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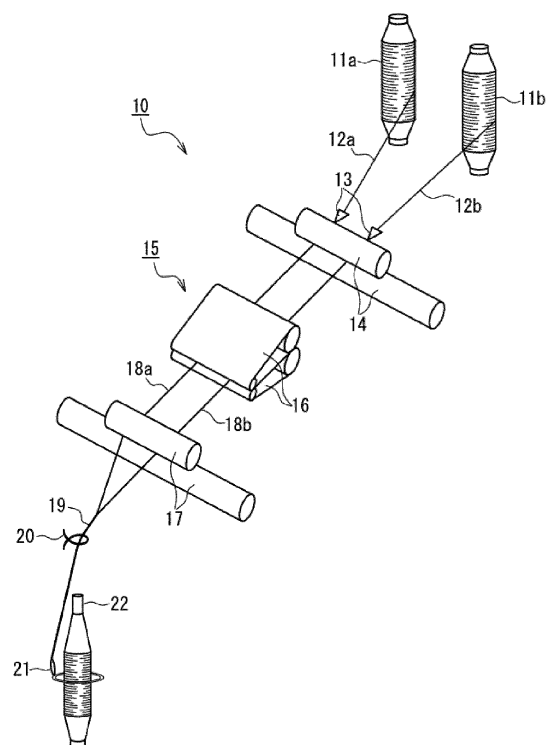
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(54) **TOWEL FABRIC AND METHOD FOR MANUFACTURING SAME**

(57) There are provided a towel cloth having a favorable uprightness of a pile, having a soft and bulky texture, and having a water absorbency in combination, and a manufacturing method thereof. The towel cloth is configured such that a warp pile yarn is engaged in a warp ground yarn and a weft ground yarn. The warp pile yarn is a siro spun yarn 19, and is a nontwisted or low twisted spun yarn applied with secondary twisting in the opposite direction to the primary twisting direction of a plurality of rovings 12a and 12b, namely, the untwisting direction. The twisting habit of primary twisting and migration of primary twisting cause entanglement between fibers. In addition, each fiber is a nontwisted yarn or a low twisted yarn, and hence each constituent fiber is present in a free state. This results in a pile yarn with a favorable uprightness and a soft and bulky texture.

Fig. 1



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Description

Technical Field

5 **[0001]** The present invention relates to a towel cloth using a siro spun yarn for a pile yarn, and a manufacturing method thereof.

Background Art

10 **[0002]** Conventionally, basically, for a towel cloth, a warp pile yarn and a warp ground yarn, and a weft ground yarn have been used, resulting in a pile woven fabric. Further, for a towel cloth, the basis weight (weight per square-meter) is relatively higher in order to make the water absorbency good, and a yarn that is thick, and has a high fineness is used for the constituent yarn.

15 **[0003]** Patent Document 1 proposes that a siro spun yarn of a synthetic fiber is used, resulting in a grandrelle yarn for a pile. Patent Documents 2 and 3 propose that a low twisted siro spun yarn is used, resulting in a pile knitted fabric.

Citation List

Patent Document

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[0004]

Patent Document 1: Patent Publication JP-A-H10-088440

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Patent Document 2: Patent Publication JP-A-2019-137941

Patent Document 3: Patent Publication JP-A-2019-137942

Summary

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Technical Problem

[0005] However, the related art technology has a problem with regard to the uprightness of pile, and the soft and bulky texture of a pile, and has been demanded to be further improved.

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[0006] The present inventors conducted a close study in order to make the maximum use of the features for a towel cloth. As a result, the present invention provides a towel cloth having a good uprightness of a pile, and a soft and bulky texture, and also having the water absorbency in combination, and a manufacturing method thereof.

Solution to Problem

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[0007] A towel cloth in accordance with one aspect of the present invention is a towel cloth including a warp ground yarn, a weft ground yarn, and a warp pile yarn, the warp pile yarn being engaged with the warp ground yarn and the weft ground yarn, characterized in that the warp pile yarn is a siro spun yarn, the siro spun yarn is a single yarn of a nontwisted or low twisted spun yarn applied with secondary twisting in an opposite direction to a primary twisting direction of a plurality of rovings, namely, in an untwisting direction, and

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the siro spun yarn has a twist multiplier K of 0 to 3.0,

where the twist multiplier (K) is calculated by the following equation (Math. 1):

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[Math. 1]

$$\text{twist multiplier (K)} = t/\sqrt{S}$$

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where t: number of twists (twists/ 25.4 mm), S: cotton count (English cotton count).

[0008] A method for manufacturing a towel cloth in accordance with one aspect of the present invention is a method for manufacturing the towel cloth, characterized in that the warp pile yarn is a siro spun yarn, and secondary twisting is applied in an opposite direction to a primary twisting direction of a plurality of rovings aligned in same twisting direction, resulting in one nontwisted or low twisted spun yarn.

Advantageous Effects of Invention

[0009] A towel in accordance with one aspect of the present invention is a towel cloth including a warp ground yarn, a weft ground yarn, and a warp pile yarn, the warp pile yarn being engaged with the warp ground yarn and the weft ground yarn, in which the warp pile yarn is a siro spun yarn, and is a nontwisted or low twisted spun yarn applied with secondary twisting in an opposite direction to a primary twisting direction of a plurality of rovings (untwisting direction). This can provide a towel cloth that is good in uprightness of a pile, and has a soft and bulky texture, and has a water absorbency in combination, and a manufacturing method thereof. Namely, along with the yarn structure in which secondary twisting is applied in the opposite direction to the primary twisting direction of a plurality of rovings (untwisting direction), the twisting habit of primary twisting and migration of primary twisting (the phenomenon in which a lint comes into the inside or comes out to the outside, to be twisted) are left, so that fibers get entangled with each other, the yarn is an nontwisted yarn or a low twisted yarn, and each constituent fiber is present in a free state. These result in a pile yarn with a favorable uprightness and a soft and bulky texture.

Brief Description of Drawings

[0010]

Fig. 1 is a schematic perspective view of a siro spun spinning device of one embodiment of the present invention.

Fig. 2 is a schematic explanatory view of a towel cloth in one embodiment of the present invention.

Fig. 3 is a textile design diagram of a towel cloth made of a fiber.

Fig. 4 is a side surface photograph (magnification 50 times) of a pile portion of a towel cloth of Example 1 of the present invention.

Fig. 5 is a planar photograph (magnification 10 times) of the towel cloth of Example 1 of the present invention.

Fig. 6 is a side surface photograph (magnification 50 times) of a pile portion of a towel cloth of Example 2 of the present invention.

Fig. 7 is a planar photograph (magnification 10 times) of the towel cloth of Example 2 of the present invention.

Fig. 8 is a side surface photograph (magnification 50 times) of a pile portion of a towel cloth of Comparative Example 1 of the present invention.

Fig. 9 is a planar photograph (magnification 10 times) of the towel cloth of Comparative Example 1 of the present invention.

Description of Embodiments

[0011] In the present invention, attention was focused on the fact that the warp pile yarn (which will be hereinafter also referred to as a pile yarn) accounting for about 70 percent of the constituent yarns of a towel cloth is an important yarn controlling the functionalities such as the uprightness of a pile, the texture and the fluff dropping of the towel cloth, and a study was conducted thereon, so that the following findings were obtained. Namely, the towel cloth of the present invention is a towel cloth including a warp ground yarn, a weft ground yarn, and a warp pile yarn, the warp pile yarn being engaged in the warp ground yarn and the weft ground yarn, in which the warp pile yarn is a siro spun yarn, and includes a nontwisted or low twisted spun yarn applied with secondary twisting in the opposite direction to the primary twisting direction of a plurality of rovings, namely, in the untwisting direction. It was found out that these provide the following advantages.

(1) The warp pile yarn is a siro spun yarn, and is applied with secondary twists in a number equal to or more than the number of twists of the primary twisting in the opposite direction to the primary twisting direction of a plurality of rovings.

As a result of this, although secondary twisting has been applied, the twisting habit of primary twisting remains, and the migration of primary twisting (the phenomenon in which a lint comes into the inside or comes out to the outside) also remains, so that fibers get entangled with each other. In addition, the yarn is a nontwisted yarn or a low twisted yarn. For these reasons, each constituent fiber is present in a free state, resulting in a pile yarn with a favorable uprightness and a soft and bulky texture. The soft and bulky texture enables soft contact with the skin, and efficient wiping away of sweat and moisture (the texture effect, the wiping away effect).

(2) The pile yarn is a nontwisted yarn or a low twisted yarn. For this reason, the constituent fiber becomes more likely to absorb the moisture. Simultaneously, the bulkiness allows the air to move actively, resulting in a higher air permeability (the water absorbency effect, the air permeation effect).

(3) The entanglement between the constituent fibers can improve the fluff dropping (the fluff dropping improving effect), and reduces a change in texture due to washing, so that a soft and bulky texture is kept (the effect of texture durability against washing).

(4) Manufacturing of a spun yarn does not require a water-soluble fiber (e.g., water-soluble PVA), an adhesive, or the like, so that the cost can be reduced as much. Further, when a water-soluble fiber (e.g., water-soluble PVA), an adhesive, and the like are used, resulting in a cloth, and then these are removed, a gap is created, so that, undesirably, the bulky feel (voluminous feel) is reduced as much, and fluff dropping also increases.

(5) Manufacturing of a spun yarn does not require a water-soluble fiber (e.g., water-soluble PVA), an adhesive, and the like. This can reduce the environmental load due to industrial liquid waste including these.

[0012] The present invention uses a siro spun yarn as a warp pile yarn. The siro spun denotes that a plurality of rovings are separately drafted at regular intervals, and then are twisted together, resulting in a yarn in a two-ply-yarn-shaped state. For the siro spun yarn, the fibers on the yarn surface are more regularly arrayed as compared with the two ply yarn including a plurality of yarns twisted therein, and the fluff dropping is less. For these reasons, the siro spun yarn can be used in a single yarn form as the warp pile yarn. Further, the yarn structure characteristic of the siro spun yarn causes entanglement between fibers even as an untwisted yarn or a low twisted yarn, causes no problems in winding, makes thread breakage during weaving less likely to occur, and provides favorable weaving step passability. Incidentally, the plurality of rovings denotes two or more rovings, and use of two or three rovings is known. Below, an example of two rovings will be described.

[0013] The siro spun yarn of the present invention preferably has a twist multiplier K of 0 to 3.5, a more preferable twist coefficient K is 0 to 3.3, and a further preferable twist multiplier K is 0 to 3.0. However, the twist multiplier (K) is calculated by the following equation (Math. 1).

$$\text{Twist multiplier (K)} = t/\sqrt{S}$$

where t: number of twists (twists / 25.4 mm), S: cotton count (English cotton count)

[0014] As a result of this, the pile yarn becomes an untwisted yarn or a low twisted yarn.

[0015] The siro spun yarn is preferably applied with secondary twists in a number equal to or more than the number of twists of primary twisting in the opposite direction to the primary twisting direction of two rovings. For example, when the primary twisting directions of the two rovings are both the direction Z, the secondary twisting is in the direction S, and the number of secondary twists is set equal to or more than the number of primary twists. As a result of this, each constituent fiber is present in a free state. For this reason, a pile yarn with a favorable uprightness and with a soft and bulky texture is provided.

[0016] The siro spun yarn is preferably 100% cotton. Being 100% cotton provides a soft and bulky texture, and the water absorbency in combination. Incidentally, a natural fiber including linen or wool, a regenerated fiber, semi-synthetic fiber, or a synthetic fiber including rayon, acetate, or polyester may be blended in such a range as not to impair the properties. The blending ratio of the fibers other than cotton is preferably 30 mass% or less. Although the yarn count of the siro spun yarn has no particular restriction, the one with a yarn count of 100 to 40 is preferably applicable to a thin cloth; a count of 30 to 16, to a medium or thick cloth; and a count of 12 to 8, to a thick cloth.

[0017] The siro spun yarn is preferably mercerized. Mercerization immerses a yarn in a caustic soda (sodium hydroxide) aqueous solution, and performs a tension treatment thereon, and thereby can improve the bounce, the resilience, the shape stabilizing, the gloss, the strength, the shrinkage resistance, and the stainability. This can be considered due to the following. A part of the crystal structure of cotton changes from type I to type II through alkali cellulose, and the structure in the periphery of the crystal is also rearranged. The mercerization itself has been well known conventionally as described in the fiber dictionary. Mercerization of a siro spun yarn nontwisted or low twisted in the untwisting direction synergistically

results in an improvement / shape stabilizing of the uprightness of a pile, the soft and bulky texture, the water absorbency, or the like, resulting in a towel cloth with a high quality. The concentration of caustic soda (sodium hydroxide) of the aqueous solution is preferably 15 mass% or more, and more preferably 20 mass% or more. For the tension treatment, preferably, the speed ratio of the supply roller and the take-up roller is set at about 1 to 1.1, and an immersion treatment in a caustic soda (sodium hydroxide) aqueous solution in a tense state is performed.

[0018] The method for manufacturing a towel cloth of the present invention includes the following steps.

(1) Secondary twisting is applied in the opposite direction (untwisting direction) to the primary twisting direction of two rovings aligned in same twist direction, resulting in a nontwisted or low twisted spun yarn. Preferably, secondary twists in a number equal to or more than the number of twists of primary twisting is applied. This results in one siro spun yarn, and with the spun yarn as a warp pile yarn, a towel cloth is manufactured.

(2) The warp ground yarn and the weft ground yarn of the towel cloth may be any yarn of an open-end spun yarn, an air spun yarn, a ring spun yarn, a conjugated yarn, a bound spun yarn, or the like.

(3) After towel cloth weaving, bleaching, scouring, dyeing, and the like are performed according to the ordinary method, resulting in a towel cloth.

[0019] The siro spun yarn is preferably cotton with a micronaire of 4 to 7, and an average fiber length of 28 to 45 mm. However, the micronaire denotes the mass microgram (μg) per inch (25.4 mm). Cotton with a micronaire of 4 to 7, and an average fiber length of 28 to 45 mm has many crimps, and a high crimp strength. For this reason, when the cotton is applied to the siro spun yarn of the present invention, the twisting habit of primary twisting and the migration of primary twisting (the phenomenon in which a lint comes into the inside or comes to the outside, to be twisted) tend to remain, and fibers tend to get entangled with each other, and each yarn is a nontwisted yarn or a low twisted yarn. For these reasons, each constituent fiber is present in a free state. For this reason, a pile yarn with a favorable uprightness and a soft and bulky texture is provided. Specific preferable examples thereof include those shown in the following Table 1. Among these, Shankar 6 from India is more preferable.

[Table 1]

Name	Cotton production nation	Raw cotton variety	Average fiber length (mm)	Micronair ($\mu\text{g}/\text{inchi}$)
Extra-long staple fiber	Egypt	GIZA 70	36.5	4.0
	China	Xinjiang T/146	38.1	4.0
	The US	American Pima	36.5	4.1
Staple fiber	Peru	Tanguis	30.2	5.8
	Egypt	GIZA 86	32.0	4.3
	India	Shankar 6	31.0	4.5
	Turkey	Turkish cotton	29.0	4.1
Medium fiber	The US	Sunforkin	29.4	4.1
	The US	Arizona	28.6	5.0
	The US	Memphis	27.8	4.8
	Australia	Andi	28.6	4.7
	West Africa	T/Manbo	27.8	4.5
High yarn count fiber	Pakistan	Afzal	26.2	4.9
	China	T/427~527	27.0	4.2
	Peru	As pero	26.2	6.7

[0020] The towel of the present invention is preferable for a bath towel (after-bath towel), a body scrub towel, a face towel, a towel handkerchief (towel chief), a wet towel, a wash towel, a hand towel, a bath mat, a sport towel, a beach towel (body towel), or the like. The mixing ratio of the cloth, the yarn kind, the yarn use, the mass per unit (basis weight), and the like are appropriately set according to the required characteristics such as the fluff dropping property and the water absorbency. The control of the basis weight can be achieved to control to the basis weights (large to small) by changing the

pile length (long to short) of the pile yarn. Herein, to give examples of preferable basis weight capable of exhibiting the effect of the present invention, preferably, a thin cloth has a basis weight of 100 to 250 g/m², a medium or thick cloth has a basis weight of 250 to 500 g/m², and a thick cloth has a basis weight of 500 to 1000 g/m². Incidentally, the one with a basis weight of less than 100 g/m² is thin and has no bulkiness, and the one with a basis weight of more than 1000 g/m² is too thick, and heavy. Neither of these is preferable.

[0021] Further, in the present invention, cotton is the most excellent in terms of the texture as the towel, the water absorbency, the hygroscopicity, and the handling property. However, cotton may be blended with a small amount of a material of linen, rayon, cupra, acetate, or wool. The one including rayon, cupra, or acetate blended therein can be imparted with the hygroscopicity, and wool can provide the heat retaining property.

[0022] The woven grey fabric is subjected to desizing by a liquid-flow dyeing machine according to the processing step of cotton, and then is scoured under the scouring conditions of cotton of the ordinary method (at a constant temperature of 95 to 98°C, for a keep time of 50 minutes, in a dilute caustic soda solution, alcohol-ethoxylate based bath). Then, following the scouring, bleaching processing is performed under the conditions of the ordinary method (98°C, 50 minutes, hydrogen peroxide solution). Then, dehydration is performed, and setting by a tenter is performed for finishing (off-white finishing). A hot water treatment is also performed in the bleaching step. When a crimped yarn of a synthetic fiber is desired to be included, crimp of a false twisted yarn is exhibited by the scouring, and further, finishing is performed as it is.

[0023] Then, when dyeing is performed following scouring and bleaching, for cotton, dyeing is performed with a reactive dye (60 to 80°C, 40 minutes). Further, for a polyester fiber, dyeing (130°C, 40 minutes) is performed with a disperse dye. When a cloth including cotton and polyester is dyed, other than plain dyeing in the two baths, dyeing can also be performed into different colors or chambray like differently using the disperse dye and the reactive dye. Alternatively, printing can also be performed on a scoured and bleached off-white cloth. Incidentally, in the case of a yarn-dyed polyester yarn, crimp can also be exhibited simultaneously with scouring by a yarn, and bleaching and dyeing are performed, and this is weaved, which can provide a yarn-dyed towel cloth. In the case of a yarn-dyed cotton yarn, refining, bleaching, and dyeing are performed, and this is weaved, which can provide a yarn-dyed towel cloth. Thus, in any case, the present invention can provide a product excellent in chromaticity and designability in various dyeing.

[0024] Below, a description will be given by reference to the accompanying drawings. In the following drawings, the same reference numerals and signs indicate the same article.

[0025] Fig. 1 is a schematic perspective view of a siro spun spinning device of one embodiment of the present invention. With the siro spun spinning device 10, two roving bobbins 11a and 11b are hung for one weight in a creel (roving supplying tool), and rovings 12a and 12b supplied from the two roving bobbins 11a and 11b pass through a duplex trumpet guide 13 provided on the upstream side (the roving bobbin side) of a back roller 14, and are fed in parallel to a draft device 15. Then, the rovings 12a and 12b are drafted spaced at prescribed intervals between the back roller 14 and an apron 16, and between the apron 16 and a front roller 17, respectively, resulting in fleeces 18a and 18b. Then, the fleeces 18a and 18b are spun from the front roller 17, and are twisted downstream of the front roller 17 by a twisting mechanism due to the rotation of a spindle 21, resulting in one spun yarn 19, which is wound to a bobbin 22 through a snail wire 20 and a traveler 21. For example, twisting is performed in the untwisting direction with the twisting directions of primary twisting of the two rovings 12a and 12b both set as the direction Z, and with the twisting direction by the spindle 21 set as the direction S. Further, the number of twists (number of secondary twists) by the spindle 21 is set equal to the number of twists of primary twisting, or larger than the number of twists of primary twisting.

[0026] Fig. 2 is a schematic explanatory view of a towel cloth 1 of one embodiment of the present invention. The towel cloth 1 includes warp pile yarns 2a and 2b, a weft ground yarn 3, and warp ground yarns 4a and 4b. The warp pile yarns 2a and 2b form a loop pile while being fixed and engaged at the ground weave including the weft ground yarn 3 and the warp ground yarns 4a and 4b. The resulting towel cloth 1 is cut into a predetermined size, and is subjected to an end treatment, resulting in a towel.

[0027] Fig. 3 is a woven fabric weave design of a towel cloth of one embodiment of the present invention. The weave design is a 3 weft towel weave (3-pick · terry · motion weave). The warp pile yarn is crossed once every time when 3 weft ground yarns are driven. The warp ground yarn G and the warp pile yarn P are arranged alternately. The 1 to 3 of the weft indicate the orders. In Fig. 3, as seen from the warp, black and x denote a float yarn, and white indicates a sink yarn.

Examples

[0028] Below, a description will be further specifically given by reference to Examples. The present invention is not limited to the following Examples.

<Evaluation of texture of finished towel cloth>

(1) Evaluation of soft texture

[0029] The softness of the texture is determined by the degree of bulkiness of the following equation expressing the softness of the texture by the volume per gram of a towel cloth.

[0030] A higher value indicates a more soft texture, and is better. Incidentally, the thickness was measured according to JIS L-1096 (2010) 8.5 degree of bulkiness test, and the basis weight was determined by weighing the weight of the 1-m square. The number of measurement sites was 5, and the average value thereof is used for expression.

$$\text{Degree of bulkiness (cm}^3\text{/g)} = \text{thickness (mm)} / \text{basis weight (g/m}^2\text{)} \times 1000$$

(2) Evaluation of bulky texture

[0031] A towel cloth was compressed at a constant speed using a compression measuring device: KES-G5 (manufactured by KATO TECH CO., LTD.), thereby determining the compression workload: WC = (gf.cm²). The number of measurement sites was 5, and the average value thereof is used for expression.

[0032] The WC value is the (energy) upon compressing the cloth. The larger the value is, the more the towel is compressed, and a larger value indicates larger bulkiness, and a higher fluffy feel, and is better.

(3) Washing durability evaluation of texture

[0033] A towel cloth was washed 20 times by a washing machine according to JIS L-0217 (1995), method 103. After drying, the compression workload: WC = (gf.cm²) was measured, and the number of measurement sites was 5, and the average value thereof is used for expression. A smaller difference in WC value between before and after washing results in less reduction of the puffy texture due to washing, and results in higher durability and is better.

(4) Evaluation of drainability with washing

[0034] A towel cloth with a width of 35 cm was cut to a length such that the weight became 80 g. The resulting cut piece was weighed to a weight to one decimal place, and this was immersed in water for 20 minutes. Thereafter, the wet towel cloth was taken up, and was centrifugally dehydrated in a dehydration tank of a washing machine for 4 minutes, and the weight was weighed. The residual moisture content (%) of the towel cloth was determined by the following equation. A smaller value indicates a more favorable drainability. A better drainability indicates that the subsequent drying speed tends to increase. The number of measurement sites was 3, and the average value thereof is used for expression.

$$\text{Residual moisture content (\%)} \text{ of cloth} = (\text{weight (W}_1\text{) of cloth after immersion in water and dehydration}) - (\text{weight (W}_0\text{) of cloth before immersion in water}) / (\text{weight (W}_0\text{) of cloth before immersion in water}) \times 100$$

(5) Evaluation of fluff dropping property due to washing of towel cloth

[0035] Fluff dropping due to washing was measured according to JIS L0217 (1995), method 103. The fluff dropping ratio (%) was determined by the following equation. A smaller value indicates less fluff dropping, and is better. The number of measurement sites was 5, and the average value thereof is used for expression.

$$\text{Fluff dropping ratio (\%)} = (\text{weight (g}_1\text{) of fluff dropped after washing}) / (\text{weight (g}_0\text{) of towel before washing}) \times 100$$

(6) Water absorbency evaluation (modified Larose method)

[0036] Measurement was performed 5 times according to the modified Larose method of JIS L 1907 (2010), and the average value thereof was determined. The Larose index (water absorption index) was calculated according to the following equation.

$$\text{Larose index (water absorption index)} = 2545V \times 1411W + 79$$

where V: maximum water absorption speed (ml/s), W: water absorption amount (ml) at the time of maximum water

absorption speed

A higher value indicates that the moisture put on the skin is absorbed more quickly, and a larger amount of moisture is absorbed, and hence is more preferable.

(7) Waver absorption speed (dropwise addition method)

[0037] The measurement of the water absorption speed of a towel cloth was evaluated on the basis of the dropwise addition method; buret method of JIS L 1907 (2010). The summary of the test is as follows: a drop of water was added dropwise from a height of 10 cm, and the water absorption time (second) for the mirror surface of the droplet of water to disappear was measured 3 times, and the average value thereof was determined. A shorter time indicates a higher water absorption speed, and is better.

<Rewetting rate testing method>

[0038] The rewetting rate of water is described in Japanese Patent No. 6991633 proposed by the present applicant. The testing method is performed in the following manner: a drop of water is dropped on a test specimen of a cloth, and the cloth is allowed to absorb the drop, and the moisture is absorbed by filter paper; and evaluation is performed as the characteristic that the cloth retains the moisture, namely, the rewetting rate of water; as a result, the evaluation is in agreement with the evaluation of the quality of the water absorbency that a person feels during use of a cloth made of a fiber such as a towel. A lower rewetting rate of water results in a higher water absorbency of the cloth, and can be evaluated as being more excellent.

(1) Test environment, other conditions

[0039]

· The test environment was set as under standard state environment, a temperature of $20 \pm 4^{\circ}\text{C}$, a relative humidity of $65 \pm 4\% \text{RH}$.

[0040] For the filter paper, the one stored under standard state environment, at a temperature of $20 \pm 4^{\circ}\text{C}$, and a relative humidity of $65 \pm 4\% \text{RH}$ for 24 hours or more was used.

· For the test specimen, the one stored under standard state environment, at a temperature of $20 \pm 4^{\circ}\text{C}$, and a relative humidity of $65 \pm 4\% \text{RH}$ for 24 hours or more was used.

· For the water to be added dropwise, the one with a temperature of $20 \pm 15^{\circ}\text{C}$ (5 to 35°C) was used.

(2) Operation procedure

[0041]

· The dimensions of a test specimen 1 of a towel cloth made of a fiber were set at 10 cm in length and 10 cm in width.

· The test specimen 1 was placed on a sample stand (not shown).

· For filter paper, the one including α cellulose of JIS P 3801 Type 1 standard as a raw material, and having a diameter of 110 mm and a thickness of 0.22 mm was used, and the weight of the filter paper was measured. As the filter paper, trade name "circular qualitative filter paper No. 1" manufactured by Advantec Co., was used.

· 0.8 ml of water was measured by a pipette, and was dropped onto the test specimen 1, and was kept waiting for 5 seconds, and the test specimen 1 was caused to absorb water.

· The paper filter was placed, and 1.3 kg (1274 Pa) of load was put thereon.

· After waiting for 5 seconds, the load was removed.

· The weight of the filter paper after water absorption was measured.

(3) Calculation of rewetting rate of water

[0042] Calculation was performed by the following equation.

$$W = [(B - A) / A] \times 100$$

where W: rewetting rate of water (%)

A: weight of filter paper before measurement (g)

B: weight of filter paper after water absorption (g)

<Napping property of pile>

[0043] Observation was performed by the side surface photograph (magnification 50 times) of the pile portion of the towel cloth by an optical microscope.

(Example 1)

(1) Warp pile yarn

[0044] A warp pile yarn was manufactured using a siro spun spinning device shown in Fig. 1. For cotton, Shankar 6 from India was used. With both the twisting directions of primary twisting of two rovings 12a and 12b set as the direction Z, and with the twisting direction by the spindle 21 set as the direction S, twisting was performed in the untwisting direction. The fineness of the roving was set at 5 g/ 6 yards (9113 decitex), and the number of twists in the direction Z of the roving was set at 5 twists / inch (twist multiplier K in terms of cotton count K = 1). The resulting spun yarn had a cotton count of 20, a number of twists of 11.7 twists / inch (twist multiplier K = 2.6).

(2) Warp ground yarn

[0045] For the warp ground yarn, batting from India was used as cotton, and a ring spun yarn 40/2, with a twist multiplier K: 3.8 for primary twists and 2.2 for final twists was used.

(3) Weft ground yarn

[0046] For the weft ground yarn, batting from India was used as cotton, and a ring spun yarn 20/1, with a twist multiplier: 4.0 was used.

(4) Weaving of towel cloth

[0047] A warp pile yarn and a warp ground yarn were subjected to sizing, and a woven fabric shown in Fig. 2 was woven with the textile design shown in Fig. 3 using a pile weaving machine. The warp density was 34 yarns/inch, the weft density was 56 yarns/inch, the basis weight was 463 g/m², and the cloth mixing ratio was cotton 100%.

(5) Refining finishing of towel cloth

[0048] Then, the grey fabric was subjected to desizing by a liquid-flow dyeing machine following the ordinary method according to processing of cotton (55°C × 20 minutes, amylase, surfactant-based bath). Then, by the same machine, scouring was performed at 98°C, a keep time of 50 minutes, in dilute caustic soda, and alcohol ethoxylate-based bath.

[0049] Then, with the ordinary method, bleaching was performed at 98°C in a hydrogen peroxide-based bath for a keep time of 50 minutes, setting was performed at 135°C by a tenter for finishing (off-white finishing). The pile length was 1.15 cm.

(Example 2)

[0050] The procedure was performed in the same manner as in Example 1, except that a warp pile yarn was immersed in a 200 g/L aqueous solution of caustic soda (sodium hydroxide), and was subjected to a tension treatment for merceriza-

tion.

(Comparative Example 1)

[0051] The procedure was performed in the same manner as in Example 1, except that with the twisting directions of primary twisting of two rovings 12a and 12b both set at the direction Z, and with the twisting direction by the spindle 21 set at the direction Z, twisting was performed. The resulting spun yarn had a cotton count of 20/1, and a number of twists of 14 per inch (twist coefficient $K = 3.1$).

[0052] The results up to this point are shown in Table 2.

[Table 2]

	Example 1	Example 2	Comparative Example 1
Basis weight (g/m ²)	463	463	463
Pile length (cm)	1.15	1.15	1.15
Material	Cotton 100%	Cotton 100%	Cotton 100%
Degree of bulkiness (cm ³ /g)	11.00	10.37	9.45
Compression workload WC before washing (gf.cm ²)	5.661	4.857	4.442
Compression workload WC after 20 washings (gf.cm ²)	6.155	6.266	3.698
Drainability in washing, residual moisture content (%)	87.3	76.6	96.8
Fluff dropping ratio (%)	0.0181	0.0356	0.0551
Modified Larose method, water absorption index	1132	999	969
Dropwise addition method, water absorption speed (second)	less than 1	less than 1	less than 1
Rewetting rate (%)	8.5%	11.73%	12.49%
Side surface photograph of pile yarn, planar photograph of cloth	Figs. 4 and 5	Figs. 6 and 7	Figs. 8 and 9

[0053] As apparent from Table 2, as compared with Comparative Example 1, each towel cloth of Example 1 and Example 2 were more favorable in terms of all of the degree of bulkiness, the compression workloads WC before washing and after washing, the fluff dropping ratio, the modified Larose method water absorption index, the water absorption speed, the rewetting rate, and the uprightness (Figs. 4, 6, and 8). As a result of this, it could be confirmed that the towel cloth of one embodiment of the present invention was a towel cloth having a good uprightness of a pile, and a soft and bulky texture, and having a water absorbency in combination, that could not be obtained with the related art technology. Further, the towel cloth (the pile yarn was a mercerized product) of Example 2 was the highest in terms of the compression workload WC after 20 washings, and the drainability in washing: residual moisture content, and was also favorable in terms of the bounce, the resilience, the shape stabilizing, the gloss, the strength, the shrinkage resistance, and the stainability.

Industrial Applicability

[0054] The towel cloth of the present invention is also preferable for a cloth of a face towel, a bath towel, a towel handkerchief, a sport towel, a bathrobe, a blanket made of toweling, or the like, clothing, socks, a carpet, bedclothes, and the like.

Reference Signs List

[0055]

- 1 Towel cloth
- 2a, 2b Warp pile yarn
- 3 Weft ground yarn
- 4a, 4b Warp ground yarn
- 10 Siro spun spinning device
- 11a, 11b Roving bobbin

12a, 12b Roving
 13 Trumpet guide
 14 Back roller
 15 Draft device
 16 Apron
 17 Front roller
 18a, 18b Fleece
 19 Spun yarn
 20 Snail wire
 21 Spindle
 22 Bobbin

Claims

1. A towel cloth comprising a warp ground yarn, a weft ground yarn, and a warp pile yarn, the warp pile yarn being engaged with the warp ground yarn and the weft ground yarn, wherein

the warp pile yarn is a siro spun yarn,
 the siro spun yarn is a single yarn of a nontwisted or low twisted spun yarn applied with secondary twisting in an opposite direction to a primary twisting direction of a plurality of rovings, namely, in an untwisting direction, and the siro spun yarn has a twist multiplier K of 0 to 3.0,
 where the twist multiplier (K) is calculated by the following equation (Math. 1):

[Math. 1]

$$\text{twist multiplier (K)} = t/\sqrt{S}$$

where t: number of twists (twists/ 25.4 mm), S: cotton count (English cotton count).

2. The towel cloth according to claim 1, wherein the siro spun yarn is cotton 100%.
3. The towel cloth according to claim 1, wherein the siro spun yarn is cotton having a micronaire of 4 to 7 μg , and an average fiber length of 28 to 45 mm,
 where the micronaire represents an average mass per inch (25.4 mm), unit: microgram (μg).
4. The towel cloth according to claim 1, wherein the siro spun yarn is mercerized.
5. The towel cloth according to claim 1, wherein the siro spun yarn has a cotton count of 8 or more and less than 40.
6. A method for manufacturing the towel cloth according to any one of claims 1 to 5, wherein
 the warp pile yarn is a siro spun yarn, and
 secondary twisting is applied in an opposite direction to a primary twisting direction of a plurality of rovings aligned in same twisting direction, resulting in one nontwisted or low twisted spun yarn.
7. The method for manufacturing the towel cloth according to claim 6, wherein
 the siro spun yarn is immersed in an alkali aqueous solution in a yarn state to be subjected to a tension treatment, thereby to be mercerized.
8. The method for manufacturing the towel cloth according to claim 6, wherein
 a number of twists of secondary twisting of the siro spun yarn is equal to a number of twists of the primary twisting, or larger than the number of twists of the primary twisting.

Fig. 1

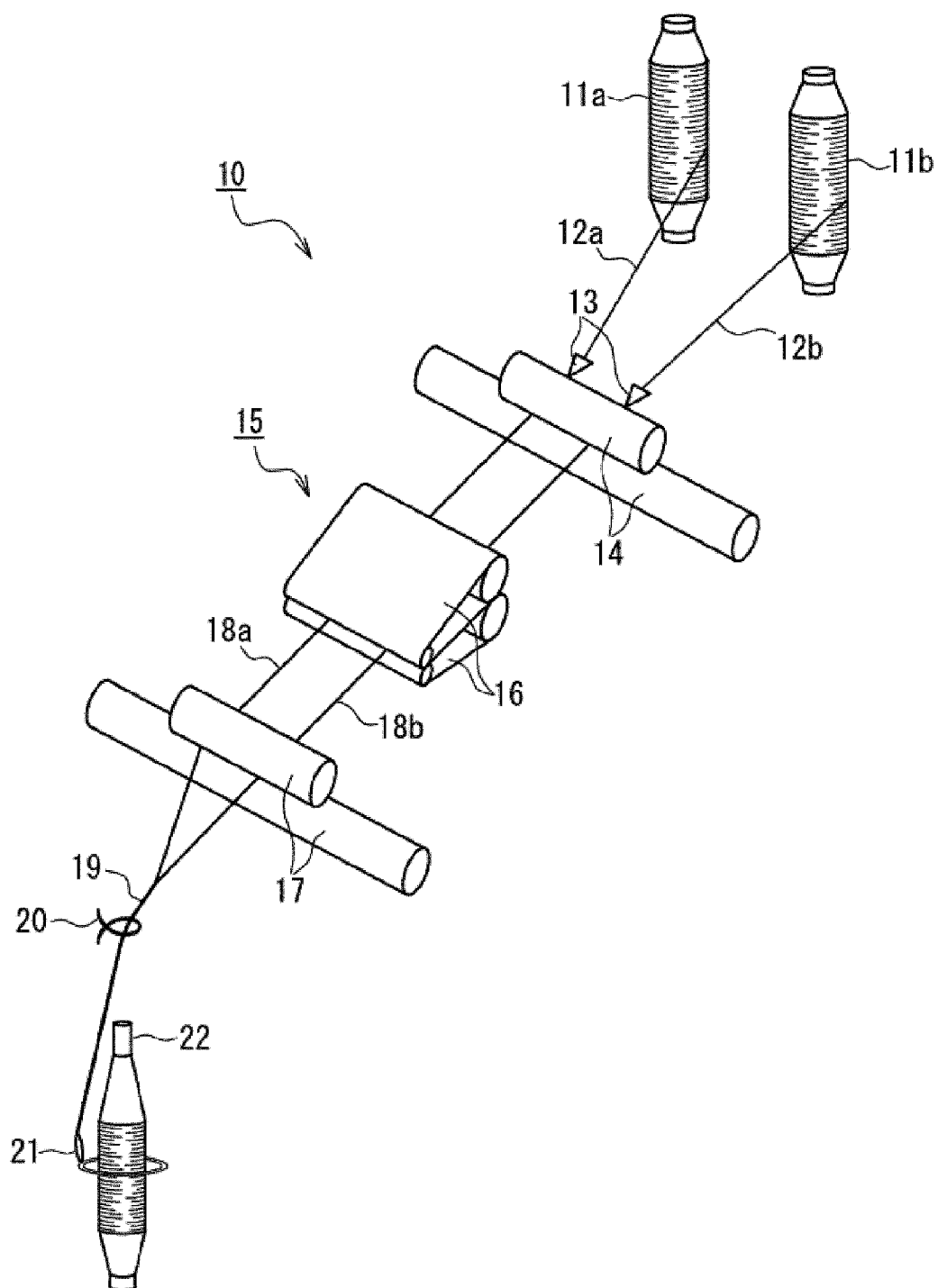


Fig. 2

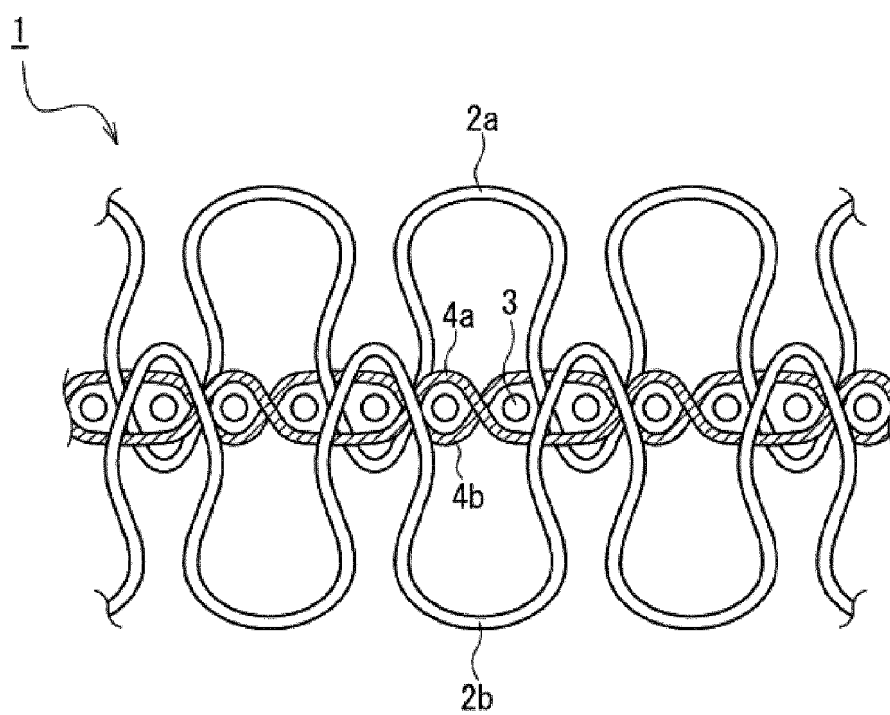


Fig. 3

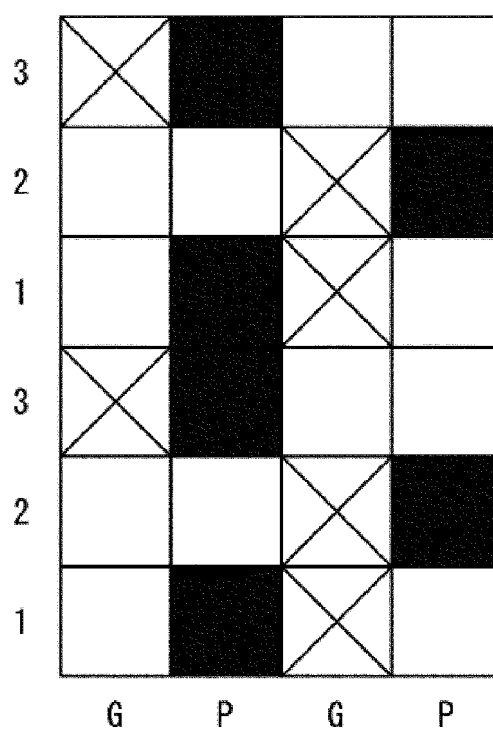


Fig. 4

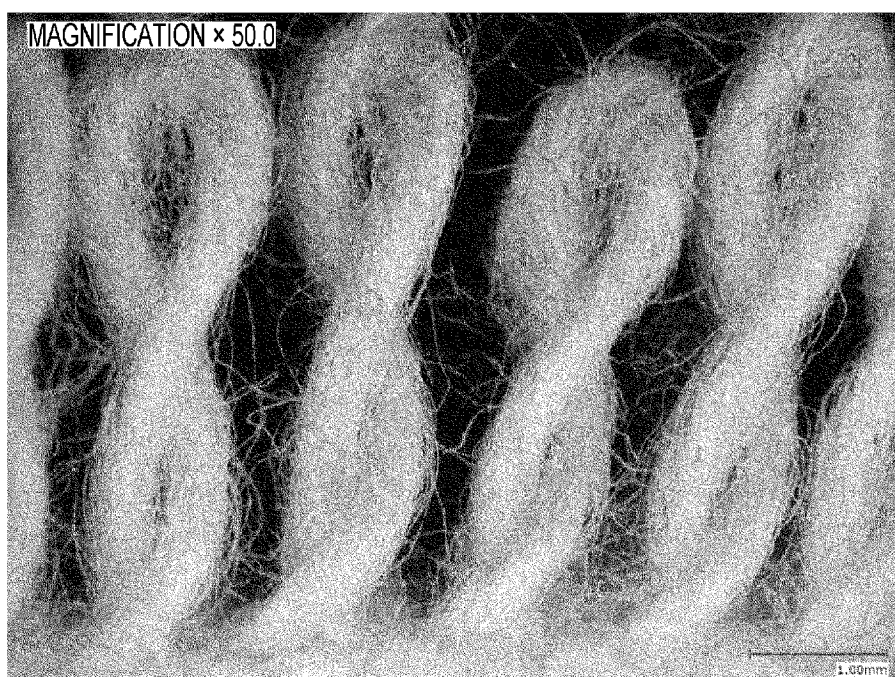


Fig. 5

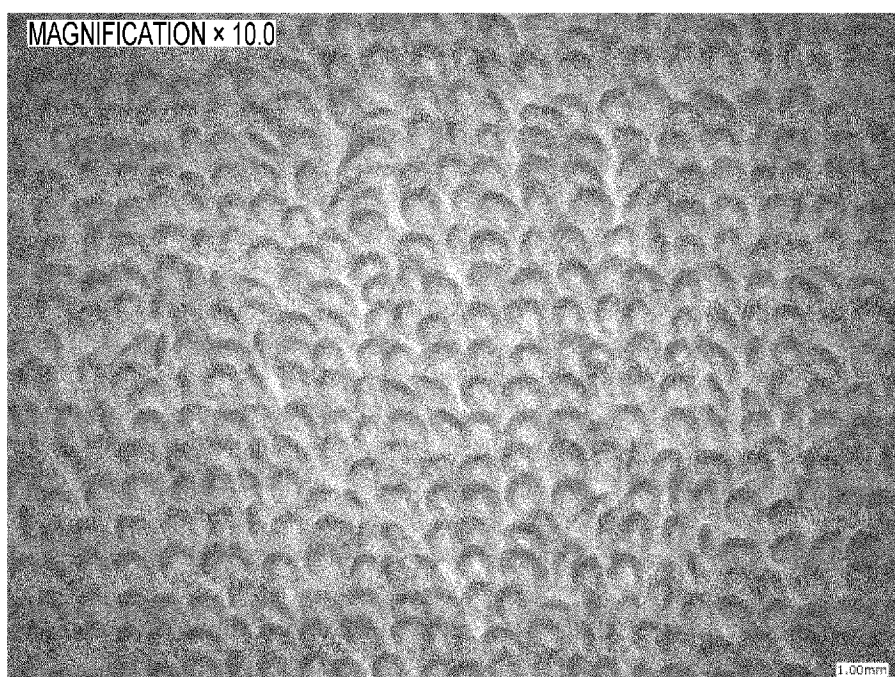


Fig. 6

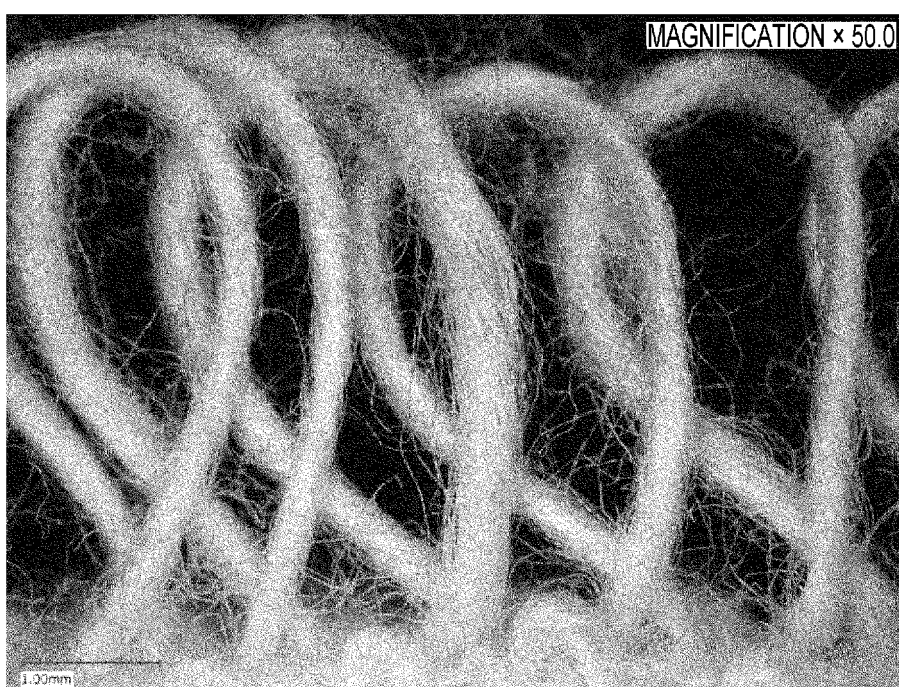


Fig. 7

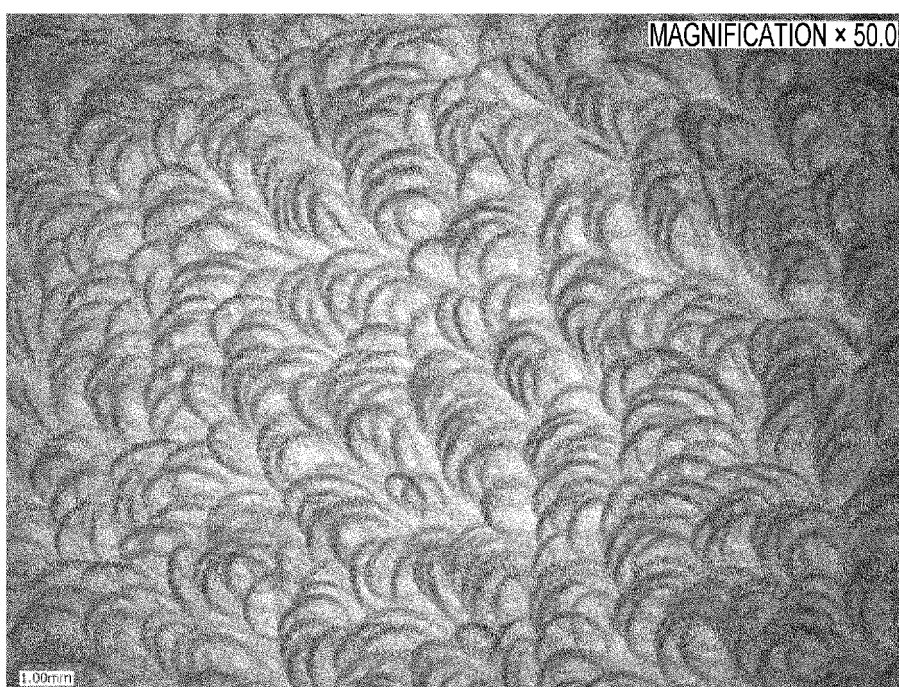
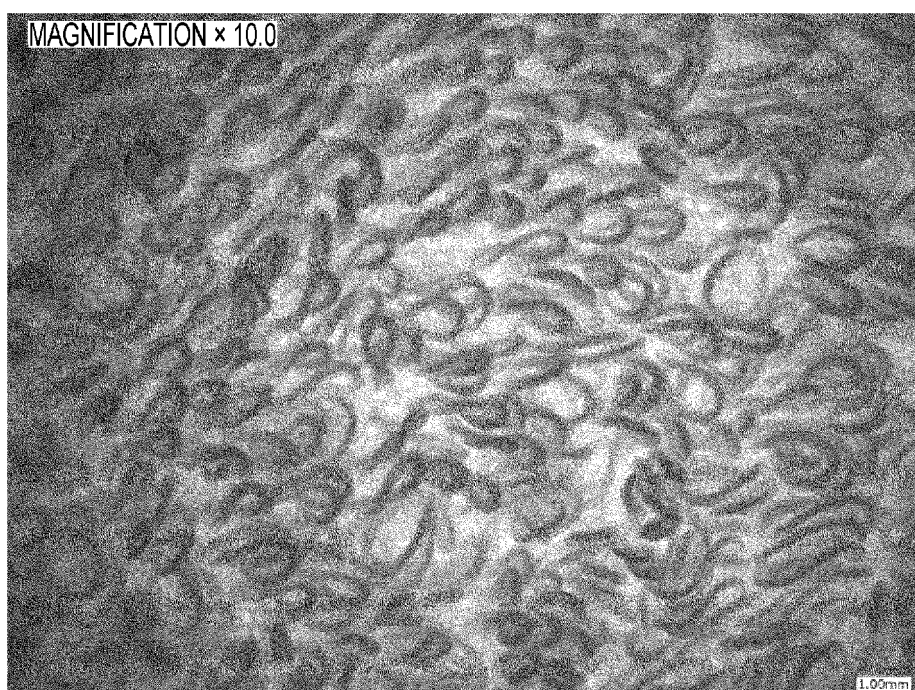


Fig. 8



Fig. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2024/015528

A. CLASSIFICATION OF SUBJECT MATTER

A47K 10/02(2006.01)i; **D02G 3/26**(2006.01)i; **D03D 27/00**(2006.01)i; **D03D 27/06**(2006.01)i; **D06M 11/38**(2006.01)i
 FI: A47K10/02 C; D03D27/06; D02G3/26; D06M11/38; D03D27/00 A

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)

A47K10/00-10/14; 10/18-10/48; D02G1/00-3/48; D02J1/00-13/00; D03D1/00-27/18

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 1971-2024
 Registered utility model specifications of Japan 1996-2024
 Published registered utility model applications of Japan 1994-2024

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.
A	WO 2022/220175 A1 (IZAWA TOWEL COMPANY, LIMITED) 20 October 2022 (2022-10-20) claims 1, 7, examples, fig. 1, paragraph [0023]	1-8
A	WO 2022/059487 A1 (IZAWA TOWEL COMPANY, LIMITED) 24 March 2022 (2022-03-24) claim 1, paragraph [0024]	1-8
A	JP 8-13283 A (KANEBO LTD.) 16 January 1996 (1996-01-16) claim 1	1-8
A	JP 60-052638 A (AONO, Shigenori) 25 March 1985 (1985-03-25) examples	1-8
A	JP 2001-348776 A (TOYO BOSEKI KABUSHIKI KAISHA) 21 December 2001 (2001-12-21) claim 1, paragraph [0001]	1-8

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

14 June 2024

Date of mailing of the international search report

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Name and mailing address of the ISA/JP

Japan Patent Office (ISA/JP)
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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2024/015528

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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2015/049887 A1 (UCHINO CO., LTD.) 09 April 2015 (2015-04-09) claim 1	1-8
A	JP 2022-128926 A (NIPPON SANMOU SENSHOKU K.K.) 05 September 2022 (2022-09-05) claim 1	1-8

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/015528

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO	2022/220175	A1	20 October 2022	EP 4324968 A1 claims 1, 7, examples, fig. 1, paragraph [0023]	
WO	2022/059487	A1	24 March 2022	US 2023/0203723 A1 claim 1, paragraph [0039]	
JP	8-13283	A	16 January 1996	(Family: none)	
JP	60-052638	A	25 March 1985	(Family: none)	
JP	2001-348776	A	21 December 2001	(Family: none)	
WO	2015/049887	A1	09 April 2015	US 2016/0206026 A1 claim 1	
JP	2022-128926	A	05 September 2022	CN 114960082 A	

REFERENCES CITED IN THE DESCRIPTION

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