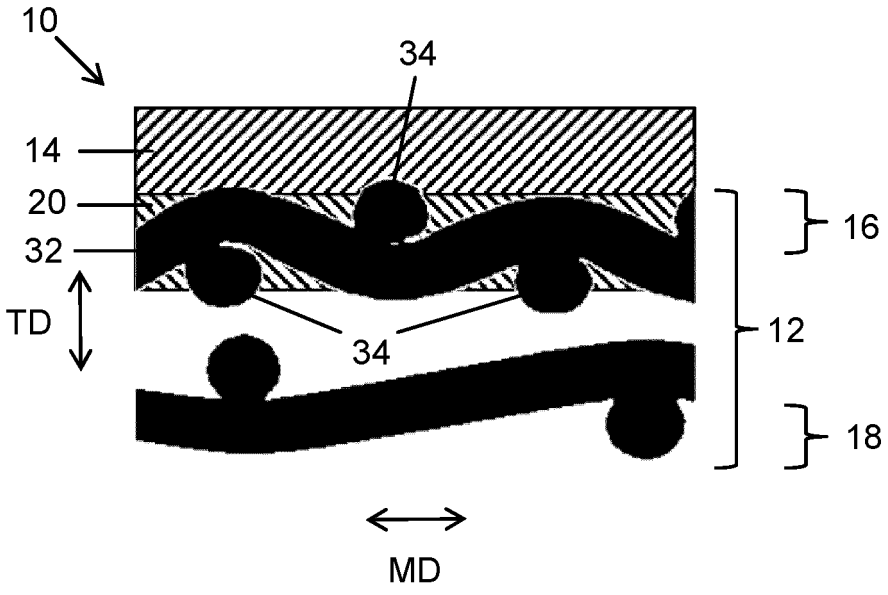


Fig. 2

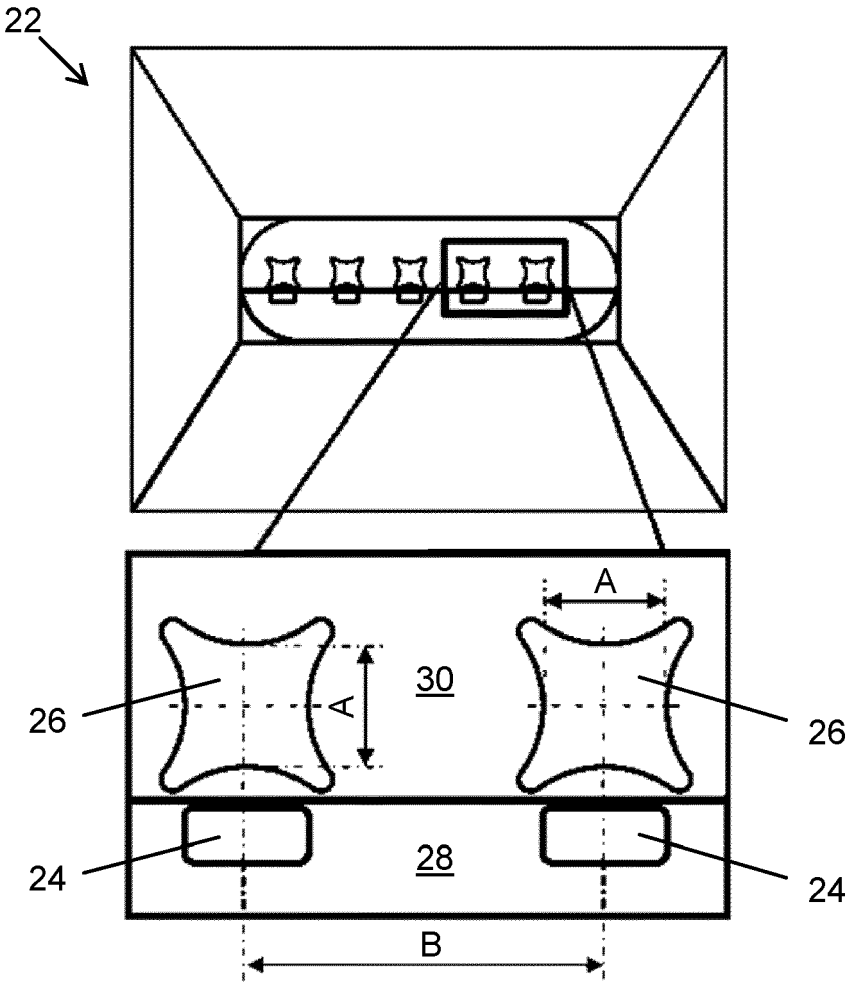


Fig. 3

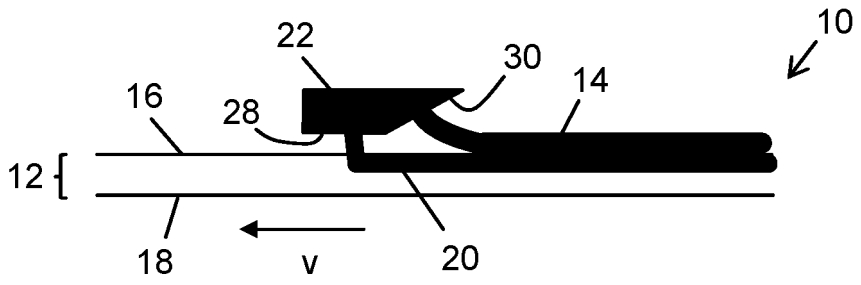


Fig. 4

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European Patent Office
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# EUROPEAN SEARCH REPORT

Application Number
EP 23 16 6785

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
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| A | * pages 6-50; figures 1-6 * | 10-16 | |
| X | US 2018/119354 A1 (BRENT JR JOHN LESLIE [US] ET AL) 3 May 2018 (2018-05-03) | 1-9 | |
| A | * pages 2-10; figures 13-18 * | 10-16 | |
| A | WO 2010/030298 A1 (ALBANY INT CORP [US]; ABERG BO-CHRISTER [SE] ET AL.) 18 March 2010 (2010-03-18) * abstract; figures 3,5 * | 1-16 | |
| A | WO 96/00812 A1 (PROCTER & GAMBLE [US]) 11 January 1996 (1996-01-11) * pages 6,7; figures 1,2 * | 1,16 | |

TECHNICAL FIELDS SEARCHED (IPC)

D21F
D21J

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 18 September 2023 | von Mittelstaedt, A |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 16 6785

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