



EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

17.06.2020 Bulletin 2020/25

(51) Int Cl.:

D06C 11/00 (2006.01) D03D 15/00 (2006.01)
D06C 23/02 (2006.01)

(21) Application number: **18843531.7**

(86) International application number:

PCT/JP2018/028880

(22) Date of filing: **01.08.2018**

(87) International publication number:

WO 2019/031356 (14.02.2019 Gazette 2019/07)

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA ME

Designated Validation States:

KH MA MD TN

(71) Applicant: **Kowa Company, Ltd.**

Nagoya-shi, Aichi 460-8625 (JP)

(72) Inventor: **SUEOKA, Toshitada**

Toyota-shi

Aichi 471-0066 (JP)

(74) Representative: **advotec.**

Patent- und Rechtsanwälte

Widenmayerstrasse 4

80538 München (DE)

(30) Priority: **07.08.2017 JP 2017152392**

(54) **ANTI-PILLING CLOTH AND METHOD FOR MANUFACTURING SAME**

(57) Provided are: a cloth including thermoplastic synthetic staple fibers, especially a woven or knitted fabric in which occurrence of pilling is suppressed and a reduction of the strength or deterioration of the texture of the cloth is suppressed; and a method for manufacturing the cloth. An anti-pilling cloth including thermoplas-

tic synthetic staple fibers, wherein the anti-pilling cloth is characterized by having, on the surface of at least one side of the cloth, melt balls at ends of the staple fibers and polishing traces of melt balls at fluff tip ends of the staple fibers; and a method for manufacturing the anti-pilling cloth.

FIG. 3



Description

FIELD

5 **[0001]** The present invention relates to an anti-pilling cloth containing thermoplastic synthetic staple fibers and to a method for manufacturing the same. More particularly, the present invention relates to an anti-pilling woven or knitted fabric containing spun yarn containing thermoplastic synthetic filaments and/or staple fibers and to a method for manufacturing the same.

10 BACKGROUND

[0002] Natural fibers are staple fibers with the exception of silk that are cut to a short length. For example, cotton has a length of about 20 mm to 35 mm and thickness of about 20 μm while merino wool has a length of about 7.5 mm to 120 mm and thickness of about 13 μm to 28 μm . For this reason, in the case of natural fibers, the staple fibers are unraveled and arranged so as to be combed out followed by twisting, bundling and spinning into yarn to obtain spun yarn. The spun yarn has occasional fluff, is bulky and is characterized by being flexible and retaining heat.

15 **[0003]** On the other hand, synthetic fibers are normally produced in the form of filaments after having gone through spinning, and for example, numerous fibers such as polyester-based or polyamide-based fibers are produced by melt spinning, while acrylic-based fibers are produced by wet spinning. In addition, regenerated cellulose fibers such as rayon or cupra and semisynthetic fibers such as acetate fibers are also produced in the form of filaments. Synthetic fibers are also used as staple fibers by cutting synthetic fibers that have been produced in the form of filaments.

[0004] Although synthetic fibers are typically characterized by being lighter and tougher (strong and resistant to breakage) in comparison with natural fibers such as cotton, hemp, silk or wool, many natural fibers have a unique light and fluffy texture and are mainly preferably used as raw materials of clothing. Although woven or knitted fabric should be woven or knitted with spun yarn of synthetic fibers in order to achieve the fluffy texture of natural fibers with synthetic fibers, woven or knitted fabric produced from spun yarn of synthetic fibers is known to be susceptible to the occurrence of pilling. Pilling refers to the surface of a cloth being subjected to rubbing during the course of wearing or washing resulting in the formation of fluff on the cloth surface and leading to the fluff becoming entangled and forming small balls of fabric (pills), and when synthetic fibers such as polyester or polyamide fibers are included in the fibers in particular, pills form easily since the fibers are strong and resistant to breakage. Although it would be preferable if the pills simply fell off, since these synthetic fibers stretch without breaking when pulled, once a pill has formed it is difficult to remove, and together with impairing appearance, also promotes deterioration of the woven or knitted fabric. Consequently, in the case of producing woven or knitted fabric using spun yarn of synthetic fibers for applications such as clothing or products that undergo repeated laundering, measures for inhibiting the occurrence of pilling (namely, anti-pilling measures) are indispensable.

[0005] In the past, fluff frequently occurred in woven cloth or knitted cloth and particularly in cotton and other spinning cloth, and when the amount of fluff increased, the surface of dyed articles became indistinct and since this also caused the formation of pills, so-called singeing was carried out that consisted of carbonizing and burning off the fluff with a gas burner or electric heater and making the fiber surface smooth in order to remove the fluff. Although singeing was carried out after weaving in the case of pre-dyed articles, it was also carried out during weaving.

40 **[0006]** On the other hand, the fibers of woven or knitted fabrics were raised to intentionally produce fluff in the manner described below.

[0007] In the case of cotton articles such as jeans, when the cloth is covered with fluff, since the jeans take on a softer and rich sensation, the color pattern appears white and indistinct, and the texture changes to a more relaxed feeling and gives off a high class feel, a thin layer of fluff is produced by washing out the cloth yielding an appearance of that resembling older clothes.

[0008] In the case of hand weaving, felted fibers are reduced by moistening, beating and rubbing stiff gray fabric to generate fluff, the fibers are scraped to further generate fluff and then cut and subjected to raising that generates fluff, and raising effects were obtained that produced a gentler sensation than card clothing raising by card clothing that generates fluff by scratching the cloth surface with a card clothing roller equipped with metal needles or by rubbing the cloth surface with the thorns of thistle fruit using a technique known as thistle raising.

50 **[0009]** In order to obtain cloth having a smooth and soft feeling on the skin, moisture retention and a luxurious feel in the manner of natural cashmere or angora, extremely long fluff referred to as carded wool is produced at a high density by card clothing and raising woven or knitted fabric using yarn spun from synthetic staple fibers such as those of polyester or acrylic fibers.

55 **[0010]** In addition, a technique referred to as emery processing (chamois processing) is known that is used to finely scuff short fluff by rubbing with a kind of sandpaper referred to as emery paper. Although the grit number of the sandpaper varies, sanding processing, which is known as a technique for raising polyester woven fabric, also carries out raising

with sandpaper, and multiple sandpaper rollers each having difference degrees of raising are superimposed vertically and rotated at low speed following by passing the cloth there between to rub and thinly raise the cloth.

[0011] In the case of having carried out hand weaving or raising in particular, shearing consisting of cutting fluff from the cloth surface is carried out to vividly express the woven structure or color pattern or adjust the appearance by cutting the fluff to a uniform length or cutting away randomly.

[0012] The following PTL1 discloses a knitted fabric for a shirt that is comprised of a knitted fabric obtained by forming polyester staple fibers having fineness of 1.0 denier to 2.5 denier and cotton fibers with a blended yarn, wherein the composition ratio of the cotton fibers in the aforementioned blended yarn is 75% to 90%, the twist factor is 3.0 to 4.5, and the knitted fabric is singed after being formed. Citation 1 describes that if the composition ratio of the cotton fibers is less than 75% (namely, if the composition ratio of the polyester staple fibers exceeds 25%), in addition to the polyester staple fibers melting during singeing after forming resulting in a hard texture, there is also greater susceptibility to soiling. In other words, when singeing, which is employed as an anti-pilling measure in natural fibers, is used as an anti-pilling measure for natural fibers in the form of polyester, instead of the fluff that causes pilling being carbonized and removed in the manner of natural fibers, the ends of the polyester fluff forms melt balls that worsens the texture in terms of the cloth becoming rough.

[0013] The following PTL2 discloses a method for producing an animal hair-like cloth by forming melt balls of synthetic fibers by singeing the napped ends of raised cloth having a nap comprised of synthetic fibers such as polyester fibers, polyamide fibers or acrylic fibers in order to obtain a soft texture in the manner of cashmere in the case of singeing synthetic fibers, followed by treating the napped ends with a solvent or hydrolytic agent of the synthetic fibers having a prescribed viscosity and subjecting to heat treatment to refine the napped ends. This is based on causing the portion where melt balls have formed to enter an amorphous orientation, and together with being able to considerably shorten treatment time by significantly increasing the dissolution rate and hydrolysis rate when treating with solvent or hydrolytic agent, also makes it possible to refine the ends to extremely sharp points. However, since methods involving treatment with a solvent or hydrolytic agent of synthetic fibers ends up causing a decrease in material strength, they are currently only used in limited applications such as women's clothing.

[0014] The following PTL3 discloses an anti-pilling denim or dungaree woven fabric that uses spun yarn containing synthetic fibers, in which the amount of fluff per number of cross-sectional fibers has been reduced by a specific spinning method, and has been subjected to singeing and/or alkali reduction, wherein pilling resistance according to Method A of JIS L1076 (ICI-type tester, 5 hours) after washing 10 times (JIS L0217, Method 103) is grade 3 or higher. PTL3 described that, although singeing treatment is required in order to prevent pilling in synthetic fibers when synthetic fiber spun yarn is used, expensive processes such as removing melt balls of the synthetic fibers that have formed as a result thereof by high-temperature alkali reduction, mercerization or shearing are required, the texture, fastness and the like become poor, the skin is irritated by melt balls present on the cloth surface in the case of singeing alone, melt balls scrape the surface of the cloth as a result of repeated wear and washing, fluff is easily induced, quality of the cloth surface and feel during wear worsen, and in the case of denim or dungaree, a chemical treatment process using strong acid or base carried out at high pressure for a long period of time is required, thereby reducing the application range of products using spun yarn containing synthetic fibers.

[0015] The following PTL4 discloses a method for producing a polyester-spun fabric in which surface fluff is finished so that the average fluff length is at least 1.1 mm to 50 mm and the average fluff density is 200 strands/cm or more by card cloth raising a spun fabric containing polyester single fibers having a single fiber density of 0.01 denier to 10 denier and single fiber strength of 2.5 g/denier or more followed by subjecting the surface of the fabric to beating and abrasion treatment with a flexible coarse surface material having an abrasive film surface on the surface of a support roller. In addition, during the beating and abrasion treatment, in addition to long, coarse fluff on the raised surface subjected to card cloth raising being cut down while powerfully pulled out with the flexible coarse surface material having an abrasive film surface, loops and aggregated fibers are severed and removed to allow slightly shorter, dense fluff to be newly generated. PTL4 describes that, in contrast to pilling resistance as determined in accordance with JIS L1076 being grade 1 to grade 2 in the case of buffing with an emery roll as in the prior art, the aforementioned treatment method using an abrasive film yields pilling resistance of grade 4 to grade 5. PTL4 also describes that, although products have been improved and commercialized from polyester staple fiber spun yarn having a high level of physical properties, spun cloth comprised of this staple fiber spun yarn has long fluff, fluff on the cloth surface is subjected to greater friction attributable to wearing and washing than ordinary worsted fabric, frequently resulting in the formation of small balls of fabric referred to as pilling that caused problems in terms of considerably impairing cloth quality and appearance, thereby resulting in fluff present on the surface of the cloth or fluff pulled out from the cloth becoming entangled as a result of staple fiber fluff on the cloth surface being rubbed and the entangled fluff easily falling off, with synthetic fibers such as polyester fibers having high fiber strength and elongation presenting a problem, and although methods such as: (1) modifying the fibers to have less strength and elongation, (2) enhancing structural binding force of the cloth, (3) embrittlement of surface fluff, (4) singeing the fluff, or (5) processing with resin are known as countermeasures against the occurrence of pilling and defects referred to as fuzz associated with mild pilling, each of these methods has both advantages and disadvantages.

tages, and it is still extremely difficult to obtain a polyester spun fabric that is soft, has the appearance of carded wool that feels good on the skin and demonstrates superior pilling resistance.

[0016] PTL4 describes that, although singeing in particular is a method applied to worsted fabrics having short fluff and consists of singeing the surface fluff of the cloth with a gas burner when dyeing and finishing the cloth, it cannot be applied to cloth having long fluff, and even if it were attempted to be applied thereto, although anti-pilling effects would be observed to a certain degree, since melt balls of fluff remain on the surface, there are problems such as the texture becoming rough, the texture being hardened by heat treatment, and the cloth lacking heat retention. In this manner, the technology disclosed in PTL4 applies anti-pilling measures that cause the generation of short, dense fluff using a specific polishing method instead of applied conventional anti-pilling measures employed in carded wool fabric of fluff using synthetic fiber spun yarn. Citation 4 describes that, since extraordinary anti-pilling effects are not obtained as a result of employing ordinary buffing, sanding or grinding with an emery roll or emery belt, spun fabric is finished by subjecting to beating and abrasion treatment on the surface of a support roller by rotating a flexible coarse surface material having an abrasive film surface in the shape of a sharp blade obtained by laminating metal plates and drastically reducing thickness moving toward the tip. The most important point regarding this specific polishing method is that, as a result of cutting down while powerfully pulling out long, coarse fluff of a card clothing raised surface, simultaneously severing and removing loops and aggregated fibers, and allowing slightly shorter, dense fluff to be newly generated, only "strong fluff" is allowed to be created thereby enhancing abrasion resistance and imparting pilling resistance by developing the surface, or in other words, removing any loose fibers capable of forming pills from the top surface.

[0017] The following PTL5 discloses a method for manufacturing a raised fabric that is capable of creating a soft, peach skin-like texture by fibrillating the surface only instead of pulling out fibers from inside the fabric in the manner of thistle raising or card clothing raising while also improving pilling properties, enabling raising of a thin fabric in the manner of boiling without causing problems such as rope wrinkles, scuffing defects or structural disorder, and further eliminating decreases in tear strength of the fabric by contacting fabric woven using glued warp with a ceramic roller comprised of an inorganic powder having a grain size of #100 to #800 while allowing the fabric to travel at a prescribed speed. PTL5 describes that, in comparison with conventional polishing using emery paper (#200), polishing with a ceramic roller comprised of an inorganic powder having a grain size of #100 to #800 improves texture and pilling resistance, and since only the fiber surface is fibrillated allowing the generation of fine fluff, posttreatment consisting of physical means such as singeing or shearing or chemical means using chemicals is not required after raising the fabric.

[0018] The following PTL6 discloses the imparting of pilling resistance and high contractility (bulkiness) by modified synthetic fibers obtained by incorporating a monomer that improves pilling resistance in the monomer composing the synthetic fibers and copolymerizing the monomers. However, this technology has the shortcomings of the applicable fiber material being limited to polyester, and the properties and texture inherently possessed by the synthetic fibers being lost as a result of fiber modification, thereby leading to decreases in fiber strength and increased costs.

[0019] As has been described above, although singeing is used in PLT1 and PTL2 as an anti-pilling measure for fabrics using synthetic fiber spun yarn, PTL3 to PTL6 conversely teach that singeing should not be carried out. Furthermore, as was previously described, although PTL3 describes to the effect that melt balls formed by singeing synthetic fibers can be removed by shearing, since shearing is inherently a method for cutting away raised fibers, it is in fact difficult to apply to products other than raised products similar to the case of polishing, and even if it were to be applied, since there is an extremely high rise of damaging the cloth material, it is not used in actuality.

[0020] In addition, although PTL4 and PTL5 disclose special polishing methods, these polishing methods are techniques applied to raised products. Since the fluff of synthetic fiber spun yarn is hard and fluff (fiber tips) end up escaping even if polished, it is difficult to only treat the fluff causing the occurrence of pilling without damaging the cloth material.

[0021] In this manner, although examples of known anti-pilling measures for textile products in general include singeing, reduction of fiber strength, polishing, shearing (shearing or cutting) and modification of the fiber material, since none of these are adequate as anti-pilling measures of fabrics using synthetic fiber spun yarn, synthetic fiber spun yarn tends to be eliminated from being a possible choice of material at the stage of examining the development of clothing products.

[0022] In addition, it is surprising to note that finishing processes combining singeing and polishing are not known and are currently not yet implemented as anti-pilling measures of fabrics using synthetic fiber spun yarn.

[CITATION LIST]

[PATENT LITERATURE]

[0023]

PTL1: Japanese Unexamined Patent Publication No. H8-144158

PTL2: Japanese Examined Patent Publication No. S61-31234

PTL3: Japanese Unexamined Patent Publication No. 2004-197243

PTL4: Japanese Unexamined Patent Publication No. H9-95859
 PTL5: Japanese Unexamined Patent Publication No. H7-97764
 PTL6: Japanese Unexamined Patent Publication No. 2016-108702

SUMMARY

[TECHNICAL PROBLEM]

[0024] With the foregoing in view, an object of the present invention is to provide a cloth containing thermoplastic synthetic staple fibers, such as a woven or knitted fabric that inhibits the occurrence of pilling in the fabric and inhibits decreasing in cloth strength and worsening of texture, and a method for manufacturing the same.

[SOLUTION TO PROBLEM]

[0025] As a result of repeatedly conducting extensive studies and experimentation to solve the aforementioned problems, the inventor of the present invention unexpectedly found that, by singeing at least one side of a fabric having fluff comprised of staple fibers obtained by using spinning yarn containing thermoplastic synthetic staple fibers for the raw yarn followed by weaving or knitting the staple fibers to form melt balls on the ends of the staple fibers, followed by rubbing off the metal balls on the ends of the fluff of the formed staple fibers by polishing with a roll polisher or belt sander to form polishing traces, fabric is obtained that demonstrates extremely superior pilling resistance and inhibits decreases in cloth strength and worsening of texture caused in the production stage or as a result of repeated use, thereby leading to completion of the present invention.

[0026] Namely, the present invention is as indicated below.

[1] An anti-pilling cloth containing thermoplastic synthetic staple fibers, having melt balls on the ends of the staple fibers and polishing traces of the melt balls on the fluff tips of the staple fibers on at least one side of the cloth.

[2] The anti-pilling cloth described in [1] above, wherein the thermoplastic synthetic staple fibers are fibers selected from the group consisting of polyester-based, polyamide-based, polyacrylic-based, polyvinyl chloride-based, polyvinylidene chloride-based, polyvinyl alcohol-based, polyolefin-based and polyurethane-based fibers.

[3] The anti-pilling cloth described in [1] or [2] above, which is a woven or knitted fabric.

[4] The anti-pilling cloth described in [3] above, wherein the anti-pilling grade as determined in accordance with Method A of JIS L1076 (method using an ICI-type tester) after washing 10 times and 30 times in accordance with Method C4M of JIS L1930 (using tumble drying) is grade 3 or higher.

[5] A method for manufacturing an anti-pilling cloth including the steps of:

using filament yarn and/or staple fibers of thermoplastic synthetic fibers as raw yarn and weaving or knitting a cloth having fluff on the cut ends of the filament yarn or fluff on the staple fibers,
 forming melt balls on the cut ends of the filament yarn or on the ends of the staple fibers by singeing at least one side of the resulting cloth, and
 forming polishing traces by scraping the melt balls on the cut ends of the filament yarn or on the fluff tips of the staple fibers formed on the thermoplastic synthetic fibers by polishing.

[6] The method described in [5] above, wherein the thermoplastic synthetic fibers are fibers selected from the group consisting of polyester-based, polyamide-based, polyacrylic-based, polyvinyl chloride-based, polyvinylidene chloride-based, polyvinyl alcohol-based, polyolefin-based and polyurethane-based fibers.

[7] The method described in [5] or [6] above, wherein the anti-pilling cloth is a woven or knitted fabric.

[8] The method described in [7], wherein the anti-pilling grade of the anti-pilling cloth as determined in accordance with Method A of JIS L1076 (method using an ICI-type tester) after washing 10 times and 30 times in accordance with Method C4M of JIS L1930 (using tumble drying) is grade 3 or higher.

[ADVANTAGEOUS EFFECTS OF INVENTION]

[0027] As a result of allowing melt balls formed by singeing to remain within the cloth with only polishing traces of melt balls on the fluff tips of the staple fibers present on the cloth surface, the anti-pilling cloth containing thermoplastic synthetic staple fibers according to the present invention is a cloth, such as a woven or knitted fabric, that demonstrates superior pilling resistance and inhibits prominent reductions in strength and exacerbation of texture occurring in the production stage and after repeated use. Consequently, woven or knitted fabric using synthetic fiber spun yarn, for which practical application thereof had previously been difficult, can be applied to various articles of clothing and other textile

products having a desired texture and appearance. The type of synthetic fibers used for the raw yarn can be freely selected without any particular restrictions thereon. In addition, the present invention can also be applied to woven or knitted fabric subjected to raising treatment. Moreover, the present invention can also be applied to woven or knitted fabric having fibers on the surface thereof that have ends formed by cutting filaments during weaving or knitting of woven or knitted fabric comprised of filaments. Consequently, the anti-pilling cloth containing thermoplastic synthetic staple fibers according to the present invention is able to provide clothing that is lighter and more durable than natural fibers while having a soft texture in the manner of natural fibers, and can be applied to various textile products such as sheets or bedding covers that are durable and resistant to deterioration even after repeated use.

BRIEF DESCRIPTION OF DRAWINGS

[0028]

FIG. 1 is an electron micrograph of a cloth surface after 10 rounds of washing a spun polyester plain woven finished article (regular processed product) produced in Comparative Example 1.

FIG. 2 is an electron micrograph of a cloth surface after 30 rounds of washing a spun polyester plain woven finished article (regularly processed product) produced in Comparative Example 1.

FIG. 3 is an electron micrograph of a cloth surface after 10 rounds of washing a spun polyester plain-woven finished article (singeing + polishing) produced in Example 1.

FIG. 4 is an electron micrograph of a cloth surface after 30 rounds of washing a spun polyester plain woven finished article (singeing + polishing) produced in Example 1.

FIG. 5 is an electron micrograph of a cloth surface (singeing only) immediately after having carried out singeing following desizing and scouring of gray fabric at an intermediate stage of the production of a spun polyester plain woven fabric produced in Example 1.

FIG. 6 is an electron micrograph of a cloth surface immediately after having finished (singeing + polishing) a spun polyester plain woven fabric finished article produced in Example 1.

FIG. 7 is an electron micrograph of a cloth surface (regular processed product) of a spun polyester plain woven fabric finished article (regular processed product) produced in Comparative Example 3.

FIG. 8 is an electron micrograph of a cloth surface (singeing only) immediately after having carried out singeing processing after desizing and scouring a spun polyester plain woven fabric finished article produced in Example 2.

FIG. 9 is an electron micrograph of a cloth surface (singeing only) immediately after having carried out singeing following desizing and scouring of gray fabric at an intermediate stage of the production of a spun polyester plain woven fabric produced in Example 2.

FIG. 10 is a schematic diagram showing one example of a belt sander apparatus for forming polishing traces by scraping the melt balls on fluff tips following singeing.

DESCRIPTION OF EMBODIMENTS

[0029] The following provides a detailed explanation of embodiments of the present invention.

[0030] One embodiment of the present invention is an anti-pilling cloth containing thermoplastic synthetic staple fibers, having melt balls on the ends of the staple fibers and polishing traces of the melt balls on the fluff tips of the staple fibers on at least one side of the cloth.

[0031] In the present description, the term "thermoplastic synthetic fibers" refers to chemical fibers comprised of a chemically synthesized polymer, although there are no particular limitations thereon provided melt balls are formed that are obtained by gas singeing and the like, and examples thereof include synthetic fibers such as polyester-based, polyamide-based, polyacrylic-based, polyvinyl chloride-based, polyvinylidene chloride-based, polyvinyl alcohol-based, polyolefin-based or polyurethane-based fibers. For example, the melting point of polyester-based staple fibers is 255°C to 260°C, the melting point of polyamide-based fibers in the form of nylon staple fibers is 215°C to 220°C, the softening point of polyacrylic-based fibers is 190°C to 240°C although the melting point is not clear, and the melting point of polyolefin-based fibers in the form of polypropylene staple fibers is 165°C to 173°C. In contrast, natural fibers in the form of cotton (upland) fibers decompose at 235°C and burn at 275°C to 456°C, while wool (merino) undergoes thermal decomposition at 130°C, becomes scorched at 205°C and carbonizes at 300°C. In addition, regenerated cellulose fibers in the form of rayon or cupra fibers do not soften or melt, but rather become colored and begin to decompose at 160°C to 300°C. The thermoplastic synthetic fibers in the present embodiment are preferably fibers selected from the group consisting of polyester-based, polyamide-based, polyacrylic-based, polyvinyl chloride-based, polyvinylidene chloride-based, polyolefin-based and polyurethane-based fibers, and are more preferably polyester-based, polyamide-based or polyacrylic-based fibers.

[0032] In the present description, the term "staple fibers" refers to fibers that have been cut to a short length, and in

the case the staple fibers are thermoplastic synthetic staple fibers, they are typically fibers obtained by cutting fibers made in the form of filaments. From the viewpoint of spinning processability, the length of the staple fibers is preferably 20 mm to 70 mm, more preferably 30 mm to 60 mm and even more preferably 38 mm to 51 mm. From the viewpoints of spinnability and retaining cloth strength, the fineness (single fiber fineness) of the staple fibers is preferably 0.01 denier to 10 denier, more preferably 0.8 denier to 5 denier and even more preferably 1.0 denier to 2.5 denier. If the single fiber fineness is less than 0.01 denier, there is increased susceptibility to soiling and fluff forms and gathers on the ends resulting in greater susceptibility to the formation of pills, while if the single fiber fineness exceeds 10 denier, although there is less generation of fluff, due to the increase in strength, it becomes difficult to remove pills once they have formed and texture is impaired. The cross-sectional shape of the staple fibers may be circular or irregular.

[0033] Furthermore, in the present description, the term "staple fibers" also includes fibers having cut ends that have formed as a result of filaments having been cut by weaving, knitting or raising treatment on the surface of gray fabric obtained by weaving or knitting using thermoplastic synthetic filaments as raw yarn.

[0034] In the present description, the term "spun yarn" refers to yarn obtained by unraveling staple fibers, arranging the fibers so as to be combed, twisting and bundling. Although the spun yarn is preferably comprised only of one type of thermoplastic synthetic staple fibers from the viewpoint of melt ball formation, the spun yarn may also be a blended yarn comprised of two or more types of thermoplastic synthetic staple fibers. In addition, the spun yarn may also be a blended yarn comprised of thermoplastic synthetic staple fibers and other natural fibers or may be composite fiber yarn, union yarn twisted with filament yarn, or spun twisted yarn. The yarn count of the spun yarn is preferably 7 to 120 (760 denier to 44 denier). The cloth becomes thick if the yarn count is less than 7, while strength decreases if the yarn count exceeds 120. In addition, the twist count is preferably 60 twists/m to 1500 twists/m.

[0035] In the present description, the term "cloth" refers to any of a woven fabric, knitted fabric (circular knitted fabric, warp knitted fabric or weft knitted fabric) or nonwoven fabric. The cloth is preferably a woven fabric or knitted fabric from the viewpoint of demonstrating a desired effect as a clothing product. Although the woven fabric is preferably composed of 100% spun yarn, a mixed fabric using filaments for the warp and spun yarn for the weft is preferable since it allows the obtaining of a soft and resilient texture. There are no particular restrictions on the woven structure or knit structure. Moreover, in the present description, the term "woven or knitted fabric" refers to either a woven fabric or knitted fabric.

[0036] In the present description, the term "fluff" refers to the ends of staple fibers that have risen from the cloth surface, while the ends of staple fibers present within the cloth or within the composing spun yarn are not referred to as fluff. FIGS. 1 and 2 indicate an example of polyester fluff, while FIG. 7 indicates an example of nylon fluff.

[0037] In the present description, the term "melt ball" refers to that which is formed into roughly a spherical shape as a result of the fluff of thermoplastic synthetic fibers being melted by singeing. In the present embodiment, melt balls present on the surface of cloth are converted to polishing traces as a result of being scraped by polishing. FIG. 5 indicates an example of polyester melt balls while FIG. 9 indicates an example of nylon melt balls.

[0038] In the present description, the term "polishing traces" refers to the ends of staple fibers of a shape having traces where melt balls on a cloth surface were scraped by polishing. FIGS. 3, 4 and 6 indicate an example of polyester polishing traces while FIG. 8 indicates an example of nylon polishing traces.

[0039] Another embodiment of the present invention is a method for manufacturing an anti-pilling cloth that includes the steps of:

- using spun yarn containing thermoplastic synthetic staple fibers as raw yarn and weaving or knitting a cloth having fluff on staple fibers,
- forming melt balls on the cut ends of the staple fibers by singeing at least one side of the resulting woven fabric or knitted fabric, and
- forming polishing traces by scraping the melt balls on the cut ends of the fluff tips of the staple fibers formed one side of the resulting woven fabric or knitted fabric by polishing.

[0040] The following provides an explanation of one example of the manufacturing of the anti-pilling cloth of the present embodiment.

[0041] Thermoplastic synthetic staple fibers are spun into spun yarn. At that time, the spun yarn may be a blended yarn of two or more types of thermoplastic synthetic fibers or may be a blended yarn of one or more types of thermoplastic synthetic fibers and one or more types of natural fibers.

[0042] Next, the spun yarn is woven using as warp yarn and/or weft yarn to obtain a gray fabric.

[0043] Next, the gray fabric is subjected to desizing and scouring.

[0044] Next, singeing is carried out in the manner described below.

(Singeing)

[0045] Melt balls are formed on the tips of fluff present on the cloth surface. At this time, although there are cases in

which the melt balls are formed on the ends of staple fibers on the exterior of the spun yarn, since melt balls may also be embedded within the cloth and melt balls present at such sites do not appear on the cloth surface, there is no risk of impairing the texture of the cloth. Singeing can be carried out by, for example, direct singeing with the flame of a gas burner (gas singeing) and/or indirect singeing by contact with a heated roller (contact singeing). Since the melting points of polyester and nylon are 210°C to 260°C, direct singeing is preferable. Indirect singeing, in which heat is transmitted in a short period of time with the temperature of the heated roller at a higher temperature, is preferable for materials having higher melting points. Although there are no particular restrictions on singeing conditions, melt balls should be allowed to form on fluff tips present on the cloth surface that cause the occurrence of pilling. The transit speed of the woven fabric supplied to the singeing step (singeing processing speed) is preferably 60 m/min to 120 m/min and more preferably 80 m/min to 100 m/min. Furthermore, in the case the spun yarn contains natural fibers, gas singeing is preferable since pilling is inhibited if the fluff of natural fibers is carbonized and burned off by gas singeing.

[0046] Next, polishing is carried out in the manner described below.

(Polishing)

[0047] Melt balls on the fluff tips of staple fibers formed on at least one side of a woven fabric or knitted fabric by singeing as described above are, for example, scraped by polishing using an abrasive or sandpaper to form polishing traces. Polishing is preferably carried out on both sides in the case melt balls are formed on both sides of the cloth. Polishing may be carried out manually or using various types of polishers. Roll polishers in which an abrasive is applied to a roller, roll polishers in which sandpaper is wrapped around a roller, or belt sanders using a sandpaper belt can be used as polishers. FIG. 10 indicates an example of a polishing apparatus that uses a belt sander. In the case of polishing both sides of a cloth using a belt sander, polishing is carried out twice by interchanging the polished side. As shown in FIG. 10, following singeing, the cloth passes over reversing rollers (1 and 2), is preheated with heated cylinders (3 to 5), passes over reversing rollers (6 to 8), and is pressed against a rotating belt sander (10) while adjusting the pressing force with a movable retainer valve (9), thereby scraping off melt balls on the cloth surface resulting in the formation of polishing traces. Powder generated by this polishing is removed with a paper powder remover (11) and cloth powder removers (12 and 14), after which the cloth from which the powder has been removed is finally recovered after being folded over with a shaking device (19).

[0048] Although conventional anti-pilling measures employing polishing consisted of fibrillation as described in PTL5, the polishing in the present embodiment is carried out in order to scrape off melt balls that have formed due to singeing. As shown in FIGS. 5 and 9, since melt balls have a roughly spherical shape of a prescribed size, when scraped off by contacting with an abrasive or sandpaper with a cloth surface, the melt balls are unable to enter inside the cloth, thereby enabling polishing and scraping to be carried out preferentially and minimizing damage to the structure of the woven fabric. Thus, as a result of this polishing, the problems of roughening of the cloth and exacerbation of texture and appearance due to melt balls remaining on the cloth, which had been the major problem associated with singeing of thermoplastic synthetic fibers, are resolved and decreases in cloth strength are inhibited. As was previously described, although PTL4 and PTL5 teach extraordinary polishing methods, these polishing methods are techniques applied to raised products, and since fluff (fluff tips) end up escaping even when polished due to the hard fluff in the case of spun yarn comprised of synthetic fibers, it is difficult to treat only that fluff that causes the occurrence of pilling without damaging the cloth material. However, the inventor of the present invention found that, since it is difficult for fluff to escape if melt balls are formed on the tips thereof by singeing, the melt balls can be polished by scraping without damaging the cloth material and woven fabric can be produced having extremely superior pilling resistance, thereby leading to completion of the present invention. In addition, as was previously described, although PTL3 describes to the effect that melt balls formed by singeing synthetic fibers can be removed by shearing, since shearing is inherently a method for cutting away raised fibers, it is in fact difficult to apply to products other than raised products in the same manner as polishing, and even if it were to be applied, since there is an extremely high risk of damaging the cloth material, in actuality it is not used.

(Raising Treatment)

[0049] The method for manufacturing an anti-pilling cloth of the present embodiment can also be applied to woven fabric or knitted fabric having a surface subjected to raising treatment. Examples of methods used to form a raised state on the surface of a woven or knitted fabric using spun yarn containing thermoplastic synthetic staple fibers for the raw yarn include processing methods in the manner of card clothing raising treatment and emery raising treatment, methods employing weaving in the manner of pile fabrics, and methods employing knitting in the manner of knitted fabrics obtained by center cutting double Raschel knit fabric. At least one side of a woven fabric or knitted fabric having a surface subjected to raising treatment is singed to form melt balls on the ends of the staple fibers, after which melt balls on the fluff tips of the staple fibers that have formed on one side of the resulting woven fabric or knitted fabric are scraped by polishing to form polishing traces.

[0050] In addition, the method for manufacturing anti-pilling cloth of the present embodiment can also be applied to woven fabric or knitted fabric in which staple fibers are present as a result of cutting filaments by weaving, knitting or raising treatment and the like on the surface of gray fabric that has been woven or knit using filaments of thermoplastic synthetic fibers for the raw yarn. This is because, if fiber ends are present on the surface on one side of a fabric, melt balls are formed on the ends of the fibers due to singeing, and polishing traces can be formed by scraping off the melt balls on the fluff tips formed on one side of the resulting woven fabric or knitted fabric by polishing, thereby making it possible to demonstrate a desired effect.

(Heat Setting)

[0051] Next, heat treatment is carried out to eliminate the effects of uneven thermal hysteresis of synthetic fibers. It is preferable to carry out heat setting in order to achieve dimensional stability and uniform dyeing of a woven fabric. In the case of polyester fibers or nylon fibers, heat treatment is carried out for about 30 seconds to 1 minute at 180°C.

(Dyeing)

[0052] There are no particular limitations on dyeing. Dyeing includes squeeze dyeing and continuous dyeing, and squeeze dyeing is most common. Although continuous dyeing is carried out for some polyester, the texture becomes hard and flexibility is impaired. In the case of squeeze dyeing, although uneven dyeing occurs if singeing is carried out prior to dyeing since the dyeing properties of melt balls differ from the cloth, in the present embodiment, since melt balls are removed from the cloth surface by polishing, the problem of uneven dyeing does not occur. Dyeing streaks occur if singeing is uneven. In cases when the problem of dyeing streaks attributable to singeing cannot be solved, singeing and polishing may be carried out on the woven fabric after having dyed the weaving yarn. Namely, dyeing may be carried out prior to singeing or after singeing.

(Finishing Drying)

[0053] Next, the cloth is finished by drying.

[0054] Since a woven fabric or knitted fabric in which anti-pilling measures have been implemented according to the aforementioned manufacturing method has gone through a singeing step and polishing step, when confirmed with an electron microscope as shown in FIGS. 3, 4, 6 and 8, melt balls on the ends of fibers are present on the outside of the spun yarn although embedded within the cloth, and polishing traces are present on the cloth surface that were formed by scraping off the melt balls on the fluff tips.

[0055] As a result of implementing anti-pilling measures including the aforementioned singeing step and polishing step, even in the case of a woven fabric or knitted fabric containing thermoplastic synthetic staple fibers of grade 1 to 2, the anti-pilling measures can improve the pilling resistance grade to grade 3 or higher, preferably grade 4 or higher and even more preferably grade 5 or higher, and the resulting woven fabric or knitted fabric inhibits decreases in strength and worsening of texture. As is indicated in the following examples, a woven fabric or knitted fabric in which the anti-pilling measures of the present embodiment have been implemented also has superior durability since the anti-pilling performance thereof persists even after repeated washing.

EXAMPLES

[EXAMPLE 1] Manufacturing of Spun Polyester Product (Singeing + Polishing)

[0056] Spun polyester fibers (polyester staple fibers, 1.6 denier, cut to 38 mm) were spun in accordance with an ordinary method to obtain polyester spun yarn (yarn count: 30).

[0057] The yarn was warped by using the resulting polyester spun yarn for the warp, warp glue consisting mainly of poval was applied to the warped yarn, and the resulting polyester spun yarn was similarly used for the weft to weave plain-woven gray fabric at a warp density of 90 yarns/inch (2.54 cm) and weft density of 70 yarns/inch.

[0058] After desizing and scouring the resulting gray fabric, both sides of the cloth were singed with a gas singeing machine (80 m/min) to form melt balls on the cloth. Next, both sides of the cloth were polished with a belt sander (#1000 mesh) to remove the melt balls formed on the surface of the cloth. Subsequently, a plain-woven test roll composed of spun polyester fibers was obtained by going through a heat setting step for 1 minute at 180°C, a squeeze dyeing step using squeezing and a drying step.

[COMPARATIVE EXAMPLE 1]

[0059] A test roll was obtained according to the same method as Example 1 with the exception of omitting the singeing step and polishing step.

[COMPARATIVE EXAMPLE 2]

[0060] A test roll was obtained according to the same method as Example 1 with the exception of carrying out alkali reduction treatment (10%) instead of the polishing step after the singeing step of Example 1.

[COMPARATIVE EXAMPLE 3]

[0061] A test roll was obtained according to the same method as Example 1 with the exception of carrying out alkali reduction treatment (20%) instead of the polishing step after the singeing step of Example 1.

[COMPARATIVE EXAMPLE 4]

[0062] A test roll was obtained according to the same method as Example 1 with the exception of carrying out alkali reduction treatment (30%) instead of the polishing step after the singeing step of Example 1.

[EXAMPLE2] Manufacturing of Spun Nylon Product (Singeing + Polishing)

[0063] Spun nylon fibers (nylon 66 staple fibers, 1.7 denier, cut to 38 mm) were spun in accordance with an ordinary method to obtain nylon spun yarn (yarn count: 30).

[0064] The yarn was warped by using the resulting nylon spun yarn for the warp, warp glue consisting mainly of poval was applied to the warped yarn, and the resulting polyester spun yarn was similarly used for the weft to weave plain-woven gray fabric at a warp density of 90 yarns/inch and weft density of 70 yarns/inch.

[0065] After desizing and scouring the resulting gray fabric, both sides of the cloth were singed with a gas singeing machine (80 m/min) to form melt balls on the cloth. Next, both sides of the cloth were polished with a belt sander (#1000 mesh) to remove the melt balls formed on the surface sides of the cloth. Subsequently, a test roll composed of spun nylon fibers was obtained by going through a heat setting step for 1 minute at 180°C, a squeeze dyeing step using squeezing and a drying step.

[COMPARATIVE EXAMPLE 5]

[0066] A test roll was obtained according to the same method as Example 2 with the exception of omitting the singeing step and the polishing step.

[EXAMPLE 3] Manufacturing of Blended Raised Material Product (Singeing +Polishing)

[0067] A pre-dyed cloth (warp 96 yarns × weft 90 yarns), which was woven using twisted yarn comprising two blended yarns (yarn number: 40), obtained by spinning polyester fibers (cut to 38 mm, top dyed) and rayon fibers (cut to 38 mm) at a blending ratio of 65:35, and one polyurethane filament yarn (40 denier) for the warp yarn and weft yarn (final blending ratio: 61:33:6), was prepared followed by further carrying out card cloth raising. Gas singeing (80 m/min was carried out on this cloth to form melt balls, followed by polishing both sides of the cloth with a belt sander (#1000 mesh) to remove the melt balls that had formed on the surface of the cloth. Subsequently, a plain-woven test roll composed of a blended material was obtained by going through a heat setting step for 1 minute at 180°C.

[COMPARATIVE EXAMPLE 6] Manufacturing of Blended Raised Material Product (Singeing

[0068] A test roll was obtained according to the same method as Example 3 with the exception of omitting the polishing step.

[COMPARATIVE EXAMPLE 7] Manufacturing of Blended Raised Material Product (Regular Processing)

[0069] A test roll was obtained according to the same method as Example 3 with the exception of omitting the singeing step and polishing step.

[0070] An anti-pilling test and tear strength test were carried out on samples without washing, after washing 10 times

EP 3 666 951 A1

or after washing 30 times using the test rolls obtained in Examples 1 to 3 and Comparative Examples 1 to 7. However, the tear strength test was omitted for the test rolls obtained in Example 2, Comparative Example 5 and Example 3, while the anti-pilling tests following 10 and 30 rounds of washing were omitted for the test rolls obtained in Comparative Examples 6 and 7. The results are shown in the following Table 1.

[0071] The anti-pilling test was carried out for 10 hours in accordance with Method A of JIS L1076 (method using ICI-type tester). The test results represent the average of the assessment results of four test pieces.

[0072] The tear strength test was carried out in accordance with JIS L1096D (pendulum method).

[0073] Washing was carried out 10 times and 30 times in accordance with Method C4M of JIS L1930 (using tumble drying).

[Table 1]

Test Roll	Washings (times)	Anti-pilling grade	Tear strength (N) (warp)	Tear strength (N) (weft)
Example 1 (PE)	0	5	38.9	30.0
	10	5	33.5	26.7
	30	5	31.3	24.1
Comparative Example 1 (PE)	0	1	39.8	31.4
	10	1	33.6	29.7
	30	1	31.3	23.6
Comparative Example 2 (PE)	0	5	16.7	15.1
	10	5	15.9	14.2
	30	5	16.2	13.6
Comparative Example 3 (PE)	0	5	13.6	8.3
	10	5	13.2	11.1
	30	5	13.3	11.1
Comparative Example 4 (PE)	0	5	7.5	7.1
	10	5	7.8	6.6
	30	5	8.1	7.2
Example 2 (NY)	0	5	-*	-
	10	5	-	-
	30	5	-	-
Comparative Example 5 (NY)	0	1.5	-	-
	10	1.5	-	-
	30	1.5	-	-
Example 3 (PE+R)	0	4.5	-	-
	10	4.5	-	-
	30	5	-	-
Comparative Example 6 (PE+R)	0	3.5	-	-
	10	-	-	-
	30	-	-	-

(continued)

Test Roll	Washings (times)	Anti-pilling grade	Tear strength (N) (warp)	Tear strength (N) (weft)
Comparative Example 7 (PE+R)	0	1	-	-
	10	-	-	-
	30	-	-	-
* -: Not performed				

[0074] Based on the results shown in Table 1, the test rolls of Examples 1 to 3 demonstrated the highest anti-pilling grade of 5 even after 30 rounds of washing as a result of having undergone singeing and polishing and exhibited extremely superior pilling resistance, favorable texture were free of decreases in strength. On the other hand, the anti-pilling grade of the test roll of Comparative Example 1, which was manufactured without undergoing singeing and polishing, was grade 1, the anti-pilling grade of the test roll of Comparative Example 5 was grade 1.5, and the anti-pilling grade of the test roll of Comparative Example 7 was grade 1, thereby indicating that a large amount of pilling occurred in the manufacturing stage.

[0075] In addition, in Comparative Examples 2 to 4, which indicate results attributable to alkali reduction treatment that has conventionally been known to be an anti-pilling measure of spun polyester fibers, although preferable results in the form of an anti-pilling grade of grade 5 were obtained in the same manner as Examples 1 and 2, results of the tear strength test were such that tear strength had fallen to roughly only 50% or less of that of Example 1, thereby demonstrating considerable deterioration of cloth strength. Consequently, it was difficult for cloth serving as the material to retain the inherent strength and texture thereof. Moreover, anti-pilling measures based on reduction processing are susceptible to variations in texture and strength due to differences in reduction rates, and are therefore not preferable from the viewpoint of serving as stable anti-pilling measures. In Comparative Example 6, although the anti-pilling grade improved in comparison with Comparative Example 7, demonstrating an anti-pilling grade of 3.5, as a result of a large number of melt balls formed due to singeing being present on the cloth surface, the feel of the cloth on the skin was poor and product value was impaired.

INDUSTRIAL APPLICABILITY

[0076] Since the anti-pilling cloth of the present invention demonstrates extremely superior pilling resistance, favorable texture and does not demonstrate remarkable decreases in strength, it can be preferably used various clothing articles and other textile products having a desired texture and appearance that are woven or knitted fabric using spun yarn comprised of synthetic fibers for which practical application has previously been difficult.

REFERENCE SIGNS LIST

[0077]

- 1 Reversing roller
- 2 Reversing roller
- 3 Heated cylinder
- 4 Heated cylinder
- 5 Heated cylinder
- 6 Reversing roller
- 7 Reversing roller
- 8 Reversing roller
- 9 Movable retainer valve
- 10 Belt sander
- 11 Paper powder remover
- 12 Cloth powder remover
- 13 Reversing roller
- 14 Cloth powder remover
- 15 Reversing roller
- 16 Guide roller
- 17 Guide roller

18 Reversing roller

19 Shaking device

5 **Claims**

1. An anti-pilling cloth containing thermoplastic synthetic staple fibers, having melt balls on the ends of the staple fibers and polishing traces of the melt balls on the fluff tips of the staple fibers on at least one side of the cloth.
- 10 2. The anti-pilling cloth according to claim 1, wherein the thermoplastic synthetic staple fibers are fibers selected from the group consisting of polyester-based, polyamide-based, polyacrylic-based, polyvinyl chloride-based, polyvinylidene chloride-based, polyvinyl alcohol-based, polyolefin-based and polyurethane-based fibers.
- 15 3. The anti-pilling cloth according to claim 1 or 2, which is a woven or knitted fabric.
4. The anti-pilling cloth according to claim 3, wherein the anti-pilling grade as determined in accordance with Method A of JIS L1076 (method using an ICI-type tester) after washing 10 times and 30 times in accordance with Method C4M of JIS L1930 (using tumble drying) is grade 3 or higher.
- 20 5. A method for manufacturing an anti-pilling cloth comprising the steps of:

using filament yarn and/or staple fibers of thermoplastic synthetic fibers as raw yarn and weaving or knitting a cloth having fluff on the cut ends of the filament yarn or fluff on the staple fibers,

forming melt balls on the cut ends of the filament yarn or on the ends of the staple fibers by singeing at least

- 25

one side of the resulting cloth, and

forming polishing traces by scraping the melt balls on the cut ends of the filament yarn or on the fluff tips of the staple fibers formed on the thermoplastic synthetic fibers by polishing.
- 30 6. The method according to claim 5, wherein the thermoplastic synthetic fibers are fibers selected from the group consisting of polyester-based, polyamide-based, polyacrylic-based, polyvinyl chloride-based, polyvinylidene chloride-based, polyvinyl alcohol-based, polyolefin-based and polyurethane-based fibers.
- 7. The method according to claim 5 or 6, wherein the anti-pilling cloth is a woven or knitted fabric.
- 35 8. The method according to claim 7, wherein the anti-pilling grade of the anti-pilling cloth as determined in accordance with Method A of JIS L1076 (method using an ICI-type tester) after washing 10 times and 30 times in accordance with Method C4M of JIS L1930 (using tumble drying) is grade 3 or higher.



FIG. 1

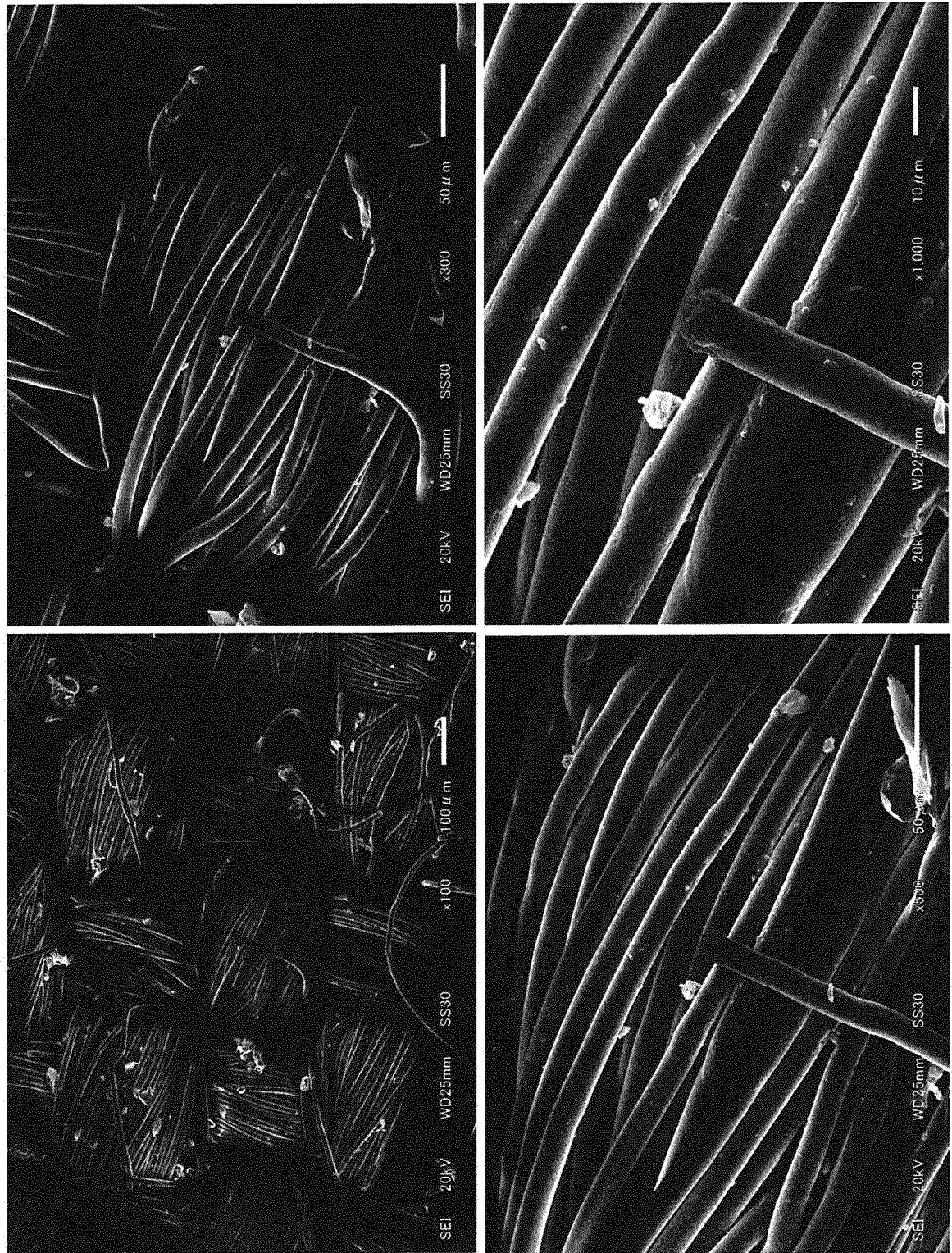


FIG. 2

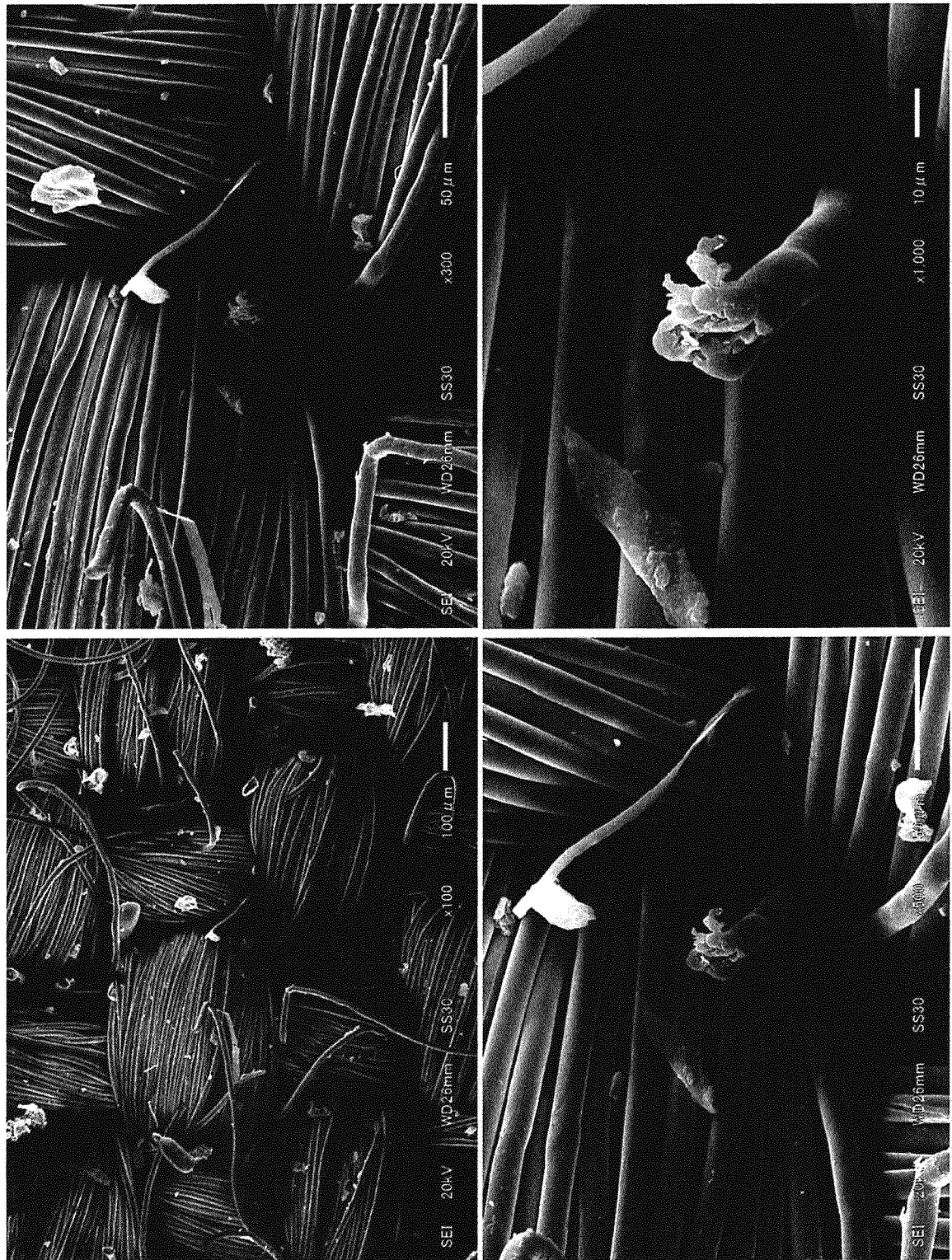


FIG. 3

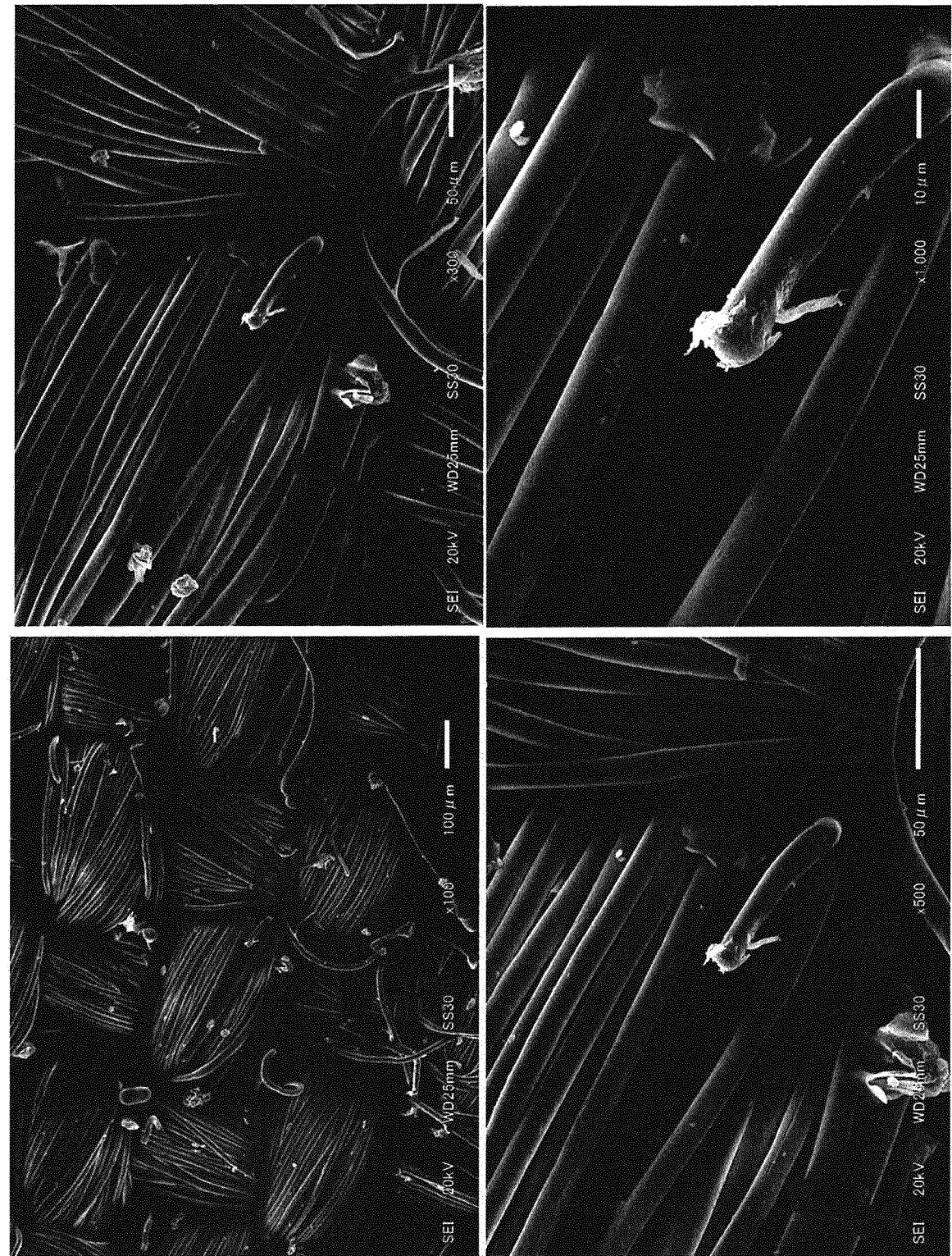


FIG. 4

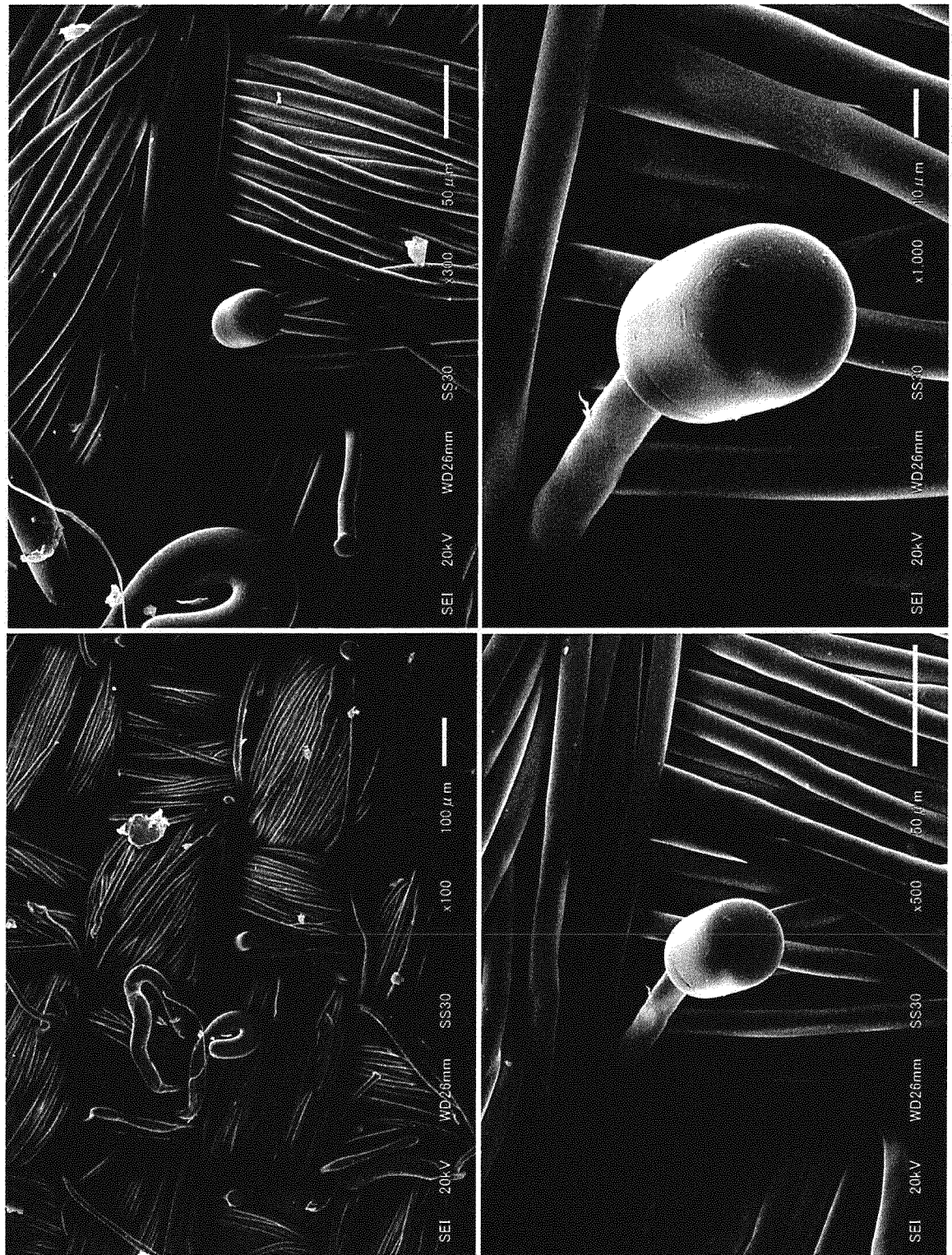


FIG. 5

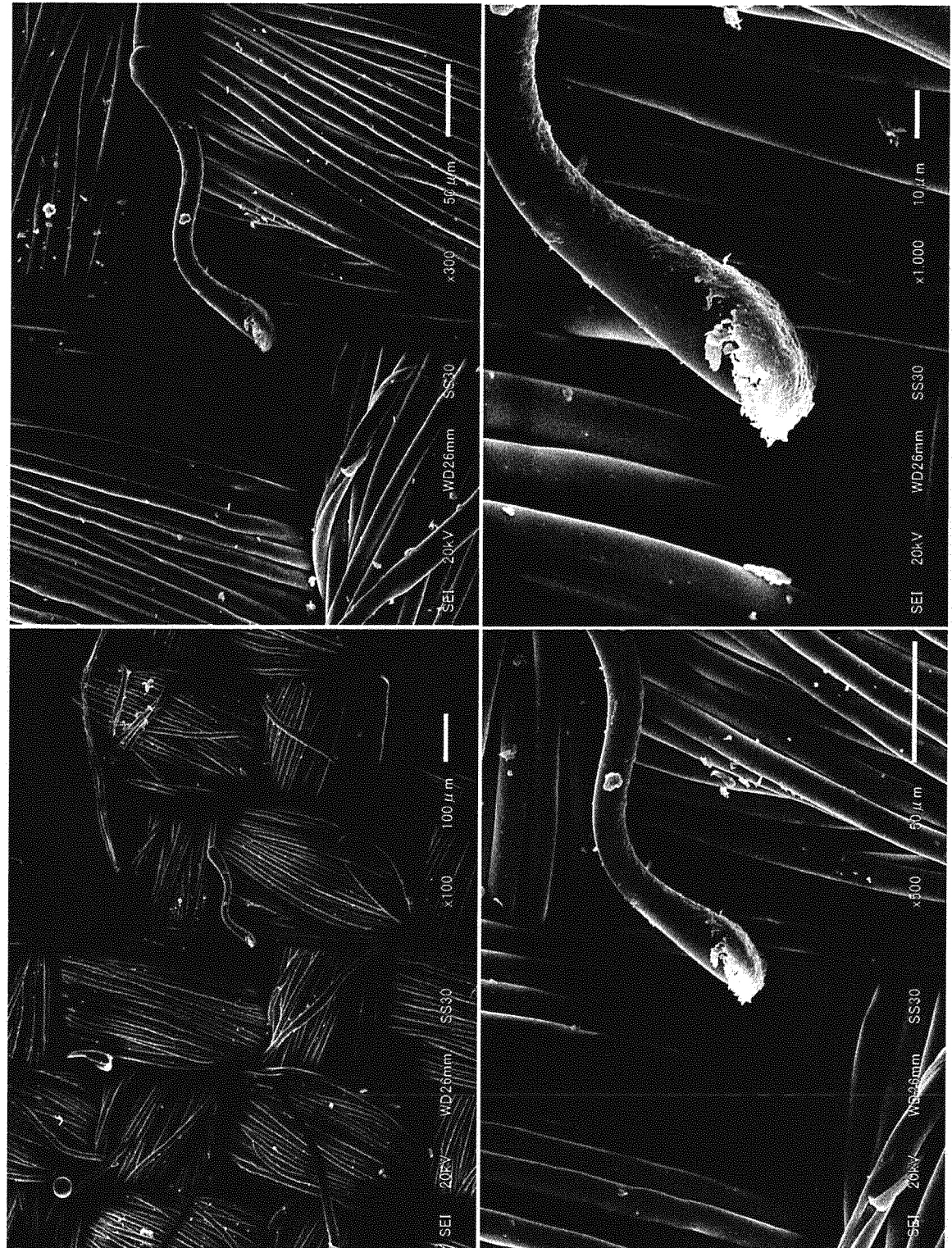


FIG. 6

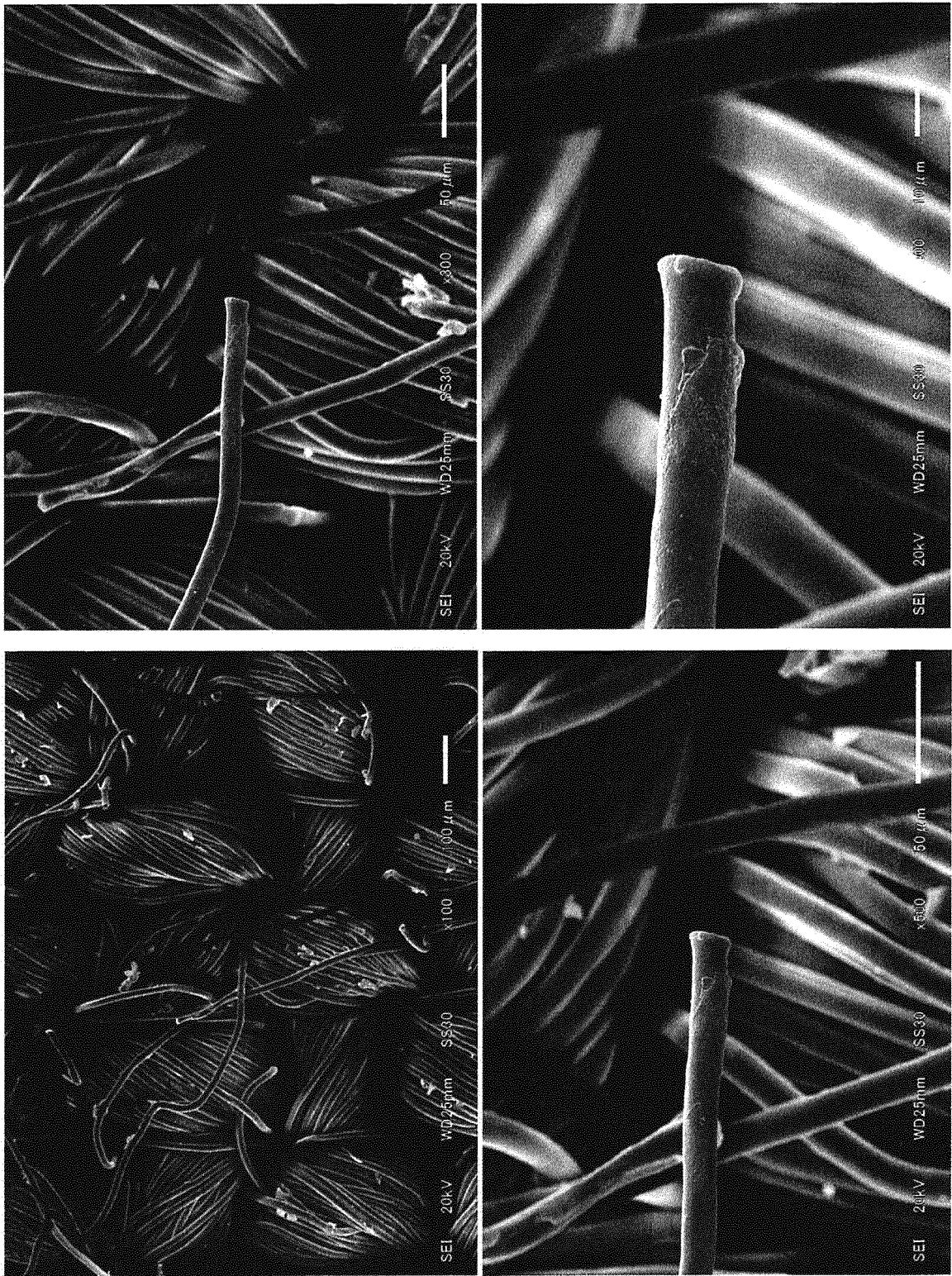


FIG. 7

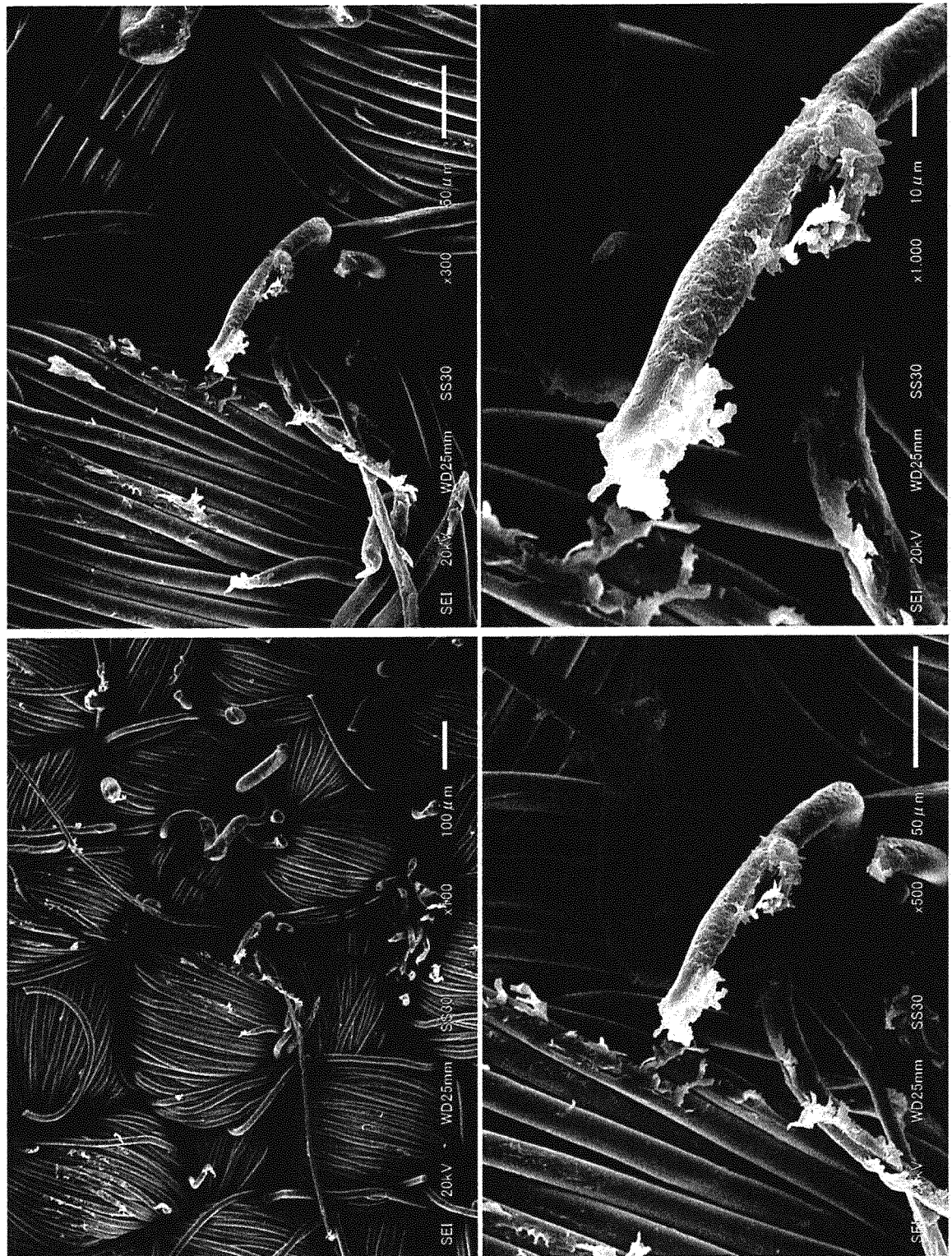


FIG. 8

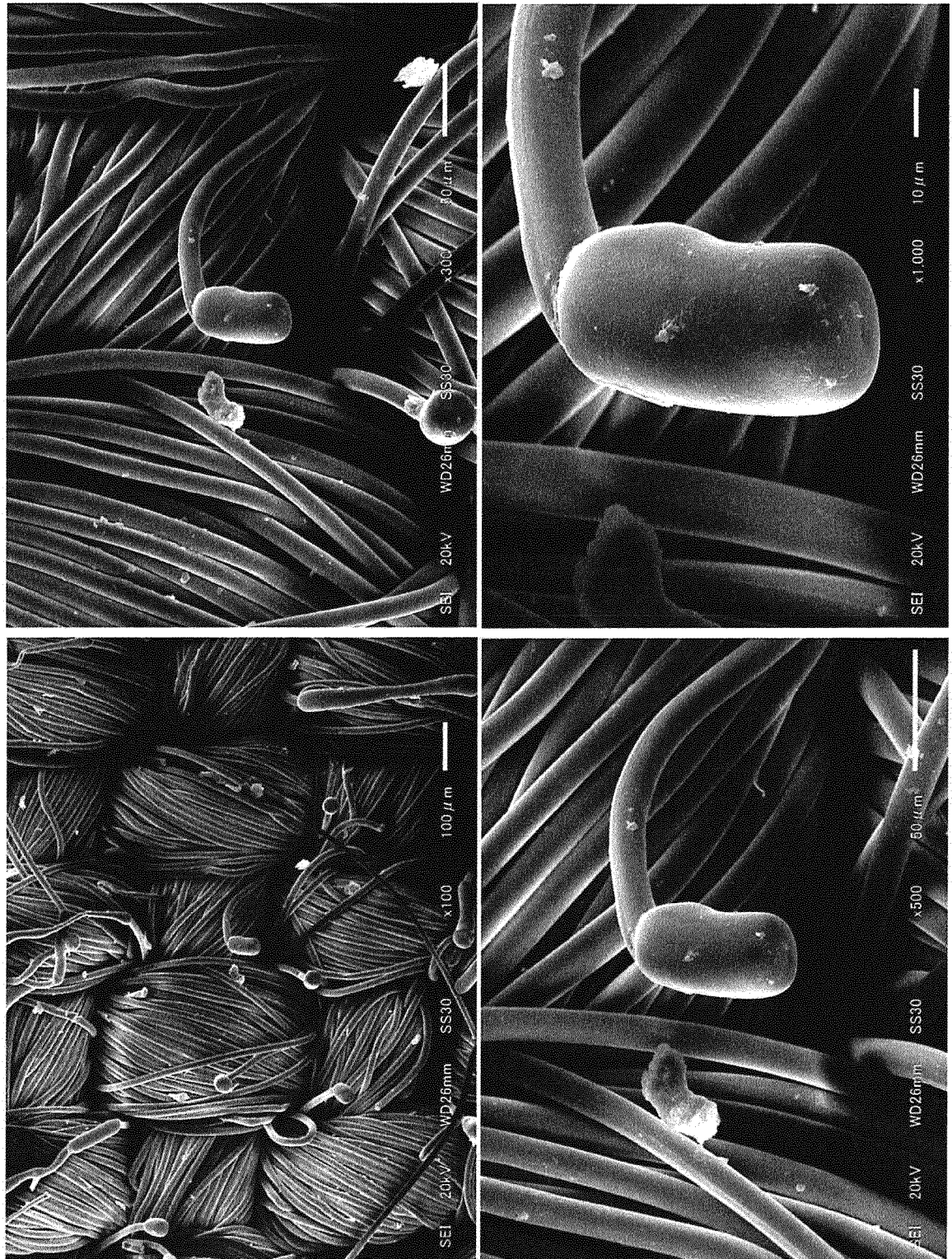
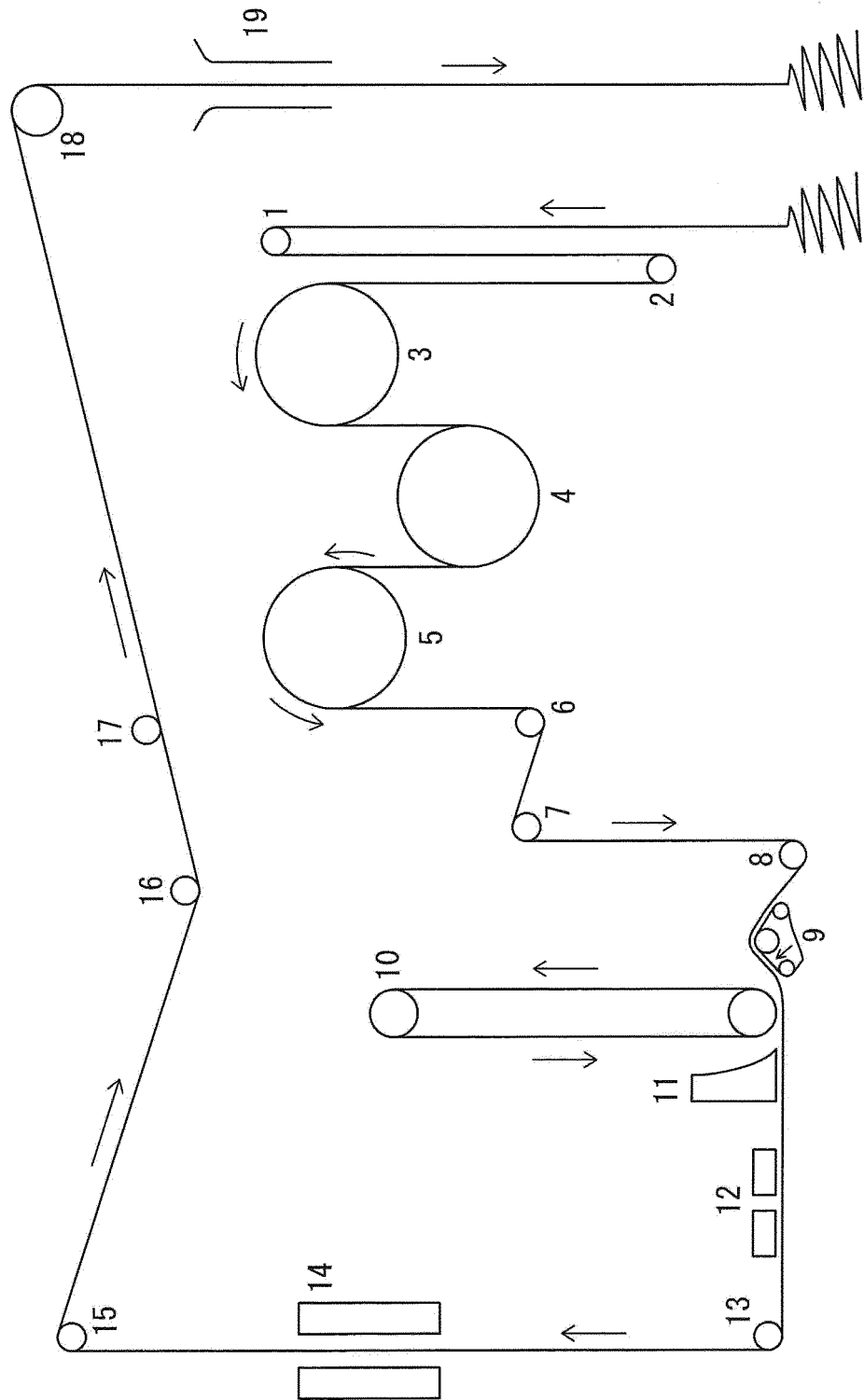


FIG. 9

FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/028880

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. D06C11/00 (2006.01) i, D03D15/00 (2006.01) i, D06C23/02 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. D06C11/00, D03D15/00, D06C23/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2018

Registered utility model specifications of Japan 1996-2018

Published registered utility model applications of Japan 1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 106757670 A (JIANGSUGOLDSUN TEXTILE TECHNOLOGY CO.) 31 May 2017, claims, example 1 (Family: none)	1-8
X	JP 01-139841 A (TORAY INDUSTRIES, INC.) 01 June 1989, claims, examples 1-3, fig. 2, page 2, lower right column (Family: none)	1-4
Y		5-8
A	JP 57-210063 A (TEIJIN LTD.) 23 December 1982, claims, page 3, upper right column (Family: none)	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

17 October 2018 (17.10.2018)

Date of mailing of the international search report

30 October 2018 (30.10.2018)

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2018/028880
--

5

10

15

20

25

30

35

40

45

50

55

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 104611944 A (NANTONG JIAYUSI TEXTILE GROUP CO., LTD.) 13 May 2015, abstract (Family: none)	1-8
A	US 2012/0263911 A1 (THE HONG KONG POLYTECHNIC UNIVERSITY) 18 October 2012, claims, abstract & US 2010/0275421 A1	1-8

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP H8144158 B [0023]
- JP S6131234 B [0023]
- JP 2004197243 A [0023]
- JP H995859 B [0023]
- JP H797764 B [0023]
- JP 2016108702 A [0023]