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Yarn

(56) Viitejulkaisut - Anförda publikationer - References cited
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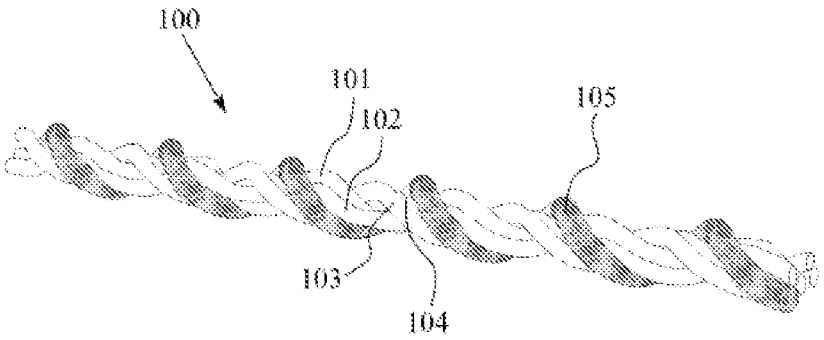
(57) Tiivistelmä - Sammandrag - Abstract

Esillä olevan keksinnön sovellusmuodon mukaan tarjotaan lanka (100), joka käsittää: useita monofilamentteja (101, 102, 103, 104) kierrettynä yhteen, ja multifilamentin tai kehrätyn langan (105), joka on kääritty useiden monofilamenttien (101, 102, 103, 104) ympärille, jossa langassa multifilamentti tai kehrätty lanka (105) käsittää biopohjaista materiaalia, kierrätettyä biopohjaista materiaalia tai kierrätettyä synteettistä materiaalia.

According to an example aspect of the present invention, there is provided a yarn (100) comprising: a plurality of monofilaments (101 102, 103, 104) twisted together, and a multifilament or a spun yarn (105) wound around the plurality of monofilaments (101, 102, 103, 104), wherein the multifilament or the spun yarn (105) comprises a bio-based material, a recycled bio-based material or a recycled synthetic material.



YARN

FIELD

[0001] The present invention relates to yarns, in particularly yarns used for manufacturing press felts.

BACKGROUND

[0002] Generally, press felts are made from yarns consisting of monofilaments or twisted monofilaments. In some special types also spun yarn is used together with the monofilaments, either twisted or wound around the filaments. The purpose of the spun yarn is to densify the felt and create a fast start-up and good nip dewatering.

[0003] However, when the spun yarn is used in a woven press felt, it causes a lot of dusting during weaving the press felt. So, there is a need to improve composition of the yarns. Furthermore, in view of the increasing requirements for sustainability and decreasing the amount of microplastics emitted to nature together with emerging interest to reduce fossil-based raw materials, there is also a need for novel yarns that exceed these expectations without sacrificing their mechanical performance.

SUMMARY OF THE INVENTION

[0004] According to a first aspect of the present invention, there is provided a yarn comprising a plurality of monofilaments twisted together, and a multifilament wound around the plurality of monofilaments, wherein the multifilament comprises a bio-based material, a recycled bio-based material or a recycled synthetic material.

[0005] According to a second aspect of the present invention, there is provided an industrial textile comprising the yarn.

[0006] According to a third aspect of the present invention, the yarn is used in an industrial textile, such as a press felt or a filter fabric.

[0007] According to a fourth aspect of the present invention, the yarn is used in a paper machine clothing.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIGURE 1 illustrates a yarn in accordance with at least some embodiments of the present invention.

EMBODIMENTS

[0009] In the present context, the term "bio-based material" refers to a material, which is wholly or partly derived from renewable biomass sources, such as plants, trees or animals. The material can be obtained from for example, a sugar containing plant (e.g. corn or sugar cane), plant fat or oil (e.g. castor oil), organic acid (e.g. succinic acid), corn starch, straw, woodchips, sawdust, recycled food waste. A bio-based material can be for example, natural fibre, such as wool, cashmere, cotton, hemp, linen, bamboo or silk. The bio-based material can be obtained by processing from natural biopolymers including polysaccharides (e.g. starch, cellulose, nanocellulose, microcellulose, chitosan and alginate) and proteins (e.g. soy protein, gluten and gelatin), or by chemically synthesizing from sugar derivatives (e.g. lactic acid) and lipids (oils and fats) from either plants or animals, or biologically generated by fermentation of sugars or lipids. This kind of bio-based material can be for example, polylactic acid (PLA), bio-polyamide (bio-PA), bio-polybutylene succinate (bio-PBS), bio-polyethylene (bio-PE), bio-polyethylene terephthalate (bio-PET), bi-polypropylene (bio-PP), or bio-polyhydroxyalkanoate (bio-PHA). Cellulose-based materials are bio-based materials manufactured from cellulose, such as cellulose fibres or cellulose derivate, for example, by dissolving pulp, treating pulp mechanically or transforming pulp directly to fibres with water and without any chemicals. The cellulose-based material can be for example, viscose, lyocell, cupro, acetate, modal, or cellulose carbamate.

[0010] In the present context, the term "synthetic material" refers to synthetic man-made polymers, which are derived from crude oil. The synthetic material can be for example, polyamide (PA), polyester (PET), polyethylene naphthalate (PEN) or polyphenylene sulphide (PPS).

[0011] In the present context, the term "overfeed" means that a multifilament yarn is fed faster than monofilaments in a yarn manufacturing. So, a length of the multifilament is longer than a length of the monofilament in the yarn.

[0012] Generally used yarns consisting twisted monofilaments and a spun yarn wound around the monofilaments cause a lot of dusting during weaving of the press felt.

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Furthermore, there is a need for sustainable yarns having a low carbon footprint. It is also important to decrease the amount of microplastics emitted from the press felt during the use. At least some of the present embodiment to solve the above-mentioned problem.

[0013] According to an embodiment, a yarn 100 comprises a plurality of monofilaments 101, 102, 103, 104 twisted together, and a multifilament 105 wound around the plurality of monofilaments 101, 102, 103, 104. The multifilament 105 comprises a bio-based material, a recycled bio-based material or a recycled synthetic material. It has surprisingly been found that whole yarn does not have to be made from high quality materials, such as synthetic polyamide, but a part of the yarns, i.e. the multifilament, can be made from a material, which has a lower strength. When the material wears off due to its lower mechanical strength or dissolves due to its chemical composition, it opens the felt structure preventing it from getting too dense. A core comprising monofilaments provides strength for the yarn, and the multifilament around the core provides a densifying effect that is needed at the start-up of the felt. Therefore, the multifilament can be made of materials having a lower carbon footprint. Thanks to this, a carbon footprint of the whole yarn and products made from the yarn is reduced. So, the yarn comprising a bio-based material, a recycled bio-based material or a recycled synthetic material provides more sustainable option for generally used yarns manufactured entirely from fossil-based raw materials. Further, using of the recycled material saves energy and material resources. So, the yarn provides longer life time for the press felt by keeping it open longer and a low carbon footprint without sacrificing mechanical properties of the yarn.

[0014] According to an embodiment, the bio-based material is a cellulose-based material. Cellulose is natural, biodegradable and recyclable material and causes significantly smaller carbon dioxide emissions than synthetic materials. Therefore, the cellulose-based material is more sustainable choice than fossil-based materials, which are refined and processed from crude oil.

[0015] According to an embodiment, the cellulose-based material is selected from the group of viscose, lyocell, cupro, acetate, modal, bamboo and cellulose carbamate. A utilization of wood-based cellulose as the raw material for fibres leads to carbon-neutral cycle, whereby carbon dioxide, which binds to wood, is transported with the product and decomposes back into the atmosphere as a result of burning or biodegradation. Further, production of the cellulose fibres has lower impact on land use and lower emissions than

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production of many other fibers, such as cotton, allowing more farmland to be used for food production.

[0016] According to an embodiment, the bio-based material is selected from the group of polylactic acid (PLA), bio-polyamide 6.10, bio-polyamide 4.10, bio-polyamide 5.10, bio-polyamide 10, bio-polyamide 10.10, bio-polyamide 11, bio-polybutylene succinate (bio-PBS), bio-polyethylene (bio-PE), bio-polyethylene terephthalate (bio-PET), bio-polypropylene (bio-PP), bio-polyhydroxyalkanoate (bio-PHA), wool, cotton, hemp, linen or bamboo. PLA can be manufactured from fermented plant starch, such as from corn, cassava, sugarcane or sugar beet pulp. Bio-polyamides and other bio-polymers are more sustainable choices than fossil-based polyamides, which are refined and processed from crude oil. Natural fibres, such as wool, cotton, hemp, linen and bamboo, are renewable and do not cause microplastic pollution.

[0017] The bio-based material can be also biodegradable. For example, PLA, bio-PBS, bio-PP and bio-PHA are also biodegradable. Thus, these materials are capable of being decomposed by bacteria or other living organisms and thereby avoiding pollution.

[0018] The recycled bio-based material can be for example, recycled cotton, which is obtained from recycled garments and textiles. Using of the recycled material saves energy and material resources, and thus reduces carbon footprint of the yarn and a final product made of the yarn.

[0019] The recycled synthetic material can be for example, recycled polyamide (PA), such as polyamide 6, polyamide 6.6, polyamide 6.10, polyamide 4.10, polyamide 10, polyamide 10.10, polyamide 11 or polyamide 12.

[0020] According to an embodiment, the plurality of monofilaments 101, 102, 103, 104 comprise polyamide (PA). The polyamide can be bio-based polyamide (bio-PA), synthetic polyamide or recycled polyamide. Bio-based polyamide can be for example, bio-polyamide 6.10, bio-polyamide 4.10, bio-polyamide 5.10, bio-polyamide 10, bio-polyamide 10.10, or bio-polyamide 11. The synthetic polyamide or the recycled polyamide can be for example, polyamide 6, polyamide 6.6, or polyamide 12. The above-mentioned polyamides are excellent choices when mechanical strength and wear resistance is needed. Polyamide 6 fibres are tough, possessing high tensile strength and elasticity. They are highly resistant to abrasion and chemicals, such as alkalis. Polyamide 6 has high water absorption. Polyamide

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6.6 has a high mechanical strength, a rigidity and a good heat and chemical stability. Polyamide 6.10 high impact resistance, chemical resistance and retention of dimension. Polyamide 11 has lower values of density, flexural and Young's modulus, water absorption, as well as melting and glass transition temperatures than polyamide 6. However, polyamide 11 is seen to have increased elasticity, abrasion resistance and, due to lower water absorption, dimensional stability in the presence of moisture than polyamide 6.

[0021] According to an embodiment, the yarn 100 comprises 3–24 monofilaments 101, 102, 103, 104, preferably 3–12 monofilaments 101, 102, 103, 104, more preferably 3–6 monofilaments 101, 102, 103, 104. For example, the yarn 100 can comprise 4, 6, 8 or 9 monofilaments 101, 102, 103, 104.

[0022] According to an embodiment, a twist direction of the plurality of monofilaments 101, 102, 103, 104 is the same as a twist direction of the multifilament 105. The direction of the twist may be to the right (Z twist), or to the left (S twist).

[0023] Alternatively, a twist direction of the plurality of monofilaments 101, 102, 103, 104 is the opposite as a twist direction of the multifilament 105. The direction of the twist may be to the right (Z twist), or to the left (S twist).

[0024] FIGURE 1 illustrates a yarn 100 in accordance with at least some embodiments. The yarn comprises four monofilaments 101, 102, 103, 104 and a multifilament 105 wound around the said monofilaments. A twist direction of the four monofilaments 101, 102, 103, 104 is the same as a twist direction of the multifilament, being a left twist.

[0025] According to an embodiment, diameters of the plurality of the monofilaments 101, 102, 103, 104 are 0.1–0.6 mm, preferably 0.2 mm. The diameters of the monofilaments can be selected according to the intended use of the yarn and the number of the monofilaments. For example, when the number of the monofilaments is increased, the diameter of the monofilaments can be decreased.

[0026] According to an embodiment, the multifilament 105 has a linear density of 50–150 dtex.

[0027] The multifilament 105 is twisted. Twisting of the multifilament 105 facilitates its handling and entangles filaments of the multifilament together. Further, the twisted

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multifilament has higher strength and elasticity (i.e. higher stretch). A surface of the twisted multifilament does not wear out so easily. Further, twisting can be used for forming texture to the yarn.

[0028] When the multifilament 105 is twisted, it may be twisted in a first direction. Then, the multifilament 105 may be twisted in a second direction, which is opposite direction than the first direction, around the plurality of monofilaments 101, 102, 103, 104. Twisting of the multifilament provides a good tenacity.

[0029] The multifilament 105 can be also textured. Texturing can be provided by curling the multifilament.

[0030] The yarn 100 has an overfeed of the multifilament 105 of 5–25 %, preferably about 15 %. The overfeed provides a densifying effect that is needed at the start-up of the felt.

[0031] The cross-section of the monofilaments, the multifilament 105 can be round, square, rectangular, oval or any other suitable shape.

[0032] According to an embodiment, a linear density of the yarn 100 is 200–600 tex.

[0033] According to an embodiment, a method for manufacturing a yarn 100 comprises providing a plurality of monofilaments 101, 102, 103, 104 and a multifilament 105, twisting the plurality of the monofilaments together, and simultaneously or afterwards, winding the multifilament 105 around the plurality of the monofilaments 101, 102, 103, 104. The multifilament 105 comprises a bio-based material, a recycled bio-based material or a recycled synthetic material. So, twisting the plurality of the monofilaments together can be done first. After that, the multifilament 105 can be wound around the plurality of the monofilaments. Alternatively, twisting the plurality of the monofilaments together and winding the multifilament 105 around the plurality of the monofilaments can be done simultaneously.

[0034] According to an embodiment, an industrial textile can comprise the yarn 100 according to an above-mentioned embodiment(s). The yarn provides fast start-up and good nip dewatering for press felts made from it. When the yarn comprises the multifilament, there is also less dusting when weaving textiles from the yarn. In addition, when the bio-

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based or recycled multifilament is wearing off, it opens the felt structure thus lengthening its lifetime.

[0035] The yarn 100 can be used in an industrial textile, such as a press felt or a filter fabric. The industrial textile can be woven or non-woven.

[0036] The yarn 100 can be used in a paper machine clothing.

[0037] It is to be understood that the embodiments of the invention disclosed are not limited to the particular structures, process steps, or materials disclosed herein, but are extended to equivalents thereof as would be recognized by those ordinarily skilled in the relevant arts. It should also be understood that terminology employed herein is used for the purpose of describing particular embodiments only and is not intended to be limiting.

[0038] Reference throughout this specification to "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrase "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment.

[0039] As used herein, a plurality of items, structural elements, compositional elements, and/or materials may be presented in a common list for convenience. However, these lists should be construed as though each member of the list is individually identified as a separate and unique member. Thus, no individual member of such list should be construed as a de facto equivalent of any other member of the same list solely based on their presentation in a common group without indications to the contrary. In addition, various embodiments and example of the present invention may be referred to herein along with alternatives for the various components thereof. It is understood that such embodiments, examples, and alternatives are not to be construed as de facto equivalents of one another, but are to be considered as separate and autonomous representations of the present invention.

[0040] Furthermore, the described features, structures, or characteristics may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided, such as examples of lengths, widths, shapes, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention can be practiced without one or more of the specific details, or with other methods, components, materials, etc. In other instances,

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well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

[0041] While the forgoing examples are illustrative of the principles of the present invention in one or more particular applications, it will be apparent to those of ordinary skill in the art that numerous modifications in form, usage and details of implementation can be made without the exercise of inventive faculty, and without departing from the principles and concepts of the invention. Accordingly, it is not intended that the invention be limited, except as by the claims set forth below.

[0042] The verb “to comprise” is used in this document as open limitations that neither exclude nor require the existence of also un-recited features. The features recited in depending claims are mutually freely combinable unless otherwise explicitly stated. Furthermore, it is to be understood that the use of "a" or "an", i.e. a singular form, throughout this document does not exclude a plurality.

REFERENCE SIGNS LIST

100	yarn
101–104	monofilament
105	multifilament

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CLAIMS:

1. A yarn (100) comprising:
   - a plurality of monofilaments (101 102, 103, 104) twisted together, and
   - a multifilament (105) wound around the plurality of monofilaments (101, 102, 103, 104),

   wherein the multifilament (105) comprises a bio-based material, a recycled bio-based material or a recycled synthetic material,

   the yarn (100) has an overfeed of the multifilament (105) of 5–25 %, and the multifilament (105) is twisted.

2. The yarn (100) of claim 1, wherein the plurality of monofilaments (101, 102, 103, 104) comprise a bio-based polyamide, such as bio-polyamide 6.10, bio-polyamide 4.10, bio-polyamide 10, bio-polyamide 10.10 or bio-polyamide 11, or a synthetic polyamide or a recycled polyamide, such as polyamide 6, polyamide 6.6 or polyamide 12.

3. The yarn (100) of any one of the preceding claims, comprising 3–24 monofilaments (101, 102, 103, 104), preferably 3–12 monofilaments (101, 102, 103, 104), more preferably 3–6 monofilaments (101, 102, 103, 104).

4. The yarn (100) of any one of the preceding claims, wherein the bio-based material is a cellulose-based material.

5. The yarn (100) of claim 4, wherein the cellulose-based material is selected from the group of viscose, lyocell, cupro, acetate, modal, bamboo and cellulose carbamate.

6. The yarn (100) of any one of the preceding claims 1–3, wherein the bio-based material is selected from the group of polylactic acid, bio-polyamide 6.10, bio-polyamide 4.10, bio-polyamide 5.10, bio-polyamide 10, bio-polyamide 10.10, bio-polyamide 11, bio-polybutylene succinate, bio-polyethylene, bio-polyethylene terephthalate, bio-polypropylene, bio-polyhydroxyalkanoate, wool, cotton, hemp, linen or bamboo.

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7. The yarn (100) of any one of the preceding claims, wherein a twist direction of the plurality of monofilaments (101, 102, 103, 104) is the same as a twist direction of the multifilament (105).

8. The yarn (100) of any one of the preceding claims, wherein diameters of the plurality of monofilaments (101, 102, 103, 104) are 0.1–0.6 mm, preferably 0.2 mm.

9. The yarn (100) of any one of the preceding claims, wherein the multifilament (105) has a linear density of 50–150 dtex.

10. The yarn (100) of any one of the preceding claims, having an overfeed of the multifilament (105) about 15 %.

11. The yarn (100) of any one of the preceding claims, having a linear density of 200–600 tex.

12. An industrial textile comprising a yarn (100) of any one of claims 1 to 11.

13. Use of a yarn (100) of any one of the claims 1 to 11 in an industrial textile, such as a press felt or a filter fabric.

14. Use of a yarn (100) of any one of the claims 1 to 11 in a paper machine clothing.

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PATENTTIVAATIMUKSET:

1. Lanka (100), joka käsittää:
   - useita monofilamentteja (101, 102, 103, 104) kierrettynä yhteen, ja
   - multifilamentin (105), joka on kääritty useiden monofilamenttien (101, 102, 103, 104) ympärille,

jossa multifilamentti (105) käsittää biopohjaista materiaalia, kierrätettyä biopohjaista materiaalia tai kierrätettyä synteettistä materiaalia, ja
langassa (100) on multifilamentin (105) 5 – 25 %:n ylisyöttö, ja multifilamentti (105) on kierretty.

2. Patenttivaatimuksen 1 mukainen lanka (100), jossa useat monofilamentit (101, 102, 103, 104) käsittävät biopohjaista polyamidia, kuten biopolyamidia 6.10, biopolyamidia 4.10, biopolyamidia 10, biopolyamidia 10.10 tai biopolyamidia 11 tai synteettistä polyamidia tai kierrätettyä polyamidia, kuten polyamidi 6, polyamidi 6.6 tai polyamidi 12.

3. Jonkin edellisen patenttivaatimuksen mukainen lanka (100), käsittäen 3–24 monofilamenttia (101, 102, 103, 104), edullisesti 3–12 monofilamenttia (101, 102, 103, 104), vielä edullisemmin 3–6 monofilamenttia (101, 102, 103, 104).

4. Jonkin edellisen patenttivaatimuksen mukainen lanka (100), jossa biopohjainen materiaali on selluloosapohjainen materiaali.

5. Patenttivaatimuksen 4 mukainen lanka (100), jossa selluloosapohjainen materiaali valitaan seuraavista: viskoosi, lyoselli, kupro, asetaatti, modaali, bambu ja selluloosakarbamaatti.

6. Jonkin patenttivaatimuksen 1–3 mukainen lanka (100), jossa biopohjainen materiaali valitaan seuraavien ryhmästä: polylaktidihappo, biopolyamidi 6.10, biopolyamidi 4.10, biopolyamidi 5.10, biopolyamidi 10, biopolyamidi 10.10, biopolyamidi 11, biopolybutyleenisukkinaatti, biopolyetyleeni, biopolyetyleeniterefatalaatti, biopolypropyleeni, biopolyhydroksialkanoaatti, villa, puuvilla, hamppu, pellava tai bambu.

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7. Jonkin edellisen patenttivaatimuksen mukainen lanka (100), jossa useiden monofilamenttien (101, 102, 103, 104) kiertosuunta on sama kuin multifilamentin (105) kiertosuunta.

8. Jonkin edellisen patenttivaatimuksen mukainen lanka (100), jossa useiden monofilamenttien (101, 102, 103, 104) halkaisijat ovat 0,1–0,6 mm, edullisesti 0,2 mm.

9. Jonkin edellisen patenttivaatimuksen mukainen lanka (100), jossa multifilamentin (105) lineaarinen tiheys on 50–150 dtex.

10. Jonkin edellisen patenttivaatimuksen mukainen lanka (100), jolla on noin 15 % multifilamentin (105) ylisyöttö.

11. Jonkin edellisen patenttivaatimuksen mukainen lanka (100), jonka lineaarinen tiheys on 200–600 tex.

12. Teollinen tekstiili, joka käsittää jonkin patenttivaatimuksen 1–11 mukaista lankaa (100).

13. Jonkin patenttivaatimuksen 1–11 mukaisen langan (100) käyttö teollisessa tekstiilissä, kuten puristinhuovassa tai suodatinkankaassa.

14. Jonkin patenttivaatimuksen 1–11 mukaisen langan (100) käyttö paperikonekankaassa.

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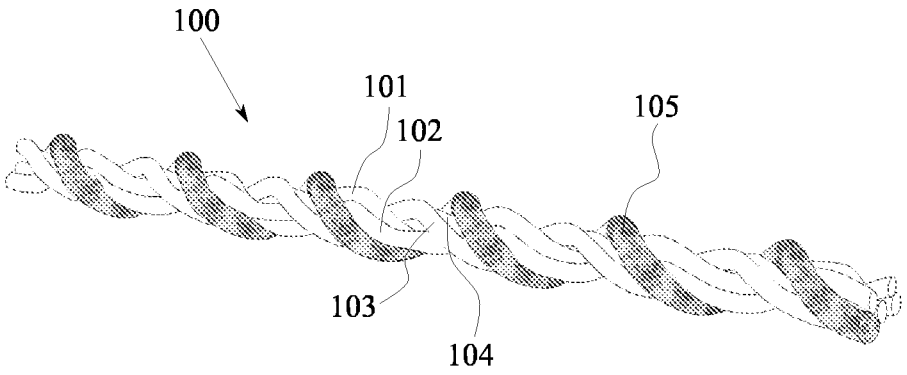

FIG. 1

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