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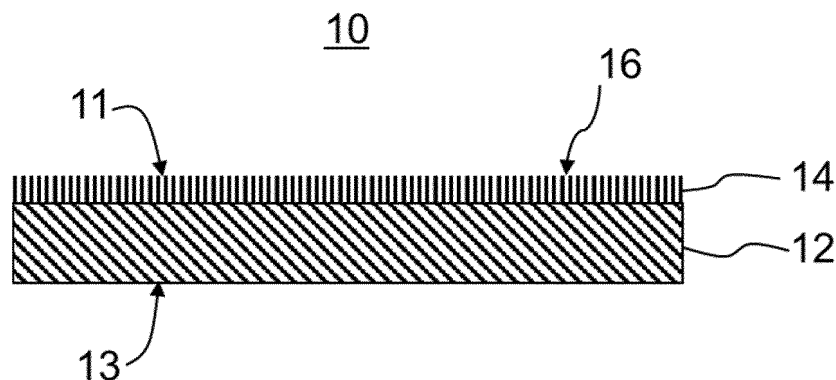
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(54) **NAPPED LEATHER-LIKE SHEET-LIKE ARTICLE**

(57) A napped leather-like sheet-shaped article includes a fibrous substrate which is a woven fabric or a knitted fabric, and a resin applied to the fibrous substrate, and includes, on a front surface thereof, a napped surface having naps with the resin adhering thereto. The number of structure points of yarns constituting the fibrous substrate per 24.5 mm square is 1,500 to 10,000 in the case

of a woven fabric, and is 3,000 to 9,000 in the case of a knitted fabric. The total number of fibers involved in crossing or entanglement at structure points per 25.4 mm square is 396,000 to 2,640,000 in the case of a woven fabric, and is 912,000 to 8,208,000 in the case of a knitted fabric. The constant load elongation rate is 5% or more, and the constant load set rate is less than 10%.

FIG. 1



EP 4 534 755 A1

Description

Technical Field

5 **[0001]** The present invention relates to a napped leather-like sheet-shaped article.

Background Art

10 **[0002]** Leather-like sheet-shaped articles have been used for, for example, vehicle interior material applications such as vehicle seats and door linings, interior material applications such as furniture and chairs, and fashion applications such as bags and shoes. Leather-like sheet-shaped articles are generally produced by applying a polymeric elastomer to a nonwoven fabric made of ultrafine fibers. A leather-like sheet-shaped article in which a knitted fabric or a woven fabric is used as its fibrous substrate, and a resin is applied thereto, has been known (see PTLs 1 and 2).

15 **[0003]** PTL 3 discloses an artificial leather including a polymeric elastomer applied to a fiber entangled body composed of ultrafine fibers and a woven fabric three-dimensionally intertangled together, the artificial leather having naps with a nap length of 200 to 600 μm and having a density of 0.50 to 0.85 g/cm^3 . Then, according to the disclosure, as a result, an artificial leather having an upscale surface appearance with a dense construction, which also is excellent in mechanical properties and dimensional stability, is provided.

20 Citation List

Patent Literature

[0004]

25 JP2022-027095A
JP2013-147758A
JP2019-112744A

30 Summary of Invention

Technical Problem

35 **[0005]** In the artificial leather of PTL 3, the short-fiber-length ultrafine fibers constituting the fiber entangled body are fixed with the polymeric elastomer that serves as a binder. It has been found that there are thus problems in that fluff loss occurs due to wear, or the surface conformability is inferior.

[0006] Meanwhile, in the case where a woven or knitted fabric is used as the fibrous substrate in order to solve the above problems, there are problems in that compared to a fiber entangled body or a nonwoven fabric, the denseness of naps is insufficient, or the structure line of the woven or knitted fabric appears on the surface, leading to a slightly inferior surface appearance.

40 **[0007]** The invention has been accomplished in light of this situation, and an objective thereof is to provide, using a woven fabric or a knitted fabric as a fibrous substrate, a napped leather-like sheet-shaped article that has a good surface appearance and is excellent in fluff loss resistance and surface conformability.

45 Solution to Problem

[0008] The invention includes the following embodiments.

50 [1] A napped leather-like sheet-shaped article including: a fibrous substrate that is a woven fabric or a knitted fabric; and a resin applied to the fibrous substrate. The napped leather-like sheet-shaped article includes, on a front surface thereof, a napped surface having naps formed from fibers constituting the fibrous substrate, the naps having the resin adhering thereto, the number of structure points of yarns constituting the fibrous substrate per 24.5 mm square of the sheet-shaped article is 1,500 to 10,000 when the fibrous substrate is a woven fabric, and is 3,000 to 9,000 when the fibrous substrate is a knitted fabric, the total number of fibers involved in crossing or entanglement at the structure points per 24.5 mm square of the sheet-shaped article is 396,000 to 2,640,000 when the fibrous substrate is a woven fabric, and is 912,000 to 8,208,000 when the fibrous substrate is a knitted fabric, and the constant load elongation rate is 5% or more in both the warp direction and the weft direction of the sheet-shaped article, while the constant load set rate is less than 10% in both the warp direction and the weft direction of the sheet-shaped article.

[2] The napped leather-like sheet-shaped article according to [1], in which the number of structure points of yarns constituting the fibrous substrate per 24.5 mm square of the sheet-shaped article is 3,500 to 9,000 when the fibrous substrate is a knitted fabric.

[3] The napped leather-like sheet-shaped article according to [1] or [2], in which the fibrous substrate is a circular-knitted knitted fabric.

[4] The napped leather-like sheet-shaped article according to [1] or [2], in which the fibrous substrate is an interlock-knitted knitted fabric.

[5] The napped leather-like sheet-shaped article according to [1] or [2], in which the fibrous substrate is a satin-weave multi-ply woven fabric.

[6] The napped leather-like sheet-shaped article according to any one of [1] to [5], in which the resin is present at least on the front surface side where the naps are present in the thickness direction of the fibrous substrate.

[7] The napped leather-like sheet-shaped article according to any one of [1] to [6], in which the resin is a polyurethane resin alone or a mixture of a silicone resin and a polyurethane resin.

[8] The napped leather-like sheet-shaped article according to any one of [1] to [7], in which the sheet-shaped article has no nap formed on a back surface thereof, and the back surface is provided with a backing.

[9] The napped leather-like sheet-shaped article according to [8], in which the backing contains a flame retardant and a binder resin.

[10] The napped leather-like sheet-shaped article according to any one of [1] to [9], in which the density of the fibrous substrate is such that when the fibrous substrate is a woven fabric, it has a warp density of 200 to 500 yarns/25.4 mm and a weft density of 50 to 150 yarns/25.4 mm, and when the fibrous substrate is a knitted fabric, it has 40 to 110 courses/25.4 mm and 30 to 70 wales/25.4 mm.

[0009] Here, "structure point" refers to a point where yarns constituting the fibrous substrate cross or entangle with one another. That is, in the case where the fibrous substrate is a woven fabric, a structure point means a point where the warp and weft cross each other. In addition, in the case where the fibrous substrate is a knitted fabric, a structure point means a stitch where a sinker loop and a needle loop are entangled, and the structure points are calculated by counting each stitch as one point.

Advantageous Effects of Invention

[0010] According to some embodiments of the invention, it is possible to provide, using a woven fabric or a knitted fabric as a fibrous substrate, a napped leather-like sheet-shaped article that has a good surface appearance and is excellent in fluff loss resistance and surface conformability.

Brief Description of Drawings

[0011]

FIG. 1 is a schematic cross-sectional view of a napped leather-like sheet-shaped article according to one embodiment.

FIG. 2 is a weave structure diagram of satin weave (7-harness satin) of Example 1.

FIG. 3 is a schematic diagram showing structure points in a knitted fabric.

FIG. 4 is a structure diagram of a brush structure of Example 13.

FIG. 5 is a schematic diagram showing the knitted construction on a front surface of the brush structure.

FIG. 6 is a structure diagram of a mockrody structure of Example 16.

FIG. 7 is a schematic diagram of a test piece for describing a test method for fatigue durability.

FIG. 8 is a schematic diagram of a test piece for describing a test method for fatigue strength.

FIG. 9 is a weave structure diagram of a 5-harness satin of Example 10.

FIG. 10 is a weave structure diagram of a 6-harness satin of Example 11.

FIG. 11 is a weave structure diagram of a 8-harness satin of Example 12.

FIG. 12 is a structure diagram of a tuck structure of Comparative Example 4.

FIG. 13 is a schematic diagram showing the knitted construction on a front surface of the tuck structure.

Description of Embodiments

[0012] A napped leather-like sheet-shaped article according to this embodiment (hereinafter also referred to simply as "sheet-shaped article") is a napped leather-like sheet-shaped article including a fibrous substrate which is a woven fabric or a knitted fabric, and a resin applied to the fibrous substrate. The sheet-shaped article includes, on a front surface thereof,

a napped surface having naps formed from fibers constituting the fibrous substrate, the naps having the resin adhering thereto. "Front surface" of a sheet-shaped article refers to, of the front and back of the sheet-shaped article, the surface that is visible when in use (design surface).

[0013] FIG. 1 is a cross-sectional view schematically showing a napped leather-like sheet-shaped article 10 according to one example. The sheet-shaped article 10 includes a fibrous substrate 12, which is a woven fabric or a knitted fabric. In this example, the fibrous substrate 12 has a non-illustrated resin applied over its entirety. On a front surface 11 of the sheet-shaped article 10, naps 14 made of a fiber constituting the woven fabric or the knitted fabric, which serves as the fibrous substrate 12, are provided. The naps 14 have a resin adhering to the fiber surfaces thereof. The front surface 11 of the sheet-shaped article 10 has formed thereon a napped surface 16 having the resin-adhering naps 14. The sheet-shaped article 10 has no nap formed on a back surface 13 thereof.

[0014] In this embodiment, the fibrous substrate is a woven fabric or a knitted fabric. Therefore, compared to the case of using a nonwoven fabric, fluff loss due to wear can be suppressed, and surface conformability can also be improved. In one embodiment, it is preferable that the fibrous substrate is composed only of a woven fabric or a knitted fabric.

[0015] Surface conformability refers to the ease of conforming to the shape of a surface when a sheet-shaped article is used as a skin material and attached to the surface of an object. Specifically, this means that when a sheet-shaped article is tensioned and attached to a seat, the sheet-shaped article moderately stretches under tension, and that after the attachment, wrinkling caused by the stretch due to tension not being sufficiently reversed can be prevented. Therefore, a sheet-shaped article excellent in surface conformability is less likely to wrinkle when attached to the surface of an object.

[0016] Woven fabrics include, for example, plain weave, twill weave, and satin weave. Among them, satin weave is preferable, and examples thereof include 5-harness satin, 6-harness satin, 7-harness satin, 8-harness satin, and 12-harness satin. The woven fabric may be a single-ply woven fabric or a multi-ply woven fabric, and is preferably a single-ply woven fabric, a double-ply woven fabric using the face yarn and the back yarn as the warp, or a triple-ply woven fabric using the face yarn, the middle yarn, and the back yarn as the warp. In the case where the fibrous substrate is a woven fabric, it is preferable to use a satin-weave multi-ply woven fabric, and it is more preferable to use a 5-harness satin or 7-harness satin double-ply woven fabric.

[0017] The fibrous substrate is preferably a knitted fabric. From the viewpoint of surface conformability, the fibrous substrate is more preferably a weft knitting, and still more preferably a circular knitting. Further, a knit structure in which the connecting yarn forms needle loops and is interlaced with the face yarn and the back yarn is preferable. As such a knit structure, interlock knitting can be mentioned. Favorable examples of interlock knitting include a brush structure and a mockrody structure. Such a knit structure leads to an increase in the yarn fill rate in needle loops, making the needle loops resistance to deformation. Therefore, the improving effects on fatigue durability and fatigue strength can be enhanced. In addition, an increase in the constant load set rate is suppressed, and the improving effect on surface conformability can be enhanced.

[0018] The fibrous substrate may be colored with a dye or a pigment, or may also be uncolored.

[0019] Fiber materials for constituting the fibrous substrate are not particularly limited, and conventionally known natural fibers, regenerated fibers, semi-synthetic fibers, synthetic fibers, and the like can be used. They can be used alone, and it is also possible to use a combination of two or more kinds. Among them, from the viewpoint of durability, particularly of mechanical strength, heat resistance, and light resistance, the fiber material is preferably a synthetic fiber, more preferably a polyester fiber, and particularly preferably a polyethylene terephthalate fiber.

[0020] As the fibrous substrate, one having naps on its surface, that is, a fibrous substrate having a napped surface, is used. The fibrous substrate has naps formed on at least one surface thereof. It is preferable that naps are formed only on one surface of the fibrous substrate. The naps are formed from fibers constituting the woven fabric or the knitted fabric, and are bound by the weave structure or knit structure. Therefore, the improving effects on fluff loss resistance, wear resistance, and the surface conformability can be enhanced. Naps are hairs (fluff) on the surface of a fibrous substrate, and is also referred to as hairy. Naps can be formed, for example, by opening a knit or weave structure or by a raising treatment.

[0021] A fineness of fibers constituting the naps (single-fiber fineness) is not particularly limited, but is preferably 0.1 to 0.5 dtex, and more preferably 0.1 to 0.4 dtex. The single-fiber fineness of 0.1 dtex or more leads to good wear resistance. The single-fiber fineness of 0.5 dtex or less is advantageous in improving surface appearance and tactile sensation.

[0022] A fineness of yarns constituting the fibrous substrate (yarn fineness) is not particularly limited, but is preferably 50 to 250 dtex, and more preferably 50 to 200 dtex. As a result of the yarn fineness being 50 dtex or more, the improving effects on wear resistance, fluff loss resistance, fatigue durability, and fatigue strength can be enhanced. As a result of the yarn fineness being 250 dtex or less, the improving effects on surface appearance and texture can be enhanced.

[0023] A thickness of the fibrous substrate is not particularly limited and may be, for example, 600 to 1,500 μm . More specifically, in the case where the fibrous substrate is a woven fabric, the thickness of the fibrous substrate is preferably 600 to 1,500 μm , and more preferably 800 to 1,200 μm . In the case where the fibrous substrate is a knitted fabric, the thickness of the fibrous substrate is preferably 600 to 1,400 μm , more preferably 600 to 1,300 μm , and still more preferably 800 to 1,200 μm . As a result of the thickness of the fibrous substrate being not less than the lower limit, the improving effects

on wear resistance, fluff loss resistance, fatigue durability, and fatigue strength can be enhanced. As a result of the thickness of the fibrous substrate being not more than the upper limit, the improving effect on texture can be improved.

[0024] The thickness of the fibrous substrate is a value measured in accordance with JIS L 1096:2010 8.4 Method A (JIS method) using a constant pressure thickness gauge (e.g., manufactured by Ozaki Mfg. Co., Ltd.: PEACOCK Dial Gauge H-30), and is a thickness measured including the napped portion.

[0025] Incidentally, the single-fiber fineness, the yarn fineness, and the thickness of the fibrous substrate described above are the single-fiber fineness, the yarn fineness, and the thickness regarding the fibrous substrate before the application of a resin. It is also possible that in a napped leather-like sheet-shaped article after resin application, the single-fiber fineness, the yarn fineness, and the thickness of the fibrous substrate (i.e., the thickness of the napped leather-like sheet-shaped article) are set within such ranges.

[0026] The resin applied to the fibrous substrate adheres to the surface of fibers constituting the fibrous substrate. As a result of applying a resin to the fibrous substrate, smoothness can be imparted to the front surface of the napped leather-like sheet-shaped article, providing the sheet-shaped article with a good texture.

[0027] In order to impart a good texture and wear resistance, the resin is present at least on the front surface side where naps are present in the thickness direction of the fibrous substrate (i.e., the napped surface side). The resin may also be present over the entire thickness of the fibrous substrate. In this case, the resin does not cover the entire napped surface of the fibrous substrate like a film (i.e., not like grain leather), but is applied to the fibrous substrate while reserving the naps. As a result, a napped leather-like sheet-shaped article having a suede-like or nubuck-like appearance and tactile sensation can be obtained.

[0028] As resins to be applied to the fibrous substrate, for example, a silicone resin, a polyurethane resin, a polyester resin, an acrylic resin, and the like can be mentioned. They can be used alone, and it is also possible to use a combination of two or more kinds as a mixture. Among them, it is preferable to use a silicone resin from the viewpoint of texture or a polyurethane resin from the viewpoint of wear resistance, and it is more preferable to use a mixture of them. As a result of using a silicone resin to impart smoothness to the front surface of the sheet-shaped article, a good texture is achieved, and, in addition, the load on structure points due to wear can be reduced. In addition, use of a polyurethane resin can prevent the silicone resin from coming off during the production process, allowing the silicone resin to sufficiently exhibit its effects described above.

[0029] Silicone resins are not particularly limited, and, for example, a methyl hydrogen silicone resin, an amino-modified silicone resin, a (meth)acrylic-modified silicone resin, and the like can be mentioned. They can be used alone, and it is also possible to use a combination of two or more kinds. Among them, from the viewpoint of wear resistance and texture, a methyl hydrogen silicone resin is preferable. Here, a (meth)acrylic-modified silicone resin means an acrylic-modified silicone resin and/or a methacrylic-modified silicone resin.

[0030] As polyurethane resins, for example, a polyether-based polyurethane resin, a polyester-based polyurethane resin, a polycarbonate-based polyurethane resin, and the like can be mentioned. They can be used alone, and it is also possible to use a combination of two or more kinds. Among them, from the viewpoint of wear resistance, a polycarbonate-based polyurethane resin is preferable.

[0031] A mass ratio between the silicone resin and the polyurethane resin applied to the fibrous substrate (in terms of solid content) is not particularly limited and may be, for example, silicone resin:polyurethane resin = 1:2 to 1:52, or 1:2 to 1:40.

[0032] Without interfering with the effects of the invention, the resin may have added thereto various additives such as catalysts, delustering agents, lubricating agents (e.g., silicone oil), surfactants, fillers, leveling agents, thickening agents, crosslinking agents, and penetrating agents.

[0033] An amount of resin adhering to the fibrous substrate is not particularly limited. In one embodiment, the amount of resin adhering to the fibrous substrate is, in terms of solid content, preferably 10 g/m² or more from the viewpoint of wear resistance and fluff loss resistance and, in addition, preferably 40 g/m² or less from the viewpoint of texture. The adhesion amount is more preferably 15 to 25 g/m² in terms of solid content. Here, the resin adhesion amount does not include the amount of the above additives. In addition, the resin adhesion amount does not include the amount of resin contained in the below-described backing. That is, the above resin applied to at least the front surface side where naps are present in the thickness direction of the fibrous substrate is considered as a first resin and distinguished from a binder resin contained in the backing, which is applied only to the back surface of the sheet-shaped article (second resin). Therefore, the resin adhesion amount is the adhesion amount of the first resin to the fibrous substrate.

[0034] A fill rate of the resin (first resin) to the fibrous substrate is not particularly limited. In one embodiment, the fill rate of the resin to the fibrous substrate is preferably 0.5 to 2.8% in the napped part, more preferably 0.5 to 2.5%, and is preferably 3 to 9% in the ground structure part. Within a range not less than the lower limit, the improving effects on wear resistance and fluff loss resistance can be enhanced. Within a range not more than the upper limit, a good texture is likely to be obtained. Here, the resin fill rate is the proportion of resin cross-sections per area in a cross-section of the napped part or the ground structure part of the sheet-shaped article. The napped part refers to the area where naps are present in the thickness direction of the sheet-shaped article. The ground structure part refers to the body part of the fibrous substrate,

which is located below the napped part and constitutes the weave structure or the knit structure.

[0035] A density of the fibrous substrate is not limited. In the case where the fibrous substrate is a woven fabric, the density of the fibrous substrate is preferably such that it has a warp density of 200 to 500 yarns/25.4 mm and a weft density of 50 to 150 yarns/25.4 mm, more preferably a warp density of 250 to 400 yarns/25.4 mm and a weft density of 50 to 100 yarns/25.4 mm. In the case where the fibrous substrate is a knitted fabric, the density of the fibrous substrate is preferably such that it has 40 to 110 courses/25.4 mm and 30 to 70 wales/25.4 mm, more preferably 60 to 90 courses/25.4 mm and 30 to 50 wales/25.4 mm. As a result of the density of the fibrous substrate being not less than the lower limit, an excellent surface appearance where the structure line of the woven fabric or the knitted fabric is not visible is likely to be obtained. In addition, this is advantageous in improving tactile sensation, wear resistance, fluff loss resistance, fatigue durability, and fatigue strength. As a result of the density of the fibrous substrate being not more than the upper limit, a good texture is likely to be obtained. Incidentally, the density regarding the fibrous substrate described above is the density in a napped leather-like sheet-shaped article with a resin applied thereto. It is also possible that the density before the application of a resin is set within the same ranges as above.

[0036] In this embodiment, a number of structure points of yarns constituting the fibrous substrate per unit area of the sheet-shaped article is set as follows. That is, in the case where the fibrous substrate is a woven fabric, the number of structure points per 24.5 mm square of the sheet-shaped article is 1,500 to 10,000, preferably 1,800 to 7,000, and more preferably 2,000 to 4,500, and may also be 3,000 to 7,000. In addition, in the case where the fibrous substrate is a knitted fabric, the number of structure points per 24.5 mm square of the sheet-shaped article is 3,000 to 9,000, preferably 3,500 to 9,000, more preferably 3,500 to 7,700, still more preferably 4,000 to 6,000, and particularly preferably 4,500 to 5,500, and may also be 3,500 to 5,500. As a result of the structure points being not less than the lower limit, the fibrous substrate has an increased density. Accordingly, an excellent surface appearance, where the structure line of the woven fabric or the knitted fabric is not visible, and good tactile sensation are achieved, and the resulting wear resistance, fluff loss resistance, fatigue durability, fatigue strength, and surface conformability are also excellent. As a result of the structure points being not more than the upper limit, a good texture is achieved. Incidentally, the number of structure points described above is the number of structure points in a napped leather-like sheet-shaped article with a resin applied thereto. It is also possible that the number of structure points before the application of a resin is set within the same ranges as above.

[0037] As used herein, "per 24.5 mm square of a sheet-shaped article" refers to per square area measuring 25.4 mm in the warp direction and 25.4 mm in the weft direction ($25.4 \times 25.4 \text{ mm}^2$) of the sheet-shaped article. The warp direction and the weft direction of a sheet-shaped article refer to, in a woven fabric, the directions in which the warp and weft run, respectively. In a knitted fabric, the terms refer to the length direction and the width direction at the time of knitting, respectively.

[0038] In the case where the fibrous substrate is a woven fabric, a structure point is the point where the warp and weft cross each other as described above. For example, in the complete weave of a 7-harness satin double-ply woven fabric shown in FIG. 2, structure points are points shown in white in the warp row marked "face" (face yarn) and also points shown in black in the warp row marked "back" (back yarn).

[0039] In the case of a woven fabric, the number of structure points per 24.5 mm square is calculated by the following formula (1).

[Math 1]

$$\text{Structure points (points/25.4 mm square)} = \sum_{k=1}^n (A_k \times B_k \times C \div D) \quad (1)$$

[0040] In the formula, n represents the number of structures of an n-ply weave structure, and is an integer of 1 to 3, for example. The integer n = 1 in the case of a single-ply woven fabric, n = 2 in the case of a double-ply woven fabric, and n = 3 in the case of a triple-ply woven fabric.

[0041] A_k represents the warp density (yarns/25.4 mm) of the k^{th} warp. In particular, in the case of a single-ply woven fabric, A_k directly represents the warp density of the woven fabric. In the case of a double-ply woven fabric, the k^{th} warp represents the face yarn or the back yarn; A_1 represents the warp density of the face yarn (first warp), and A_2 represents the warp density of the back yarn (second warp). In the case of a triple-ply woven fabric, the k^{th} warp represents the face yarn, the middle yarn, or the back yarn; A_1 represents the warp density of the face yarn (first warp), A_2 represents the warp density of the middle yarn (second warp), and A_3 represents the warp density of the back yarn (third warp).

[0042] B_k represents the number of crossings with the weft per k^{th} warp yarn in the weft repeating unit (crossings/yarn) and can be determined from the structure diagram of the weave structure. Here, the weft repeating unit refers to the number of weft yarns forming a complete weave and can be determined from the structure diagram of the weave structure. For example, in the case of the structure diagram shown in FIG. 2, the weft repeating unit is 14 yarns, and B_1 and B_2 are each 2 crossings/yarn.

[0043] C represents the weft density (yarns/25.4 mm). D represents the weft repeating unit (yarns).

[0044] In the case where the fibrous substrate is a knitted fabric, a structure point means a stitch where a sinker loop and a needle loop are entangled as described above. That is, in FIG. 3, the portion encircled by a dotted line is a stitch where a sinker loop and a needle loop are entangled (structure point), and the structure points are calculated by counting each stitch as one point.

[0045] In the case of a knitted fabric, the calculation formula for structure points differs depending on the knit structure. Therefore, the calculation formula for structure points may be derived from each structure diagram, and the number of structure points is calculated from the obtained calculation formula. For example, in the case of interlock knitting, the number of structure points per 24.5 mm square is calculated by the following formula (2).

[Math 2]

Structure points (points/25.4mm square)

$$= (G_F \times H_F) \times (I_F \times J_F) + (G_R \times H_R) \times (I_R \times J_R) \quad (2)$$

[0046] In the formula, G_F represents the course density on the front surface (courses/25.4 mm). H_F represents the existence probability of structure points in the warp direction (length direction) on the front surface. I_F represents the wale density on the front surface (wales/25.4 mm). J_F represents the existence probability of structure points in the weft direction (width direction) on the front surface. G_R represents the course density (courses/25.4 mm) on the back surface. H_R represents the existence probability of structure points in the warp direction on the back surface. I_R represents the wale density (wales/25.4 mm) on the back surface. J_R represents the existence probability of structure points in the weft direction on the back surface.

[0047] For example, in the case of a brush structure, the structure diagram is represented by FIG. 4, and the simplified knitted construction as seen from the front surface is as shown in FIG. 5. In this case, with respect to the existence probability H_F of structure points in the warp direction on the front surface, as shown in FIG. 5, in the warp direction, out of the three courses, structure points are present for three courses, that is, structure points are present for G_F out of G_F , and thus $H_F = G_F/G_F$. Similarly, the existence probability H_R of structure points in the warp direction on the back surface is also $H_R = G_R/G_R$. With respect to the existence probability J_F of structure points in the weft direction on the front surface, as shown in FIG. 5, in the weft direction, out of the three wales, structure points are present for three wales, that is, structure points are present for I_F out of I_F , and thus $J_F = I_F/I_F$. Similarly, the existence probability J_R of structure points in the weft direction on the back surface is also $J_R = I_R/I_R$. Therefore, in the case of a brush structure, the number of structure points is represented by the following formula (2-1).

[Math 3]

Strucrure points (points/25.4mm square)

$$= G_F \times \left(\frac{G_F}{G_F}\right) \times I_F \times \left(\frac{I_F}{I_F}\right) + G_R \times \left(\frac{G_R}{G_R}\right) \times I_R \times \left(\frac{I_R}{I_R}\right)$$

$$= G_F \times I_F + G_R \times I_R \quad (2-1)$$

[0048] In the case of a mockrody structure, the structure diagram is represented by FIG. 6. According to the structure diagram, on the front surface, the face yarn and the connecting yarn alternately form courses or wales. In addition, on the back surface, the back yarn and the connecting yarn alternately form courses or wales. According to the structure diagram, the existence probabilities H_F , J_F , H_R , and J_R are the same as in the case of a brush structure, that is, $H_F = G_F/G_F$, $J_F = I_F/I_F$, $H_R = G_R/G_R$, and $J_R = I_R/I_R$. Therefore, the number of structure points in the case of a mockrody structure is represented by the above formula (2-1).

[0049] In this embodiment, in addition, a total number of fibers involved in crossing or entanglement at the structure points per unit area of the sheet-shaped article (hereinafter also referred to as "the number of structure point fibers") is set as follows. That is, in the case where the fibrous substrate is a woven fabric, the total number of fibers involved in crossing at structure points per 24.5 mm square of the sheet-shaped article is 396,000 to 2,640,000, preferably 500,000 to 1,848,000, more preferably 700,000 to 1,500,000, and still more preferably 800,000 to 1,300,000. In addition, in the case where the fibrous substrate is a knitted fabric, the total number of fibers involved in entanglement at structure points per 24.5 mm square of the sheet-shaped article is 912,000 to 8,208,000, preferably 1,050,000 to 7,022,400, more preferably 1,500,000 to 4,000,000, and still more preferably 1,800,000 to 3,000,000. As a result of the number of structure point fibers being not less than the lower limit, the naps have an increased density. Accordingly, an excellent surface appearance, where the

structure line of the woven fabric or the knitted fabric is not visible, and good tactile sensation are achieved, and the resulting surface conformability is excellent. In addition, when the number of structure point fibers is not more than the upper limit, the resulting texture is good (no core remains). Incidentally, the number of structure point fibers described above is the number in a napped leather-like sheet-shaped article with a resin applied thereto. It is also possible that the number of structure point fibers before the application of a resin is set within the same ranges as above.

[0050] Here, the number of structure point fibers is the number of fibers determined by determining the number of fibers (also referred to as single fibers) constituting the crossing or entangled yarns at each of structure points present in a 24.5 mm square of a sheet-shaped article, and summing the numbers for all the structure points present in the 24.5 mm square.

[0051] In the case where the fibrous substrate is a woven fabric, the number of structure point fibers is calculated by the following formula (3).

[Math 4]

The number of structure point fibers (fibers/25.4mm square)

$$= \sum_{k=1}^n (A_k \times B_k \times C \div D) \times (E_k + F) \quad (3)$$

[0052] In the formula, n , A_k , B_k , C , and D are the same as in formula (1). E_k represents the number of single fibers (fibers) in the k^{th} warp. In the case of a single-ply woven fabric, E_k directly represents the number of single fibers in the warp. In the case of a double-ply woven fabric, E_1 represents the number of single fibers in the face yarn (first warp), and E_2 represents the number of single fibers in the back yarn (second warp). In the case of a triple-ply woven fabric, E_1 represents the number of single fibers in the face yarn (first warp), E_2 represents the number of single fibers in the middle yarn (second warp), and E_3 represents the number of single fibers in the back yarn (third warp). F represents the number of single fibers (fibers) in the weft.

[0053] In the case where the fibrous substrate is a knitted fabric, the calculation formula for the number of structure point fibers differs depending on the knit structure. Therefore, the calculation formula is derived from each structure diagram, and the number of structure point fibers is calculated from the obtained calculation formula. For example, in the case of a brush structure, according to the structure diagram shown in FIG. 4, on the front surface, the face yarn and the connecting yarn form loops for both needle loops and sinker loops. Therefore, at a structure point on the front surface, the face yarn and the connecting yarn constituting the sinker loop and the face yarn and the connecting yarn constituting the needle loop, a total of four yarns, are involved in entanglement. Thus, the number of fibers involved in entanglement at a structure point on the front surface is the sum of the numbers of single fibers in these four yarns. On the back surface, the back yarn and the connecting yarn form loops for both needle loops and sinker loops. Therefore, at a structure point on the back surface, the back yarn and the connecting yarn constituting the sinker loop and the back yarn and the connecting yarn constituting the needle loop, a total of four yarns, are involved in entanglement. Thus, the number of fibers involved in entanglement at a structure point on the back surface is the sum of the numbers of single fibers in these four yarns.

[0054] From above, in the case of a brush structure, the number of structure point fibers is calculated by the following formula (4-1).

[Math 5]

The number of structure point fibers (fibers/25.4mm square)

$$= G_F \times I_F \times (K + L) \times 2 + G_R \times I_R \times (M + L) \times 2 \quad (4-1)$$

[0055] In the formula, G_F , I_F , G_R , and I_R are the same as in formula (2). K represents the number of single fibers in the face yarn. L represents the number of single fibers in the connecting yarn. M represents the number of single fibers in the back yarn.

[0056] In the case of a mockrody structure, according to the structure diagram shown in FIG. 6, at a structure point on the front surface, the face yarn and the connecting yarn, a total of two yarns, are involved in entanglement. Thus, the number of fibers involved in entanglement at a structure point on the front surface is the sum of the numbers of single fibers in these two yarns. At a structure point on the back surface, the back yarn and the connecting yarn, a total of two yarns, are involved in entanglement. Thus, the number of fibers involved in entanglement at a structure point on the back surface is the sum of the numbers of single fibers in these two yarns. From above, in the case of a mockrody structure, the number of structure point fibers is calculated by the following formula (4-2).

[Math 6]

The number of structure point fibers (fibers/25.4mm square)

$$= G_F \times I_F \times (K + L) + G_R \times I_R \times (M + L) \quad (4 - 2)$$

[0057] In the formula, G_F , I_F , G_R , and I_R are the same as in formula (2). K represents the number of single fibers in the face yarn. L represents the number of single fibers in the connecting yarn. M represents the number of single fibers in the back yarn.

[0058] "The number of single fibers" described above refers to the number of single fibers constituting the yarn, and, for example, in the case of a multifilament yarn, the term refers to the number of filaments constituting the multifilament yarn. In the case where the yarn is a split yarn, the number of single fibers refers to the number of single fibers after splitting.

[0059] In the napped leather-like sheet-shaped article according to this embodiment, it is preferable that a length of naps on the napped surface is set at 200 to 500 μm . That is, it is preferable the length of naps in the state of having the above resin adhering thereto is 200 to 500 μm . As a result of the length of naps being 200 μm or more, the improving effects on surface appearance, wear resistance, and tactile sensation can be enhanced. In addition, as a result of the length of naps being 500 μm or less, the improving effect on wear resistance can be enhanced. The length of naps is more preferably 250 μm or more, still more preferably 300 μm or more, and is also preferably 400 μm or less.

[0060] More particularly, in the case where the fibrous substrate is a woven fabric, the length of naps is more preferably 200 to 400 μm . In the case where the fibrous substrate is a knitted fabric, the length of naps is more preferably 200 to 500 μm , still more preferably 250 to 500 μm , yet more preferably 250 to 400 μm , and particularly preferably 300 to 400 μm .

[0061] Incidentally, the length of naps described above is the length of naps in a napped leather-like sheet-shaped article with a resin applied thereto. It is also possible that the length of naps before the application of a resin is set within the same ranges as above.

[0062] The length of naps is measured as follows. That is, before measurement, the napped surface is stroked three times with a hand in the against-grain direction to raise the hair, and then the length of naps (length from the root of the hair to the tip of the hair) is measured. In the measurement, a vertical section of a napped leather-like sheet-shaped article is observed under a microscope at 100 $\times$ magnification (e.g., VHX-200/100F manufactured by Keyence Corporation) to measure the lengths of random 10 naps, and their average is calculated. Here, the against-grain direction refers to the direction opposite to the grain direction, and the grain direction refers to the direction in which the naps lie.

[0063] The napped leather-like sheet-shaped article according to this embodiment has a constant load elongation rate of 5% or more in both the warp direction and the weft direction of the sheet-shaped article. That is, the constant load elongation rate of the sheet-shaped article in the warp direction is 5% or more, and the constant load elongation rate in the weft direction is 5% or more. As a result, the sheet-shaped article is excellent in surface conformability. In particular, when the sheet-shaped article is stretched, its length can be moderately extended. The constant load elongation rate is affected by the number of structure points and the number of structure point fibers. The fewer the structure points, the more stretchy the sheet-shaped article. The greater the number of structure point fibers, the less stretchy the sheet-shaped article.

[0064] It is preferable that the constant load elongation rate of the sheet-shaped article is 6% to 40% in both the warp direction and the weft direction. In particular, in the case where the fibrous substrate is a woven fabric, the constant load elongation rate is preferably 5 to 20%, and more preferably 5.5 to 15%. In the case where the fibrous substrate is a knitted fabric, the constant load elongation rate is preferably 10 to 40%, and more preferably 15 to 35%.

[0065] As used herein, the constant load elongation rate refers to the elongation rate of an 80-mm-wide test piece when the test piece is gripped at both ends at a grip distance of 150 mm in the length direction, and a load of 98.1 N is applied for 10 minutes. A detailed measurement method is as described in the Examples.

[0066] The napped leather-like sheet-shaped article according to this embodiment has a constant load set rate of less than 10% in both the warp direction and the weft direction of the sheet-shaped article. That is, the constant load set rate of the sheet-shaped article in the warp direction is less than 10%, and the constant load set rate in the weft direction is less than 10%. As a result, the sheet-shaped article is excellent in surface conformability. In particular, it is possible to, when the sheet-shaped article is stretched and installed, prevent the stretched sheet-shaped article from not returning to its original shape. Therefore, the sheet-shaped article can conform to surfaces of various shapes. The constant load set rate is affected by the number of structure points and the number of structure point fibers, and the more the structure points are, the lower the constant load set rate becomes. In addition, the greater the number of structure point fibers is, the less movable the yarns become at structure points, leading to a lower constant load set rate.

[0067] The constant load set rate of the sheet-shaped article is preferably 0 to 8.5%, or may also be 0.5 to 8.5%, in both the warp direction and the weft direction. In particular, in the case where the fibrous substrate is a woven fabric, the constant load set rate is preferably 6% or less, and may also be 0.5% to 6%. In the case where the fibrous substrate is a knitted fabric, the constant load set rate is preferably 8.5% or less, and may also be 0.5% to 8.5%.

[0068] As used herein, the constant load set rate is the elongation rate that remains in an 80-mm-wide test piece when after the test piece is gripped at both ends at a grip distance of 150 mm in the length direction, a load of 98.1 N is applied thereto for 10 minutes, then the load is released, and the test piece is left for further 10 minutes. A detailed measurement

method is as described in the Examples.

[0069] In one embodiment, the napped leather-like sheet-shaped article may have a backing provided on a back surface thereof. In a preferred embodiment, it is possible that the sheet-shaped article has no nap formed on the back surface, and the back surface with no nap formed is provided with a backing, which is a resin layer.

[0070] The backing is provided, for example, for the purpose of imparting flame retardancy and preventing fraying in the case where the fibrous substrate is a woven fabric and, for example, for the purpose of imparting flame retardancy in the case where the fibrous substrate is a knitted fabric. The backing can be formed by coating the back surface of the fibrous substrate with a backing agent containing a flame retardant and a binder resin. In addition to the flame retardant and the binder resin, the backing agent may also contain various additives such as solvents and thickening agents.

[0071] Flame retardants are not particularly limited, and phosphorus-based flame retardants can be used, for example. Examples of phosphorus-based flame retardants include ammonium polyphosphates, aluminum phosphates, phosphate esters, guanidine phosphates, and organic phosphine oxides. Any one of them can be used alone, and it is also possible to use a mixture of two or more kinds.

[0072] As a binder resin, a resin that functions as a binder to allow a flame retardant to adhere to the fibrous substrate can be used, and, for example, a polyurethane resin, an acrylic resin, a silicone resin, a polyvinyl chloride resin, and the like can be mentioned. It is preferable to use a polyurethane resin. The flame retardant and binder resin mass ratio (in terms of solid content) is not particularly limited and may be, for example, flame retardant:binder resin = 5:5 to 9:1, or 6:4 to 8:2.

[0073] The coating amount of the backing agent in the sheet-shaped article is not particularly limited and may be, as the amount in terms of solids (i.e., the amount of backing), 10 to 100 g/m², or 40 to 80 g/m².

[0074] A method for producing the napped leather-like sheet-shaped article according to this embodiment is not particularly limited. A production method according to one embodiment includes, in the following order, (1) a step of forming, on at least one surface of a fibrous substrate that is a woven fabric or a knitted fabric, naps from fibers constituting the woven fabric or the knitted fabric and (2) a step of applying a resin to the fibrous substrate having the naps formed thereon. Further, the method may also include (3) a step of subjecting the resin-applied fibrous substrate to at least one in-bath treatment selected from the group consisting of dyeing, scouring, and soaping. The method may further include (4) a step of providing a backing on the back surface of the fibrous substrate. In this manner, because the application of a resin to the fibrous substrate (2) is performed before the in-bath treatment step (3), wear resistance can be improved.

[0075] In the step of forming naps in (1) above, the method for forming naps is not particularly limited, and known methods can be mentioned. For example, a method that opens the knit or weave structure of a double-ply woven fabric, a sinker pile circular-knitted fabric, a double-knitted fabric, or the like, and a method using a raising machine, such as a card clothing raising machine or an emery raising machine, can be mentioned. Among them, from the viewpoint of appearance and tactile sensation, a method using a raising machine is preferable. Methods using a raising machine include full-cut raising, semi-cut raising, and loop raising, and a method through semi-cut raising is more preferable. Here, full-cut raising refers to raising in which all the fibers constituting raised looped yarns are cut. Semi-cut raising is raising in which some of the fibers constituting raised looped yarns are cut. Loop raising is raising in which raised looped yarns are not cut.

[0076] In the step of applying a resin in (2) above, a resin composition liquid is applied to the fibrous substrate. The resin composition liquid may contain a solvent, such as a highly polar solvent, as necessary. From the viewpoint of environmental load, water is preferably used as the solvent.

[0077] As methods for applying a resin composition liquid to the fibrous substrate, conventionally known various methods can be employed without no particular limitation. For example, techniques such as dipping, coating, spraying, and printing can be mentioned. Among them, application by dipping allows the resin to be uniformly applied to the fibrous substrate and thus is preferable.

[0078] In the case where dipping is used as a method for applying a resin composition liquid to the fibrous substrate, the pickup rate is not particularly limited, and is preferably 20 to 80 mass%. As a result of the pickup rate being within this range, the desired amount can be evenly applied.

[0079] After the resin composition liquid is applied to the fibrous substrate, a heat treatment is performed as necessary. The heat treatment is performed for the purpose of evaporating the solvent in the resin composition liquid and drying the resin. In addition, in the case of using a catalyst or a crosslinking agent that causes a crosslinking reaction upon a heat treatment, or in the case of using a two-component curable resin, the heat treatment is performed for the purpose of promoting the reaction and forming a coating film with sufficient strength. The heat treatment temperature may be 130 to 190°C, or 150 to 170°C, for example. The heat treatment time may be 1 to 3 minutes, or 2 to 3 minutes.

[0080] The in-bath treatment step in (3) above is not particularly limited, and any desired process can be employed. For example, a dyeing process, a scouring process, a soaping process, and the like can be mentioned. These processes are conventionally known processes, and conventionally known methods can be used.

[0081] The backing treatment step in (4) above is not particularly limited, and the resin-applied fibrous substrate, or the fibrous substrate that has been further dyed, for example, is coated with a backing agent on the back surface (i.e., the surface opposite to the napped surface). Coating is followed by a heat treatment, whereby a backing layer is formed on the back surface of the fibrous substrate.

[0082] In the napped leather-like sheet-shaped article according to this embodiment, a woven or knitted fabric is used as a fibrous substrate, and also its density (the number of structure points and the number of structure point fibers) is specified. As a result, a surface appearance and a texture which are comparable to artificial leather using a nonwoven fabric as a fibrous substrate can be obtained. At the same time, its fluff loss resistance, fatigue durability, fatigue strength, and surface conformability are excellent.

[0083] The applications of the napped leather-like sheet-shaped article according to this embodiment are not particularly limited. As specific examples of applications, interior material applications for various vehicles, including automotive interior materials such as automotive seats, ceiling materials, dashboards, door lining materials, and steering wheels, can be mentioned. In addition, interior applications, such as covering for sofas and chairs, and fashion applications, such as bags and shoes, can be mentioned.

[0084] Incidentally, with respect to the various numerical ranges described herein, the upper and lower limits thereof can be arbitrarily combined, and all such combinations are incorporated herein as preferred numerical ranges. In addition, the description of a numerical range "X to Y" means X or more and Y or less.

Examples

[0085] Hereinafter, the invention will be described in further detail with reference to examples. However, the invention is not limited to the following examples.

[0086] Evaluation of each item was performed according to the following method.

[Constant Load Elongation Rate]

[0087] Three test pieces each measuring 80 mm in width and 250 mm in length were taken from a sheet-shaped article in the warp direction and also in the weft direction. At the longitudinal center of each test piece, gauge lines were given at an interval of 100 mm. In an atmosphere having a room temperature of $23 \pm 2^\circ\text{C}$ and a humidity of $50 \pm 5\% \text{RH}$, the test piece was placed in the grippers of a constant load elongation tester (Martens type) (manufactured by Daiei Kagaku Seiki Mfg. Co., Ltd.) at a grip distance of 150 mm without slack. To the lower gripper, a load of 98.1 N, including the weight of the gripper, was applied. A distance L (mm) between the gauge lines after being left for 10 minutes was measured, and the constant load elongation rate (%) was calculated by the following formula.

$$\text{Constant load elongation rate (\%)} = \{(L-100)/100\} \times 100$$

[0088] The constant load elongation rates in the warp direction and the weft direction were each calculated by averaging the measurements of the three test pieces. When the constant load elongation rate in the warp direction and that in the weft direction are both 5% or more, the surface conformability is excellent.

[Constant Load Set Rate]

[0089] Three test pieces each measuring 80 mm in width and 250 mm in length were taken from a sheet-shaped article in the warp direction and also in the weft direction. At the longitudinal center of each test piece, gauge lines were given at an interval of 100 mm. In an atmosphere having a room temperature of $23 \pm 2^\circ\text{C}$ and a humidity of $50 \pm 5\% \text{RH}$, the test piece was placed in the grippers of a constant load elongation tester (Martens type) (manufactured by Daiei Kagaku Seiki Mfg. Co., Ltd.) at a grip distance of 150 mm without slack. To the lower gripper, a load of 98.1 N, including the weight of the gripper, was applied. After being left for 10 minutes, the test piece was removed from the tester and left on a horizontal table for 10 minutes. The distance L1 (mm) between the gauge lines after being left for 10 minutes was measured. The constant load set rate was calculated by the following formula.

$$\text{Constant load set rate (\%)} = \{(L1-100)/100\} \times 100$$

[0090] The constant load set rates in the warp direction and the weft direction were each calculated by averaging the measurements of the three test pieces. When the constant load set rate in the warp direction and that in the weft direction are both less than 10%, the surface conformability is excellent.

[Fatigue Durability (Seam Fatigue)]

[0091] Test pieces each measuring 100 mm in width and 100 mm in length were taken from a sheet-shaped article in the warp direction and in the weft direction in pairs, and two pairs were prepared. The front surfaces of the two test pieces were

attached and sewn together at a position 6 mm from the edge of one side. The sewing conditions were as follows: knitting needle: No. 21-S (manufactured by Organ Needle Co., Ltd.), sewing yarn: polyester #8, seam style: lockstitch, seam pitch: 25 ± 2 stitches/100 mm. From each edge of each of the two sides opposing the sewn side and at a position 25 mm, a 92-mm-long straight cut perpendicular to the sewn side was made, that is, a total of four cuts were made, preparing a test piece (see FIG. 7).

[0092] Using a TTD type seam fatigue tester (TTD-100, manufactured by the Daiei Kagaku Seiki Mfg. Co., Ltd.), a clamp part was set in the middle portion of the three sections divided by the above cuts. The test piece was placed in a horizontal position and fixed to the left and right chucks at an interval of 120 mm in such a manner that the seam was at the center. Under a load of 29.4 N, the left and right sides were each repeatedly pulled 2,500 times at a stroke of 150 mm and a speed of 30 times/min. After 2,500 pulls, in a rest state under load, the maximum seam slippage (hole size) was measured. The fatigue durability in the warp direction and that in the weft direction were each represented by the value of one of the two sets of test pieces, whichever was larger. When the result is 2.2 mm or less, the fatigue durability can be said to be excellent.

[Fatigue Strength (Seam Strength)]

[0093] Test pieces each measuring 100 mm in width and 100 mm in length were taken from a sheet-shaped article in the warp direction and in the weft direction in pairs, and three pairs were prepared. The front surfaces of the two test pieces were attached and sewn together at a position 6 mm from the edge of one side. The sewing conditions were as follows: knitting needle: No. 21-S (manufactured by Organ Needle Co., Ltd.), sewing yarn: polyester #8, seam style: lockstitch, seam pitch: 25 ± 2 stitches/100 mm. Using a tensile tester (Autograph AG-1, manufactured by Shimadzu Corporation), the test piece was gripped by a gripping jig (size, both upper and lower grippers: front side: 25.4 mm in height, 25.4 mm in width, back side: 25.4 mm in height, 50.8 mm in width) at an interval of 76 mm (see FIG. 8). The test piece in this state was pulled at a speed of 200 mm/min, and the load (N) required for fracture at that time was measured. The fatigue strength in the warp direction and that in the weft direction were each represented by the value of one of three sets of test pieces, whichever was the smallest. When the result is 300 N or more, the fatigue strength can be said to be excellent.

[Wear Resistance and Fluff Loss]

[0094] A test piece measuring 70 mm in width and 300 mm in length was taken from a sheet-shaped article in the weft direction. Subsequently, a urethane foam sheet measuring 70 mm in width, 300 mm in length, and 10 mm in thickness was attached to the back surface, and the test piece was fixed to a surface abrasion tester T-TYPE (manufactured by Daiei Kagaku Seiki Mfg. Co., Ltd.). The front surface (napped surface) of the test piece was rubbed with a friction block covered with a cotton cloth (cotton canvas) under a load of 9.8 N. The friction block was moved on the front surface of the test piece for a distance of 140 mm to give 10,000 double rubs at a speed of 60 double rubs/minute. The front surface of the test piece was observed before and after rubbing, and the wear resistance was evaluated according to the following criteria. In addition, in the table, those where fluff loss was present are described as "present", and those without loss are described as "absent".

<Evaluation Criteria>

[0095]

Level 5: No change in the condition of the worn portion.

Level 4: Surface fibers are slightly entangled along the worn surface, but it is barely noticeable.

Level 3: Surface fibers are entangled along the worn surface, but it is not noticeable.

Level 2: Surface fibers are entangled along the worn surface, and it is significantly noticeable. Slight fluff loss occurred.

Level 1: Entangled fibers and yarns are lost (fluff loss occurred), and the ground yarn is visible.

[Texture (Stiffness)]

[0096] In accordance with JIS L 1096:2010 Method A (45° cantilever method), a test piece was subjected to measurement with the front surface facing upward. When the results in the warp direction and the weft direction are both 130 mm or less, the texture can be said to be excellent.

[Texture (Sensory Evaluation)]

[0097] A napped leather-like sheet-shaped article was held in the hand and evaluated according to the following

evaluation criteria.

<Evaluation Criteria>

5 **[0098]**

Level 5: Hardness of the fibrous substrate (hardness with a core) is not sensed.
 Level 4: Hardness of the fibrous substrate (hardness with a core) is hardly sensed.
 Level 3: Hardness of the fibrous substrate (hardness with a core) is sensed, but it is negligible.
 10 Level 2: Hardness of the fibrous substrate (hardness with a core) is sensed.
 Level 1: Hardness of the fibrous substrate (hardness with a core) is strongly sensed.

[Surface Appearance]

15 **[0099]** After stroking the front surface of a napped leather-like sheet-shaped article five times with a hand in the grain direction, the front surface was visually checked and evaluated according to the following evaluation criteria.

<Evaluation Criteria>

20 **[0100]**

Level 5: The structure line is not visible.
 Level 4: The structure line is slightly visible, but it is barely noticeable.
 Level 3: The structure line is visible, but it is not noticeable.
 25 Level 2: The structure line is visible, and it is somewhat noticeable.
 Level 1: The structure line is visible, and it is significantly noticeable.

[Fill Rate Calculation Method]

30 **[0101]** In sections perpendicular and parallel to the warp direction of a knit or weave structure, respectively, the napped part and the ground structure part were photographed under a scanning electron microscope at 1,000× magnification (S-3000N, Hitachi High-Technologies Corporation). The captured images were enlarged and printed in A4 size. In each printed image, the portion of the resin cut sections was painted red. The red-painted portion was then cut out, then the paper mass in the entire observation area (Ma) and the paper mass in the cut-out resin portion (Mb) were measured, and
 35 the fill rate of the resin per area was calculated as $(Mb/Ma) \times 100 (\%)$. Five random points were measured on each of the perpendicular section and the parallel section, and the measurements at three points, excluding the maximum and minimum values, a total of six points, were averaged to determine the fill rate.

[Example 1]

40 **[0102]** As the warp, a different-shrinkage mixed yarn composed of an 83 dtex/24 f polyester textured yarn (16-split yarn) and a 33 dtex/12 f polyester high-shrinkage yarn was used as the face yarn, and an 83 dtex/36 f polyester textured yarn was used as the back yarn. A 167 dtex/48 f polyester textured yarn was used as the weft. A 7-harness satin woven fabric was formed according to the weave structure shown in the structure diagram of FIG. 2.

45 **[0103]** The obtained woven fabric was washed with water and dried. Subsequently, using a card clothing raising machine equipped with a card clothing roll having 12 pile rollers and 12 counter-pile rollers, a raising treatment was performed to fluff the surface of the woven fabric. In the raising treatment, at a card clothing roll torque of 10 MPa and a cloth speed of 15 m/min, raising from the weave start direction and raising from the weave end direction were performed alternately three times.

50 **[0104]** Next, a heat treatment was performed in a heat setter at 150°C for 3 minutes, followed by semi-cut raising using an emery raising machine having sandpaper (#320). In particular, the surface of the woven fabric (raised surface) was ground at a sandpaper surface rotation speed of 1,000 rpm, a clearance of 0.8 mm, and a cloth speed of 8 m/min, thereby giving a napped woven fabric (basis weight: 250 g/m², thickness: 1,050 μm, single-fiber fineness of napped part: 0.22 dtex, length of naps: 300 μm, fibrous substrate warp density: 366 yarns/25.4 mm, weft density: 60 yarns/25.4 mm) was obtained.

55 **[0105]** The obtained napped woven fabric was subjected to a dipping treatment with a resin composition liquid of Formulation 1 shown in Table 1 using a mangle at a pickup rate of 50 mass%. Next, using a heat setter, a heat treatment was performed at 170°C for 3 minutes. As a result, a sheet-shaped article, in which a napped woven fabric serving as a fibrous substrate had a silicone resin and a polyurethane resin applied thereto by impregnation, was obtained. The

obtained sheet-shaped article was dyed with a disperse dye at 130°C for 50 minutes using a liquid flow dyeing machine, and then heat-treated in a heat setter at 130°C for 3 minutes.

[0106] The back surface of the obtained woven fabric was coated with the below-described backing agent using a knife coater to a dry coating weight of 60 g/m². Next, a heat treatment was performed in a heat setter at 130°C for 3 minutes to give a napped leather-like sheet-shaped article of Example 1. In the obtained napped leather-like sheet-shaped article, the fibrous substrate had a warp density of 366 yarns/25.4 mm and a weft density of 60 yarns/25.4 mm, the number of structure points per 25.4 mm square was 3,137, the total number of fibers involved in crossing at structure points per 25.4 mm square was 828,206, the constant load elongation rate was 5% or more in both the warp direction and the weft direction, and the constant load set rate was less than 10% in both the warp direction and the weft direction.

[Backing Agent]

[0107] A flame retardant and a binder resin were mixed in a mass ratio of 7:3 in terms of solid content, and water was added to give a mixture having a solids content of 50 mass%. As the flame retardant, ammonium polyphosphate (NH₄PO₃)_n (powder, manufactured by Ameda Corporation) was used. As the binder resin, a polyurethane resin (HYDRAN WLS-201 manufactured by DIC Corporation, solids content: 33 to 37 mass%) was used. The obtained mixture was adjusted to a viscosity of 15,000 mPa·s using a thickening agent (ADEKANOL UH-540 manufactured by ADEKA Corporation, solids content: 30 mass%) and used as a backing agent.

[Example 3]

[0108] A fibrous substrate having naps was prepared in the same manner as in Example 1, except that a 3-ply yarn obtained by twisting three 83 dtex/36 f polyester yarns together was used as the back yarn (warp) and also as the weft, and the basis weight, thickness, and density were changed as shown in Table 2. A napped leather-like sheet-shaped article of Example 3 was obtained in the same manner as in Example 1, except that Formulation 2 shown in Table 1 was used as the resin composition liquid to be applied to the fibrous substrate.

[Examples 4 and 5]

[0109] Napped leather-like sheet-shaped articles of Examples 4 and 5 were obtained in the same manner as in Example 1, except that the basis weight or density of the fibrous substrate was changed as shown in Tables 2 and 3.

[Examples 2 and 6 to 9]

[0110] Napped leather-like sheet-shaped articles of Examples 2 and 6 to 9 were obtained in the same manner as in Example 1, except for using, as a resin composition liquid to be applied to the fibrous substrate, Formulations 2, 3, and 6 to 8 shown in Table 1 each as shown in Tables 2 to 4.

[Examples 10 to 12]

[0111] Napped leather-like sheet-shaped articles of Examples 10 to 12 were obtained in the same manner as in Example 1, except that the weave structure of the fibrous substrate was changed to the 5-harness satin shown in FIG. 9 in Example 10, to the 6-harness satin shown in FIG. 10 in Example 11, and to the 8-harness satin shown in FIG. 11 in Example 12.

[Comparative Example 1]

[0112] In place of a woven fabric, a nonwoven fabric having a polycarbonate-based polyurethane resin adhering at 8.9 mass% to fibers (manufactured by Asahi Kasei Corporation, 3007B, basis weight: 280 g/m²) was used. The nonwoven fabric was subjected to the same raising treatment as in Example 1 to give a raised nonwoven fabric. In the obtained raised nonwoven fabric, the total basis weight of the fibrous substrate and the polyurethane resin was 280 g/m², the basis weight of the fibrous substrate was 257 g/m², the thickness was 900 μm, the napped part had single-fiber finenesses of 0.15 dtex and 0.3 dtex, the length of naps was 130 μm. A resin composition liquid was applied by the same procedure as in Example 1, except for using Formulation 3 shown in Table 1 as the resin composition liquid for treating the raised nonwoven fabric, and a dyeing/heat treatment was performed. Subsequently, a backing treatment was performed by the same procedure as in Example 1, except for applying the backing agent to a dry coating weight of 70 g/m², thereby giving a napped leather-like sheet-shaped article of Comparative Example 1.

[Comparative Examples 2 and 3]

[0113] Napped leather-like sheet-shaped articles of Comparative Examples 2 and 3 were obtained in the same manner as in Example 1, except that the basis weight and density of the fibrous substrate were changed as shown in Table 5.

[0114] The details and evaluation of the obtained napped leather-like sheet-shaped articles are shown in Tables 2 to 5. With respect to "Resin" in Tables 2 to 5, "Resin Adhesion Amount" is the amount of resin (in terms of solid content) applied to the fibrous substrate using each resin composition liquid shown in Table 1 (the same applies to Tables 6 to 8 below). In the case where a combination of two or more kinds of resins is used in a resin composition liquid shown in Table 1, for example, in Example 1, the amount is the total adhesion amount of the silicone resin and the polyurethane resin (in terms of solid content). In the case where a resin is used alone in a resin composition liquid, for example, in Examples 6, 7, and 9, the amount is the adhesion amount of the resin (in terms of solid content).

[0115] In "napped leather-Like Sheet-Shaped Article" in Tables 2 to 5, "Thickness (μm)", "Length of Naps (μm)", "Single-Fiber Fineness of Napped Part", "Density of Fibrous Substrate", "The Number of Structure Points", "The Number of Structure Point Fibers", "Constant Load Elongation Rate (%)", and "Constant Load Set Rate (%)" are values in a napped leather-like sheet-shaped article (the same applies to Tables 6 to 8 below).

[0116] In Example 1, the number of structure points is calculated by the above formula (1) as follows. From the structure diagram of FIG. 2 and the density of the fibrous substrate in Table 2, in formula (1), $n = 2$, $A_1 = 183 \text{ yarns}/25.4 \text{ mm}$, $A_2 = 183 \text{ yarns}/25.4 \text{ mm}$, $B_1 = 2 \text{ crossings/yarn}$, $B_2 = 2 \text{ crossings/yarn}$, $C = 60 \text{ yarns}/25.4 \text{ mm}$, and $D = 14 \text{ yarns}$. Therefore, the number of structure points is determined by the following formula.

Structure points (points/25.4mm square)

$$= (183 \times 2 \times 60 \div 14) + (183 \times 2 \times 60 \div 14) = 3137$$

[0117] Also in Examples 3 to 5 and Comparative Examples 2 and 3 with different fibrous substrate configurations, the number of structure points is similarly determined by formula (1).

[0118] In Example 10, the weft repeating unit $D = 10 \text{ yarns}$, $B_1 = 2 \text{ crossings/yarn}$, and $B_2 = 2 \text{ crossings/yarn}$. In Example 11, the weft repeating unit $D = 6 \text{ yarns}$, $B_1 = 1 \text{ crossing/yarn}$, and $B_2 = 1 \text{ crossing/yarn}$. In Example 12, the weft repeating unit $D = 16 \text{ yarns}$, $B_1 = 2 \text{ crossings/yarn}$, and $B_2 = 2 \text{ crossings/yarn}$. In formula (1), n , A_1 , A_2 , and C are the same as in Example 1. Using them, the number of structure points in Examples 10 to 12 is calculated by formula (1).

[0119] In Example 1, the number of structure point fibers is calculated by the above (3) as follows. From the yarn usage in the fibrous substrate in Table 2, $E_1 = 24 \times 16 + 12 \text{ (fibers)}$, $E_2 = 36 \text{ (fibers)}$, and $F = 48 \text{ (fibers)}$. Therefore, the number of structure point fibers is determined by the following formula. [

[Math 8]

The number of structure point fibers (fibers/25.4mm square)

$$= (183 \times 2 \times 60 \div 14) \times (24 \times 16 + 12 + 48)$$

$$+ (183 \times 2 \times 60 \div 14) \times (36 + 48)$$

$$= 828206$$

[0120] Also in Examples 3 to 5 and 10 to 12 and Comparative Examples 2 and 3 with different fibrous substrate configurations, the number of structure point fibers is similarly determined by formula (3).

[Table 1]

Component	Solids Content	Blend (parts by mass)							
		Formulation 1	Formulation 2	Formulation 3	Formulation 4	Formulation 5	Formulation 6	Formulation 7	Formulation 8
Silicone resin 1	50%	4	3	4	2	8			
Silicone resin 2	36%							5.5	
Silicone oil 1	42%								5
Polyurethane resin 1	36%	36	27		18	72	36	36	36
Catalyst solution 1	18%	4	3	4	2	8			
Water		56	67	92	78	12	64	58.5	64
Total		100	100	100	100	100	100	100	100

EP 4 534 755 A1

[0121] The details of each component in Table 1 are as follows.

- Silicone resin 1: Resin solution (solids content: 50 mass%) obtained by blending 50 parts by mass of methyl hydrogen silicone oil ("KF99" manufactured by Shin-Etsu Chemical Co., Ltd., solids content: 100 mass%, forms a three-dimensional network when used together with a catalyst and heat-treated), 2 parts by mass of polyoxyethylene polyoxypropylene glycol (manufactured by FUJIFILM Wako Pure Chemical Corporation, dispersant, solids content: 100 mass%), and 48 parts by mass of water.
- Silicone resin 2: "NICCA SILICON AMZ-3" manufactured by Nicca Chemical Co., Ltd., amino-modified silicone resin, solids content: 36 mass%.
- Silicone oil 1: Dimethyl silicone oil, "Elasfinish S-65" manufactured by DKS Co., Ltd., active ingredient: 42 mass%.
- Polyurethane resin 1: "EVAFANOL APC-66" manufactured by Nicca Chemical Co., Ltd., polycarbonate-based polyurethane resin (water-based one-component type, forced emulsion type, solids content: 36 mass%).
- Catalyst solution 1: Crosslinking catalyst solution (solids content: 18 mass%) obtained by blending 14 parts by mass of zinc stearate (manufactured by FUJIFILM Wako Pure Chemical Corporation, catalyst, solids content: 100 mass%), 4 parts by mass of polyoxyethylene polyoxypropylene glycol (manufactured by FUJIFILM Wako Pure Chemical Corporation, dispersant, solids content: 100 mass%), and 82 parts by mass of water.

[Table 2]

		Ex. 1	Ex. 2	Ex. 3	Ex. 4
[Fibrous Substrate]					
Kind		Raised woven fabric	Raised woven fabric	Raised woven fabric	Raised woven fabric
Weave Structure		7-Harness satin	7-Harness satin	7-Harness satin	7-Harness satin
Yarn Usage	Warp (front)	83dtex-24-split yarn +33dtex-12	83dtex-24-split yarn +33dtex-12	83dtex-24-split yarn +33dtex-12	83dtex-24-split yarn +33dtex-12
	Warp (back)	83dtex-36	83dtex-36	83dtex-36/3	83dtex-36
	Weft	167dtex-48	167dtex-48	83dtex-36/3	167dtex-48
Basis Weight (g/m ²)		250	250	300	220
Thickness (μm)		1050	1050	960	1050
Density of Fibrous Substrate	Warp (yarns/25.4 mm)	366	366	366	163
	Weft (yarns/25.4 mm)	60	60	65	65
Length of Naps (μm)		300	300	300	300
Single-Fiber Fineness of Napped Part (dtex)		0.22	0.22	0.22	0.22
[Resin]					
Formulation of Resin Composition Liquid		Formulation 1	Formulation 2	Formulation 2	Formulation 1
Resin Adhesion Amount (g/m ²)		19.9	12.9	12.2	17.5
Resin Fill Rate	Napped Part	1.3%	0.9%	1.1%	1.0%
	Ground Structure Part	5.3%	3.6%	3.8%	4.9%
Coating Weight of Backing Agent (g/m ²)		60.0	60.0	60.3	60.0

EP 4 534 755 A1

(continued)

		Ex. 1	Ex. 2	Ex. 3	Ex. 4
5	[Napped Leather-Like Sheet-Shaped Article]				
	Thickness (μm)	1050	1050	960	1050
	Length of Naps (μm)	300	300	300	300
10	Single-Fiber Fineness of Napped Part (dtex)	0.22	0.22	0.22	0.22
15	Density of Fibrous Substrate	Warp (yarns/25.4 mm)	366	366	366
		Weft (yarns/25.4 mm)	60	60	65
	Structure Points (number/25.4 mm square)	3137	3137	3399	1514
20	Number of Structure Point Fibers (fibers/25.4 mm square)	828,206	828,206	1,223,486	399,583
25	Constant Load Elongation Rate (%)	Warp	6.7	6.9	5.2
		Weft	12.3	12.7	11.1
25	Constant Load Set Rate (%)	Warp	1.7	2.5	1.4
		Weft	4.5	5.1	3.9
	[Evaluation]				
30	Fatigue Durability (mm)	Warp	0.8	1.1	0.7
		Weft	1	1.7	0.8
35	Fatigue Strength (N)	Warp	568	505	894
		Weft	532	497	581
	Wear Resistance (level)	4	3	4	3
	Fluff Loss	Absent	Absent	Absent	Absent
40	Texture (Stiffness) (mm)	Warp	110	94	125
		Weft	52	45	60
45	Texture (Sensory Evaluation) (level)	4	4	3	4
	Surface Appearance (level)	4	3	3	3

[Table 3]

50		Ex. 5	Ex. 6	Ex. 7	Ex. 8
	[Fibrous Substrate]				
	Kind	Raised woven fabric	Raised woven fabric	Raised woven fabric	Raised woven fabric
55	Weave Structure	7-Harness satin	7-Harness satin	7-Harness satin	7-Harness satin

EP 4 534 755 A1

(continued)

		Ex. 5	Ex. 6	Ex. 7	Ex. 8
5	Yarn Usage	Warp (front)	83dtex-24-split yarn +33dtex-12	83dtex-24-split yarn +33dtex-12	83dtex-24-split yarn +33dtex-12
		Warp (back)	83dtex-36	83dtex-36	83dtex-36
		Weft	167dtex-48	167dtex-48	167dtex-48
10	Basis Weight (g/m ²)		310	250	250
	Thickness (μm)		1050	1050	1050
15	Density of Fibrous Substrate	Warp (yarns/25.4 mm)	436	366	366
		Weft (yarns/25.4 mm)	145	60	60
	Length of Naps (μm)		300	300	300
20	Single-Fiber Fineness of Napped Part (dtex)		0.22	0.22	0.22
	[Resin]				
	Formulation of Resin Composition Liquid		Formulation 1	Formulation 6	Formulation 3
25	Resin Adhesion Amount (g/m ²)		24.8	17.2	2.7
	Resin Fill Rate	Napped Part	2.4%	1.4%	0.1%
		Ground Structure Part	8.7%	5.0%	0.6%
30	Coating Weight of Backing Agent (g/m ²)		60.0	60.0	60.0
	[Napped Leather-Like Sheet-Shaped Article]				
35	Thickness (μm)		1050	1050	1050
	Length of Naps (μm)		300	300	300
	Single-Fiber Fineness of Napped Part (dtex)		0.22	0.22	0.22
40	Density of Fibrous Substrate	Warp (yarns/25.4 mm)	436	366	366
		Weft (yarns/25.4 mm)	145	60	60
45	Structure Points (number/25.4 mm square)		9031	3137	3137
	Number of Structure Point Fibers (fibers/25.4 mm square)		2,384,297	828,206	828,206
50	Constant Load Elongation Rate (%)	Warp	5.1	6.2	5.9
		Weft	10.2	11.9	12.1
55	Constant Load Set Rate (%)	Warp	0.6	1.6	2.1
		Weft	1.0	4.6	4.3
	[Evaluation]				

EP 4 534 755 A1

(continued)

			Ex. 5	Ex. 6	Ex. 7	Ex. 8
5	Fatigue Durability (mm)	Warp	1.0	0.9	1.0	1.1
		Weft	0.9	1.0	1.0	0.8
	Fatigue Strength (N)	Warp	936	555	498	549
		Weft	731	530	460	521
10	Wear Resistance (level)		4	4	2	4
	Fluff Loss		Absent	Absent	Absent	Absent
15	Texture (Stiffness) (mm)	Warp	130	107	81	115
		Weft	129	50	34	53
	Texture (Sensory Evaluation) (level)		3	3	4	4
20	Surface Appearance (level)		4	4	4	4

[Table 4]

		Ex. 9	Ex. 10	Ex. 11	Ex. 12
25	[Fibrous Substrate]				
	Kind		Raised woven fabric	Raised woven fabric	Raised woven fabric
	Weave Structure		7-Harness satin	5-Harness satin	6-Harness satin
30	Yarn Usage	Warp (front)	83dtex-24-split yarn +33dtex-12	83dtex-24-split yarn +33dtex-12	83dtex-24-split yarn +33dtex-12
		Warp (back)	83dtex-36	83dtex-36	83dtex-36
		Weft	167dtex-48	167dtex-48	167dtex-48
35	Basis Weight (g/m ²)		250	250	250
	Thickness (μm)		1050	1050	1050
40	Density of Fibrous Substrate	Warp (yarns/25.4 mm)	366	366	366
		Weft (yarns/25.4 mm)	60	60	60
	Length of Naps (μm)		300	300	300
45	Single-Fiber Fineness of Napped Part (dtex)		0.22	0.22	0.22
	[Resin]				
	Formulation of Resin Composition Liquid		Formulation 8	Formulation 1	Formulation 1
50	Resin Adhesion Amount (g/m ²)		16.9	19.6	19.7
	Resin Fill Rate	Napped Part	1.2%	1.5%	1.2%
		Ground Structure Part	5.1%	5.2%	5.0%
55	Coating Weight of Backing Agent (g/m ²)		60.0	60.0	60.0

EP 4 534 755 A1

(continued)

		Ex. 9	Ex. 10	Ex. 11	Ex. 12
5	[Napped Leather-Like Sheet-Shaped Article]				
	Thickness (μm)	1050	1050	1050	1050
	Length of Naps (μm)	300	300	300	300
10	Single-Fiber Fineness of Napped Part (dtex)	0.22	0.22	0.22	0.22
	Density of Fibrous Substrate	Warp (yarns/25.4 mm)	366	366	366
15		Weft (yarns/25.4 mm)	60	60	60
	Structure Points (number/25.4 mm square)	3137	4392	3660	2745
20	Number of Structure Point Fibers (fibers/25.4 mm square)	828,206	1,159,488	966,240	724,680
	Constant Load Elongation Rate (%)	Warp	6.6	6.0	6.4
25		Weft	12.1	11.0	11.9
	Constant Load Set Rate (%)	Warp	2.0	1.7	1.6
		Weft	5.0	4.8	4.5
	[Evaluation]				
30	Fatigue Durability (mm)	Warp	1.2	1.1	1.0
		Weft	0.9	0.9	1.0
35	Fatigue Strength (N)	Warp	541	577	570
		Weft	507	550	540
	Wear Resistance (level)	4	4	4	4
	Fluff Loss	Absent	Absent	Absent	Absent
40	Texture (Stiffness) (mm)	Warp	112	109	105
		Weft	52	53	56
45	Texture (Sensory Evaluation) (level)	4	4	4	4
	Surface Appearance (level)	4	4	4	4

[Table 5]

50		Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3
	[Fibrous Substrate]			
	Kind	Raised nonwoven fabric	Raised woven fabric	Raised woven fabric
55	Weave Structure		7-Harness satin	7-Harness satin

EP 4 534 755 A1

(continued)

			Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3
5	Yarn Usage	Warp (front)	0.15/0.3	83dtex-24-split yarn +33dtex-12	83dtex-24-split yarn +33dtex-12
		Warp (back)	-	83dtex-36	83dtex-36
		Weft	-	167dtex-48	167dtex-48
10	Basis Weight (g/m ²)		257	200	320
	Thickness (μm)		900	1050	1050
	Density of Fibrous Substrate	Warp (yarns/25.4 mm)	-	141	436
		Weft (yarns/25.4 mm)	-	52	176
15	Length of Naps (μm)		130	300	300
	Single-Fiber Fineness of Napped Part (dtex)		Mixture of 0.15 and 0.3	0.22	0.22
20	[Resin]				
	Formulation of Resin Composition Liquid		Formulation 3	Formulation 1	Formulation 1
	Resin Adhesion Amount (g/m ²)		26.5	15.9	19.9
25	Resin Fill Rate	Napped Part	1.4%	0.9%	2.6%
		Ground Structure Part	4.3%	4.7%	9.1%
	Coating Weight of Backing Agent (g/m ²)		70.0	60.0	60.0
30	[Napped Leather-Like Sheet-Shaped Article]				
	Thickness (μm)		900	1050	1050
	Length of Naps (μm)		130	300	300
35	Single-Fiber Fineness of Napped Part (dtex)		Mixture of 0.15 and 0.3	0.22	0.22
	Density of Fibrous Substrate	Warp (yarns/25.4 mm)	-	141	436
		Weft (yarns/25.4 mm)	-	52	176
40	Structure Points (number/25.4 mm square)		-	1047	10962
	Number of Structure Point Fibers (fi- bers/25.4 mm square)		-	276,521	2,894,043
45	Constant Load Elon- gation Rate (%)	Warp	2.7	8.1	4.2
		Weft	3.9	15.0	9.6
50	Constant Load Set Rate (%)	Warp	0.1	5.6	0.5
		Weft	1.9	10.3	1.1
	[Evaluation]				
55	Fatigue Durability (mm)	Warp	2.0	2.4	0.9
		Weft	1.8	2.3	0.7

(continued)

		Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3
5	Fatigue Strength (N)			
	Warp	481	277	1065
	Weft	468	259	871
	Wear Resistance (level)	2	2	4
	Fluff Loss	Present	Absent	Absent
10	Texture (Stiffness) (mm)			
	Warp	105	96	141
	Weft	104	43	136
	Texture (Sensory Evaluation) (level)	3	4	2
15	Surface Appearance (level)	2	2	4

[0122] The results are as shown in Tables 2 to 5. In the napped leather-like sheet-shaped article of Comparative Example 1 using a nonwoven fabric as the fibrous substrate, fluff loss occurred. In addition, the scrim was exposed, and the surface appearance was also inferior. Further, the constant load elongation rate was low, and the surface conformability was also inferior.

[0123] In the napped leather-like sheet-shaped article of Comparative Example 2, although a woven fabric was used as the fibrous substrate, because the number of structure points per 25.4 mm square was less than 1,500, and the number of structure point fibers was less than 396,000, the fatigue durability, fatigue strength, and surface appearance were inferior. In addition, in Comparative Example 2, the constant load set rate in the weft direction was 10% or more, and the surface conformability was inferior. In the napped leather-like sheet-shaped article of Comparative Example 3, because the number of structure points per 25.4 mm square was more than 10,000, and the number of structure point fibers was more than 2,640,000, the texture was inferior.

[0124] In contrast, in the napped leather-like sheet-shaped articles of Examples 1 to 12, a surface appearance and a texture comparable to artificial leather using a nonwoven fabric as the fibrous substrate were obtained. At the same time, there was no fluff loss due to abrasion, and the fatigue durability and fatigue strength were excellent. In addition, in Examples 1 to 12, because the constant load elongation rate was 5% or more, and the constant load set rate was less than 10%, when such a sheet-shaped article is attached to a seat, the sheet-shaped article can be appropriately stretched under tension and attached. In addition, after the attachment, as a result of releasing the tension, excess stretch can be reversed, and thus the sheet-shaped article can be prevented from wrinkling. Therefore, the sheet-shaped articles of Examples 1 to 12 were excellent in surface conformability.

[Example 13]

[0125] Using a 24G circular knitting machine, an 83 dtex/24 f polyester textured yarn (16-split yarn) was introduced as the face yarn, an 83 dtex/12 f polyester textured yarn was introduced as the connecting yarn, and a 167 dtex/48 f polyester textured yarn was introduced as the back yarn, forming a circular-knitted fabric according to the knit structure of a brush structure shown in FIG. 4.

[0126] The obtained circular-knitted fabric was washed with water and dried. Subsequently, using a card clothing raising machine equipped with a card clothing roll having 12 pile rollers and 12 counter-pile rollers, a raising treatment was performed to fluff the surface of the circular-knitted fabric. In the raising treatment, at a card clothing roll torque of 10 MPa and a cloth speed of 15 m/min, raising from the knit start direction and raising from the knit end direction were performed alternately three times.

[0127] Next, a heat treatment was performed in a heat setter at 150°C for 3 minutes, followed by semi-cut raising using an emery raising machine having sandpaper (#320). In particular, the surface of the circular-knitted fabric (raised surface) was ground at a sandpaper surface rotation speed of 1,000 rpm, a clearance of 0.8 mm, and a cloth speed of 8 m/min. Next, a heat treatment was performed in a heat setter at 150°C for 3 minutes to cause tenting to the desired density. As a result, a napped circular-knitted fabric (basis weight: 400 g/m², thickness: 1,100 μm, single-fiber fineness of napped part: 0.22 dtex, length of naps: 300 μm, density of fibrous substrate: 73 courses/25.4 mm, 33 wales/25.4 mm) was obtained.

[0128] The obtained napped circular-knitted fabric was subjected to a dipping treatment with a resin composition liquid of Formulation 1 shown in Table 1 using a mangle at a pickup rate of 50 mass%. Next, using a heat setter, a heat treatment was performed at 170°C for 3 minutes. As a result, a sheet-shaped article, in which a napped circular-knitted fabric serving as a fibrous substrate had a silicone resin and a polyurethane resin applied thereto by impregnation, was obtained. The

obtained sheet-shaped article was dyed with a disperse dye at 130°C for 50 minutes using a liquid flow dyeing machine, and then heat-treated in a heat setter at 130°C for 3 minutes.

[0129] The back surface of the obtained circular-knitted fabric was coated with the backing agent described above using a knife coater to a dry coating weight of 65 g/m². Next, a heat treatment was performed in a heat setter at 130°C for 3 minutes to give a napped leather-like sheet-shaped article of Example 13. In the obtained napped leather-like sheet-shaped article, the number of structure points per 25.4 mm square was 4,818, the total number of fibers involved in entanglement in structure points per 25.4 mm square was 2,197,008, the constant load elongation rate was 5% or more in both the warp direction and the weft direction, and the constant load set rate was less than 10% in both the warp direction and the weft direction.

[Examples 14 and 15]

[0130] Napped leather-like sheet-shaped articles of Examples 14 and 15 were obtained in the same manner as in Example 13, except for using, as a resin composition liquid to be applied to the fibrous substrate, Formulations 4 and 5 shown in Table 1 each as shown in Table 6.

[Example 16]

[0131] A napped leather-like sheet-shaped article of Example 16 was obtained in the same manner as in Example 1, except that the knit structure of the fibrous substrate was changed to the mockrody structure shown in FIG. 6.

[Example 17]

[0132] The tentering conditions during the heat treatment in a heat setter at 150°C for 3 minutes after semi-cut raising were changed, thereby giving a napped circular-knitted fabric (basis weight: 280 g/m², thickness: 900 μm, single-fiber fineness of raised part: 0.22 dtex, length of naps: 200 μm, density of fibrous substrate: 50 courses/25.4 mm, 30 wales/25.4 mm). The dipping treatment of the obtained napped circular-knitted fabric was performed at a pickup rate of 54 mass%. In otherwise the same manner as in Example 13, a napped leather-like sheet-shaped article of Example 17 was obtained.

[Example 18]

[0133] During the heat treatment in a heat setter after semi-cut raising, instead of tentering, the fabric was heat-treated at 150°C for 3 minutes to cause width shrinkage to the desired density, thereby giving a napped circular-knitted fabric (basis weight: 480 g/m², thickness: 1,200 μm, single-fiber fineness of napped part: 0.22 dtex, length of naps: 400 μm, density of fibrous substrate: 90 courses/25.4 mm, 45 wales/25.4 mm). The dipping treatment of the obtained napped circular-knitted fabric was performed at a pickup rate of 49 mass%. In otherwise the same manner as in Example 13, a napped leather-like sheet-shaped article of Example 18 was obtained.

[Example 19]

[0134] An 83 dtex/24 f polyester textured yarn (8-split yarn) was used as the face yarn. The tentering conditions during the heat treatment in a heat setter at 150°C for 3 minutes after semi-cut raising were changed, thereby giving a napped circular-knitted fabric (basis weight: 300 g/m², thickness: 1,000 μm, single-fiber fineness of napped part: 0.44 dtex, length of naps: 200 μm, density of fibrous substrate: 55 courses/25.4 mm, 33 wales/25.4 mm). The dipping treatment of the obtained napped circular-knitted fabric was performed at a pickup rate of 57 mass%. In otherwise the same manner as in Example 13, a napped leather-like sheet-shaped article of Example 19 was obtained.

[Example 20]

[0135] A 2-ply yarn obtained by twisting two 83 dtex/24 f polyester textured yarns (16-split yarns) together was used as the face yarn. In addition, the dipping treatment of the napped circular-knitted fabric was performed at a pickup rate of 51 mass%. In otherwise the same manner as in Example 13, a napped leather-like sheet-shaped article of Example 20 was obtained.

[Example 21]

[0136] A 3-ply yarn obtained by twisting three 83 dtex/24 f polyester textured yarns (16-split yarns) together was used as the face yarn. During the heat treatment in a heat setter after semi-cut raising, instead of tentering, the fabric was heat-

treated at 150°C for 3 minutes to cause width shrinkage to the desired density, thereby giving a napped circular-knitted fabric (basis weight: 460 g/m², thickness: 1,400 μm, single-fiber fineness of napped part: 0.22 dtex, length of naps: 400 μm, density of fibrous substrate: 73 courses/25.4 mm, 45 wales/25.4 mm). The dipping treatment of the obtained napped circular-knitted fabric was performed at a pickup rate of 49 mass%. In otherwise the same manner as in Example 13, a

[Comparative Example 4]

[0137] A napped leather-like sheet-shaped article of Comparative Example 4 was obtained in the same manner as in Example 13, except that using a 24G circular knitting machine, a 77 dtex/216 f polyester textured yarn was introduced as the face yarn and also as the connecting yarn, while a 121 dtex/36 f polyester textured yarn was introduced as the back yarn, and a circular-knitted fabric was formed according to the knit structure of the tuck structure shown in FIG. 12. The simplified knitted construction of the tuck structure as seen from the front surface is as shown in FIG. 13.

[Comparative Example 5]

[0138] The tentering conditions during the heat treatment in a heat setter at 150°C for 3 minutes after semi-cut raising were changed, thereby giving a napped circular-knitted fabric (basis weight: 270 g/m², thickness: 900 μm, single-fiber fineness of napped part: 0.22 dtex, length of naps: 200 μm, density of fibrous substrate: 40 courses/25.4 mm, 28 wales/25.4 mm). The dipping treatment of the obtained napped circular-knitted fabric was performed at a pickup rate of 53 mass%. In otherwise the same manner as in Example 13, a napped leather-like sheet-shaped article of Comparative Example 5 was obtained.

[Comparative Example 6]

[0139] During the heat treatment in a heat setter after semi-cut raising, instead of tentering, the fabric was heat-treated at 150°C for 3 minutes to cause width shrinkage to the desired density, thereby giving a napped circular-knitted fabric (basis weight: 490 g/m², thickness: 1,200 μm, single-fiber fineness of napped part: 0.22 dtex, length of naps: 410 μm, density of fibrous substrate: 95 courses/25.4 mm, 50 wales/25.4 mm). The dipping treatment of the obtained napped circular-knitted fabric was performed at a pickup rate of 49 mass%. In otherwise the same manner as in Example 13, a napped leather-like sheet-shaped article of Comparative Example 6 was obtained.

[Comparative Example 7]

[0140] An 83 dtex/24 f polyester textured yarn (8-split yarn) was used as the face yarn. The tentering conditions during the heat treatment in a heat setter at 150°C for 3 minutes after semi-cut raising were changed, thereby giving a napped circular-knitted fabric (basis weight: 290 g/m², thickness: 1,000 μm, single-fiber fineness of napped part: 0.44 dtex, length of naps: 200 μm, density of fibrous substrate: 50 courses/25.4 mm, 33 wales/25.4 mm). The dipping treatment of the obtained napped circular-knitted fabric was performed at a pickup rate of 56 mass%. In otherwise the same manner as in Example 13, a napped leather-like sheet-shaped article of Comparative Example 7 was obtained.

[Comparative Example 8]

[0141] A 3-ply yarn obtained by twisting three 83 dtex/24 f polyester textured yarns (16-split yarns) together was used as the face yarn. During the heat treatment in a heat setter after semi-cut raising, instead of tentering, the fabric was heat-treated at 150°C for 3 minutes to cause width shrinkage to the desired density, thereby giving a napped circular-knitted fabric (basis weight: 470 g/m², thickness: 1,400 μm, single-fiber fineness of napped part: 0.22 dtex, length of naps: 400 μm, density of fibrous substrate: 73 courses/25.4 mm, 50 wales/25.4 mm). The dipping treatment of the obtained napped circular-knitted fabric was performed at a pickup rate of 49 mass%. In otherwise the same manner as in Example 13, a napped leather-like sheet-shaped article of Comparative Example 8 was obtained.

[0142] The details and evaluation of the obtained napped leather-like sheet-shaped articles are shown in Tables 6 to 8.

[0143] In Examples 13 to 15, the number of structure points is calculated by the above formula (2-1) as follows. From the structure diagram of FIG. 4 and the fibrous substrate density in Table 6, in formula (2-1), $G_F = G_R = 73$ courses/25.4 mm, and $I_F = I_R = 33$ wales/25.4 mm. Therefore, the number of structure points is determined by the following formula.

[Math 9]

$$\text{Structure points (points/25.4mm square)} = 73 \times 33 + 73 \times 33 = 4818$$

[0144] In Examples 13 to 15, the number of structure point fibers is calculated by the above formula (4-1) as follows. From the yarn usage in the fibrous substrate in Table 6, $K = 24 \times 16$ (fibers), $L = 12$ (fibers), and $M = 48$ (fibers). Therefore, the number of structure point fibers is determined by the following formula.

[Math 10]

The number of structure point fibers (fibers/25.4mm square)

$$= 73 \times 33 \times (24 \times 16 + 12) \times 2 + 73 \times 33 \times (48 + 12) \times 2 = 2197008$$

[0145] Also in Examples 17 to 21 and Comparative Examples 5 to 8, the number of structure points is calculated by formula (2-1), and the number of structure point fibers is calculated by formula (4-1).

[0146] In Example 16, the number of structure points is determined by the above formula (2-1) as in Example 13, and is 4,818 points/25.4 mm square. The number of structure point fibers is calculated by the above formula (4-2) as follows.

[Math 11]

The number of structure point fibers (fibers/25.4mm square)

$$= 73 \times 33 \times (24 \times 16 + 12) + 73 \times 33 \times (48 + 12) = 1098504$$

[0147] In Comparative Example 4, the number of structure points is determined as follows. In a tuck structure (double-knitted fabric), tuck stitches are present on the front surface, while the back surface has no tuck stitch. Therefore, structure points on the front surface and those on the back surface are separately calculated, and they are added together. The back surface with no tuck stitch can be considered in the same manner as for a brush structure. Meanwhile, on the front surface, from FIG. 12 and FIG. 13, there is one tuck stitch for every four courses in the warp direction, and there is one tuck stitch for every two wales in the weft direction. Therefore, the number of structure points on the front surface is the value obtained by subtracting the number of tuck stitches from the number of structure points calculated in the same manner as for a brush structure. Therefore, the number of structure points is calculated by the following formula (in the formula, G_R and I_R are the same as in the above formula (2)).

[Math 12]

$$\text{Structure points on the front surface (points/25.4mm square)} = G_F \times I_F - \left(\frac{G_F}{4} \times \frac{I_F}{2} \right)$$

$$= 53 \times 46 - \left(\frac{53}{4} \times \frac{46}{2} \right) = 2133.25$$

$$\text{Structure points on the back surface (points/25.4mm square)} = G_R \times I_R = 53 \times 46$$

$$= 2438$$

$$\text{Structure points (points/25.4mm square)} = 2133.25 + 2438 = 4571.25$$

[0148] In Comparative Example 4, in the same as for the number of structure points, the number of structure point fibers on the front surface and that on the back surface are separately calculated, and they are added together. On the front surface, as shown in FIG. 12 and FIG. 13, the number of entangled yarns differs between structure points without tuck stitches (non-tuck structure points) and structure points with tuck stitches (tuck structure points). At a non-tuck structure

point, a face yarn and a face yarn, a total of two yarns, are entangled. At a tuck structure point, two face yarns and one connecting yarn, a total of three yarns, are entangled. In addition, of the 2,133.25 structure points on the front surface, the number of tuck structure points is 304.75 ($= 53/4 \times 46/2$), and the number of non-tuck structure points is 1,828.5 ($= 2,133.25 - 304.75$). Meanwhile, on the back surface, the number of structure points is 2,438, and, at each structure point, a back yarn and a connecting yarn, a total of two yarns, are entangled. Therefore, the number of structure point fibers is calculated by the following formula.

[Math 13]

The number of structure point fibers on the front surface (fibers/25.4mm square)

$$= 1828.5 \times (216 + 216) + 304.75 \times (216 + 216 + 216) = 987390$$

The number of structure point fibers on the back surface (fibers/25.4mm square)

$$= 2438 \times (36 + 216) = 614376$$

The number of structure point fibers (fibers/25.4mm square square)

$$= 987390 + 614376 = 1601766$$

[Table 6]

		Ex. 13	Ex. 14	Ex. 15	Ex. 16	Ex. 17
[Fibrous Substrate]						
Kind		Raised circular-knitted fabric	Raised circular-knitted fabric	Raised circular-knitted fabric	Raised circular-knitted fabric	Raised circular-knitted fabric
Knit Structure		Brush	Brush	Brush	Mockrody	Brush
Yarn Usage	Face Yarn	83dtex-24-split yarn	83dtex-24-split yarn	83dtex-24-split yarn	83dtex-24-split yarn	83dtex-24-split yarn
	Connecting Yarn	83dtex-12	83dtex-12	83dtex-12	83dtex-12	83dtex-12
	Back Yarn	167dtex-48	167dtex-48	167dtex-48	167dtex-48	167dtex-48
Basis Weight (g/m ²)		400	400	400	380	280
Thickness (μm)		1100	1100	1100	1100	900
Length of Naps (μm)		300	300	300	300	200
Single-Fiber Fineness of Napped Part (dtex)		0.22	0.22	0.22	0.22	0.22
Density of Fibrous Substrate	Courses/25.4 mm	73	73	73	73	50
	Wales/25.4 mm	33	33	33	33	30
[Resin]						
Formulation of Resin Composition Liquid		Formulation 1	Formulation 4	Formulation 5	Formulation 1	Formulation 1
Resin Adhesion Amount (g/m ²)		22.7	11.1	38.3	20.5	17.1

EP 4 534 755 A1

(continued)

			Ex. 13	Ex. 14	Ex. 15	Ex. 16	Ex. 17
5	Resin Fill Rate	Napped Part	2.1%	1.1%	2.4%	2.0%	1.8%
		Ground Structure Part	5.9%	4.3%	8.8%	5.8%	4.5%
	Coating Weight of Backing Agent (g/m ²)		65.0	65.0	65.0	65.0	65.0
10	[Napped Leather-Like Sheet-Shaped Article]						
	Thickness (μm)		1100	1100	1100	1100	900
	Length of Naps (μm)		300	300	300	300	200
15	Single-Fiber Fineness of Napped Part (dtex)		0.22	0.22	0.22	0.22	0.22
20	Density of Fibrous Substrate	Courses/25.4 mm	73	73	73	73	50
		Wales/25.4 mm	33	33	33	33	30
	Structure Points (number/25.4 mm square)		4818	4818	4818	4818	3000
25	Number of Structure Point Fibers (fibers/25.4 mm square)		2,197,008	2,197,008	2,197,008	1,098,504	1,368,000
30	Constant Load Elongation Rate (%)	Warp	16.0	16.2	15.4	16.4	22.6
		Weft	33.0	33.3	32.1	33.1	38.0
35	Constant Load Set Rate (%)	Warp	1.0	1.2	1.0	1.1	2.1
		Weft	6.0	8.2	2.2	6.2	8.0
	[Evaluation]						
40	Fatigue Durability (mm)	Warp	1.1	1.3	1.0	1.4	2.0
		Weft	1.0	1.2	1.0	1.4	2.0
	Fatigue Strength (N)	Warp	518	468	533	460	337
		Weft	894	703	905	710	311
	Wear Resistance (level)		4	3	4	4	3
45	Fluff Loss		Absent	Absent	Absent	Absent	Absent
	Texture (Stiffness) (mm)	Warp	73	59	78	70	65
		Weft	68	66	70	66	60
50	Texture (Sensory Evaluation) (level)		4	4	3	4	4
	Surface Appearance (level)		4	4	4	4	3

[Table 7]

55		Ex. 18	Ex. 19	Ex. 20	Ex. 21
	[Fibrous Substrate]				

EP 4 534 755 A1

(continued)

			Ex. 18	Ex. 19	Ex. 20	Ex. 21
5	Kind		Raised circular-knitted fabric	Raised circular-knitted fabric	Raised circular-knitted fabric	Raised circular-knitted fabric
	Knit Structure		Brush	Brush	Brush	Brush
	Yarn Usage	Face Yarn	83dtex-24-split yarn	83dtex-24-split yarn	83dtex-24/2-split yarn	83dtex-24/3-split yarn
10		Connecting Yarn	83dtex-12	83dtex-12	83dtex-12	83dtex-12
		Back Yarn	167dtex-48	167dtex-48	167dtex-48	167dtex-48
	Basis Weight (g/m ²)		480	300	440	460
	Thickness (μm)		1200	1000	1200	1400
15	Length of Naps (μm)		400	200	300	400
	Single-Fiber Fineness of Napped Part (dtex)		0.22	0.44	0.22	0.22
	Density of Fibrous Substrate	Courses/25.4 mm	90	55	73	73
20		Wales/25.4 mm	45	33	33	45
	[Resin]					
	Formulation of Resin Composition Liquid		Formulation 1	Formulation 1	Formulation 1	Formulation 1
25	Resin Adhesion Amount (g/m ²)		26.7	19.3	25.2	25.7
	Resin Fill Rate	Napped Part	2.3%	1.5%	2.4%	2.6%
30		Ground Structure Part	7.3%	4.6%	6.2%	6.9%
	Coating Weight of Backing Agent (g/m ²)		65.0	65.0	65.0	65.0
	[Napped Leather-Like Sheet-Shaped Article]					
35	Thickness (μm)		1200	1000	1200	1400
	Length of Naps (μm)		400	200	300	400
	Single-Fiber Fineness of Napped Part (dtex)		0.22	0.44	0.22	0.22
	Density of Fibrous Substrate	Courses/25.4 mm	90	55	73	73
40		Wales/25.4 mm	45	33	33	45
	Structure Points (number/25.4 mm square)		8100	3630	4818	6570
	Number of Structure Point Fibers (fibers/25.4 mm square)		3,693,600	958,320	4,047,120	8,041,680
50	Constant Load Elongation Rate (%)	Warp	12.9	22.1	14.5	9.0
		Weft	25.6	38.6	26.0	24.5
	Constant Load Set Rate (%)	Warp	0.8	3.1	0.9	0.5
55		Weft	3.5	8.1	3.8	1.0
	[Evaluation]					

EP 4 534 755 A1

(continued)

5			Ex. 18	Ex. 19	Ex. 20	Ex. 21
	Fatigue Durability (mm)	Warp	0.7	1.2	0.8	0.6
		Weft	0.7	1.3	0.9	0.6
10	Fatigue Strength (N)	Warp	612	368	582	650
		Weft	943	352	928	953
	Wear Resistance (level)		4	3	4	4
15	Fluff Loss		Absent	Absent	Absent	Absent
	Texture (Stiffness) (mm)	Warp	79	66	76	80
		Weft	75	62	70	78
	Texture (Sensory Evaluation) (level)		3	4	4	3
20	Surface Appearance (level)		4	3	4	4

[Table 8]

			Comp. Ex. 4	Comp. Ex. 5	Comp. Ex. 6	Comp. Ex. 7	Comp. Ex. 8
25	[Fibrous Substrate]						
	Kind		Raised circu- lar-knitted fabric	Raised circu- lar-knitted fabric	Raised circu- lar-knitted fabric	Raised circu- lar-knitted fabric	Raised circu- lar-knitted fabric
30	Knit Structure		Tuck	Brush	Brush	Brush	Brush
	Yarn Usage	Face Yarn	77dtex-216	83dtex-24- split yarn	83dtex-24- split yarn	83dtex-24- split yarn	83dtex-24/3- split yarn
35		Connecting Yarn	77dtex-216	83dtex-12	83dtex-12	83dtex-12	83dtex-12
		Back Yarn	121 dtex-36	167dtex-48	167dtex-48	167dtex-48	167dtex-48
	Basis Weight (g/m ²)		400	270	490	290	470
	Thickness (μm)		1000	900	1200	1000	1400
40	Length of Naps (μm)		320	200	410	200	400
	Single-Fiber Fineness of Napped Part (dtex)		0.36	0.22	0.22	0.44	0.22
45	Density of Fibrous Substrate	Courses/25.4 mm	53	40	95	50	73
		Wales/25.4 mm	46	28	50	33	50
	[Resin]						
50	Formulation of Resin Compo- sition Liquid		Formulation 1	Formulation 1	Formulation 1	Formulation 1	Formulation 1
	Resin Adhesion Amount (g/m ²)		22.7	16.2	27.4	18.5	26.1
55	Resin Fill Rate	Napped Part	2.0%	1.3%	2.4%	1.0%	2.8%
		Ground Struc- ture Part	5.5%	4.0%	7.8%	4.3%	7.0%

EP 4 534 755 A1

(continued)

			Comp. Ex. 4	Comp. Ex. 5	Comp. Ex. 6	Comp. Ex. 7	Comp. Ex. 8
5	Coating Weight of Backing Agent (g/m ²)		65.0	65.0	65.0	65.0	65.0
	[Napped Leather-Like Sheet-Shaped Article]						
	Thickness (μm)		1000	900	1200	1000	1400
10	Length of Naps (μm)		320	200	410	200	400
	Single-Fiber Fineness of Napped Part (dtex)		0.36	0.22	0.22	0.44	0.22
15	Density of Fibrous Substrate	Courses/25.4 mm	53	40	95	50	73
		Wales/25.4 mm	46	28	50	33	50
20	Structure Points (number/25.4 mm square)		4571	2240	9500	3300	7300
	Number of Structure Point Fibers (fibers/25.4 mm square)		1,601,766	1,021,440	4,332,000	871,200	8,935,200
25	Constant Load Elongation Rate (%)	Warp	11.3	23.1	11.0	24.0	8.7
		Weft	88.1	38.9	24.7	39.1	22.6
30	Constant Load Set Rate (%)	Warp	1.4	3.2	0.7	3.4	0.3
		Weft	31.3	8.2	3.4	8.3	0.9
	[Evaluation]						
35	Fatigue Durability (mm)	Warp	1.3	2.4	0.6	1.5	0.4
		Weft	1.2	2.2	0.7	1.3	0.4
	Fatigue Strength (N)	Warp	589	287	641	356	662
		Weft	597	250	963	344	987
40	Wear Resistance (level)		4	2	4	3	4
	Fluff Loss		Absent	Absent	Absent	Absent	Absent
45	Texture (Stiffness) (mm)	Warp	61	60	85	62	87
		Weft	60	56	82	57	84
	Texture (Sensory Evaluation) (level)		4	4	2	4	2
	Surface Appearance (level)		4	2	4	2	4

50 [0149] The results are as shown in Tables 6 to 8. In the napped leather-like sheet-shaped article of Comparative Example 4, although a knitted fabric was used as the fibrous substrate, the knit structure was a tuck structure. It is believed that in a tuck structure, because each needle loop is formed skipping one or more courses, the needle loop fill rate is low, and the needle loops are prone to deformation, leading to an increased constant load set rate. In Comparative Example 4, because the constant load set rate was high like this, when the sheet-shaped article was tensioned and attached to a seat, the stretch due to tension was not sufficiently reversed, and the sheet-shaped article was prone to wrinkling. Thus, the surface conformability was inferior.

55 [0150] In the napped leather-like sheet-shaped article of Comparative Example 5, although a knitted fabric was used as

the fibrous substrate, because the number of structure points per 25.4 mm square was small, the fatigue durability, fatigue strength, and surface appearance were inferior. In the napped leather-like sheet-shaped article of Comparative Example 6, because the number of structure points per 25.4 mm square was too large, the texture was inferior. In the napped leather-like sheet-shaped article of Comparative Example 7, because the number of structure point fibers per 25.4 mm square was small, the tactile sensation and surface appearance were inferior. In the napped leather-like sheet-shaped article of Comparative Example 8, because the number of structure point fibers per 25.4 mm square was too large, the texture was inferior.

[0151] In contrast, in the napped leather-like sheet-shaped articles according to Examples 13 to 21, a surface appearance and a texture comparable to artificial leather were obtained. At the same time, there was no fluff loss due to abrasion, and the fatigue durability, fatigue strength, and wear resistance were excellent. In addition, in Examples 13 to 21, because the constant load elongation rate was high, and the constant load set rate was low, the surface conformability was excellent.

Reference Signs List

[0152] 10: Napped leather-like sheet-shaped article, 11: Front surface, 12: Fibrous substrate, 13: Back surface, 14: Nap, 16: Napped surface

Claims

1. A napped leather-like sheet-shaped article comprising: a fibrous substrate that is a woven fabric or a knitted fabric; and a resin applied to the fibrous substrate,

wherein the napped leather-like sheet-shaped article includes, on a front surface thereof, a napped surface having naps formed from fibers constituting the fibrous substrate, the naps having the resin adhering thereto, the number of structure points of yarns constituting the fibrous substrate per 24.5 mm square of the sheet-shaped article is 1,500 to 10,000 when the fibrous substrate is a woven fabric, and is 3,000 to 9,000 when the fibrous substrate is a knitted fabric,

the total number of fibers involved in crossing or entanglement at the structure points per 24.5 mm square of the sheet-shaped article is 396,000 to 2,640,000 when the fibrous substrate is a woven fabric, and is 912,000 to 8,208,000 when the fibrous substrate is a knitted fabric, and the constant load elongation rate is 5% or more in both the warp direction and the weft direction of the sheet-shaped article, while the constant load set rate is less than 10% in both the warp direction and the weft direction of the sheet-shaped article.

2. The napped leather-like sheet-shaped article according to claim 1, wherein the number of structure points of yarns constituting the fibrous substrate per 24.5 mm square of the sheet-shaped article is 3,500 to 9,000 when the fibrous substrate is a knitted fabric.

3. The napped leather-like sheet-shaped article according to claim 1, wherein the fibrous substrate is a circular-knitted knitted fabric.

4. The napped leather-like sheet-shaped article according to claim 1, wherein the fibrous substrate is an interlock-knitted knitted fabric.

5. The napped leather-like sheet-shaped article according to claim 1, wherein the fibrous substrate is a satin-weave multi-ply woven fabric.

6. The napped leather-like sheet-shaped article according to claim 1, wherein the resin is present at least on the front surface side where the naps are present in the thickness direction of the fibrous substrate.

7. The napped leather-like sheet-shaped article according to claim 1, wherein the resin is a polyurethane resin alone or a mixture of a silicone resin and a polyurethane resin.

8. The napped leather-like sheet-shaped article according to claim 1, wherein the sheet-shaped article has no nap formed on a back surface thereof, and the back surface is provided with a backing.

9. The napped leather-like sheet-shaped article according to claim 8, wherein the backing contains a flame retardant and a binder resin.
10. The napped leather-like sheet-shaped article according to claim 1, wherein the density of the fibrous substrate is such that when the fibrous substrate is a woven fabric, it has a warp density of 200 to 500 yarns/25.4 mm and a weft density of 50 to 150 yarns/25.4 mm, and when the fibrous substrate is a knitted fabric, it has 40 to 110 courses/25.4 mm and 30 to 70 wales/25.4 mm.

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FIG. 1

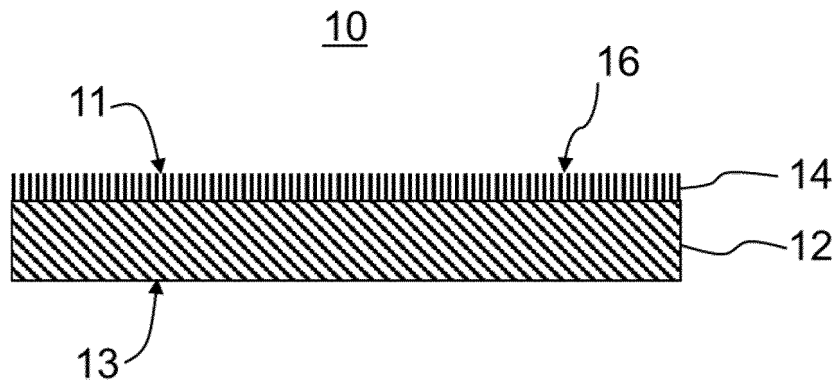


FIG. 2

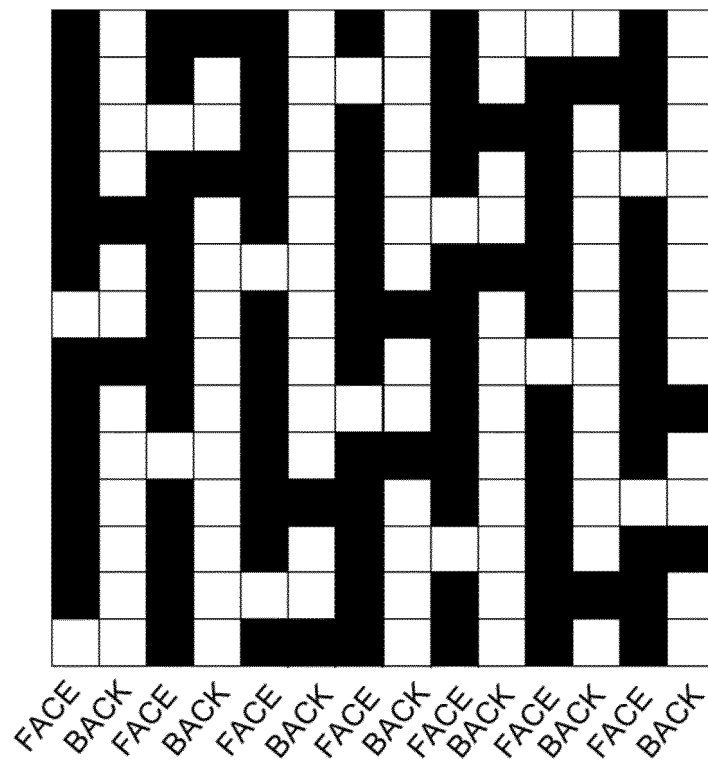


FIG. 3

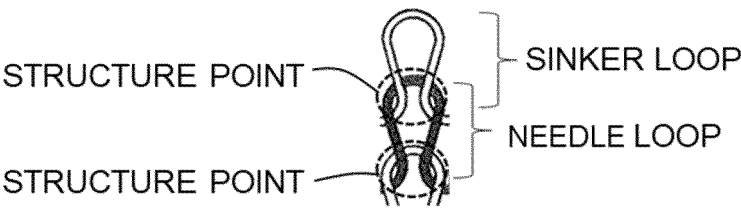


FIG. 4

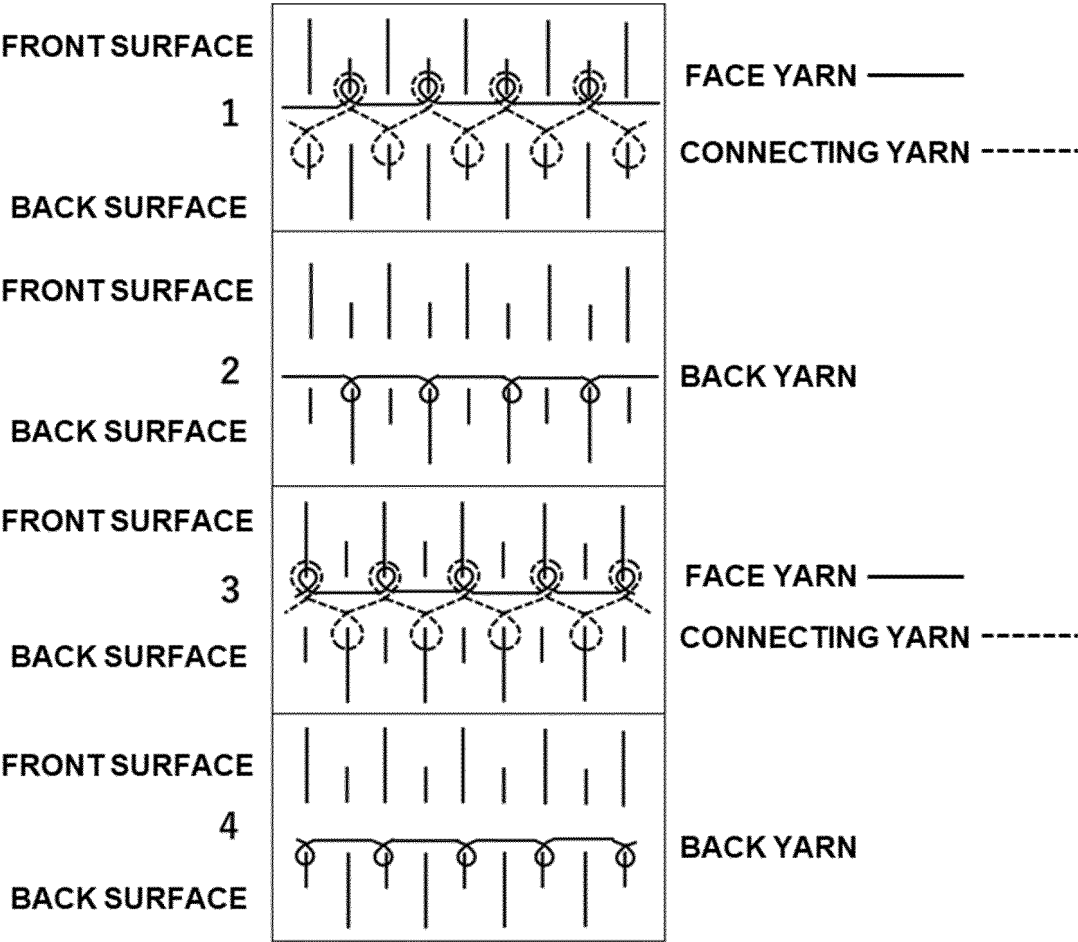


FIG. 5

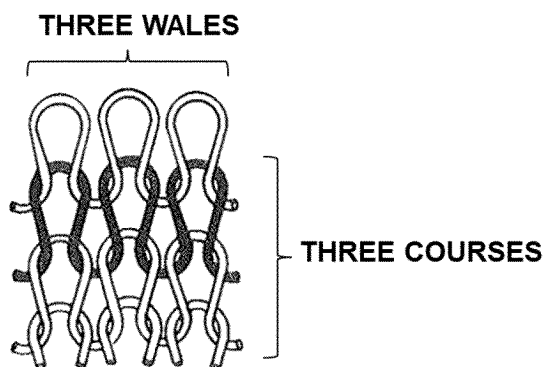


FIG. 6

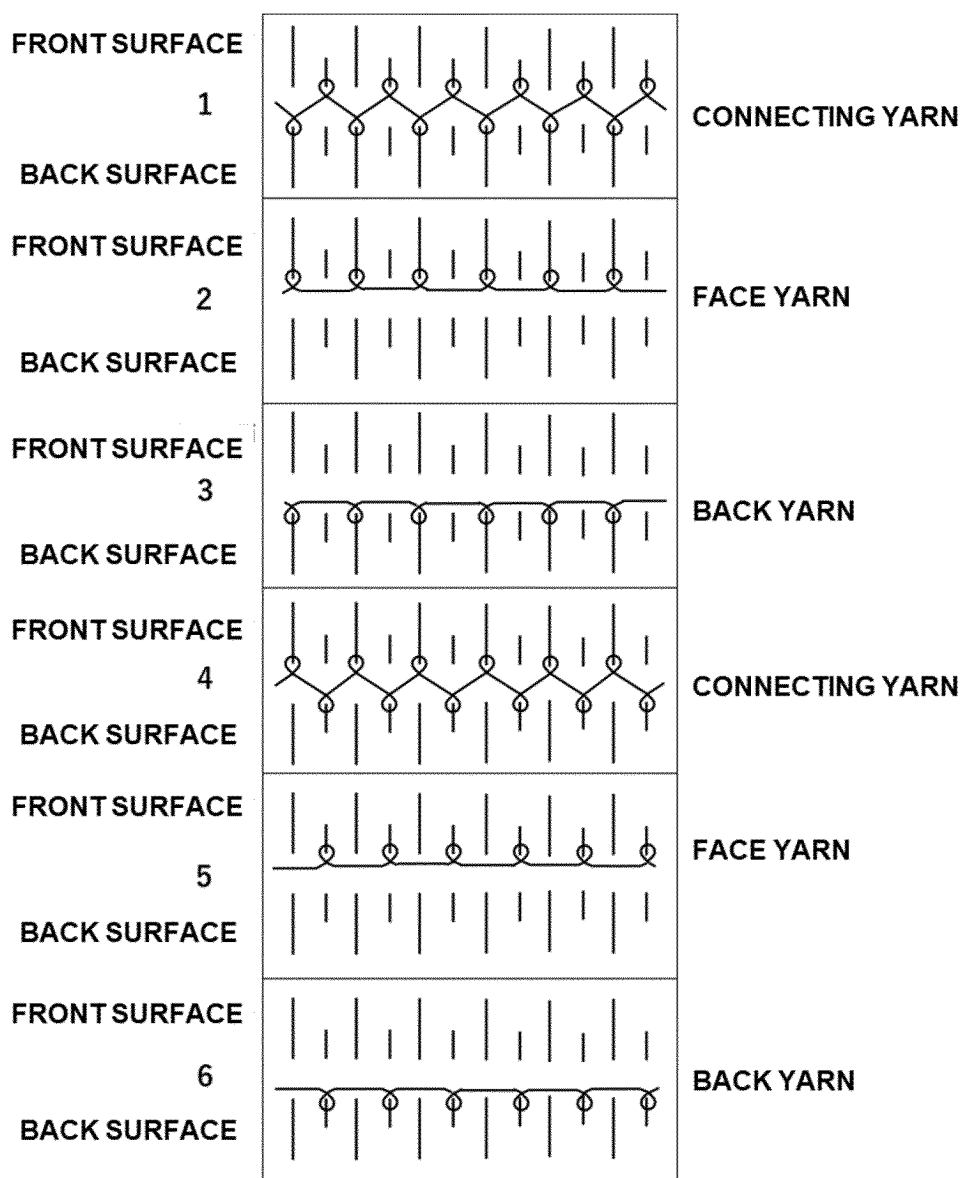


FIG. 7

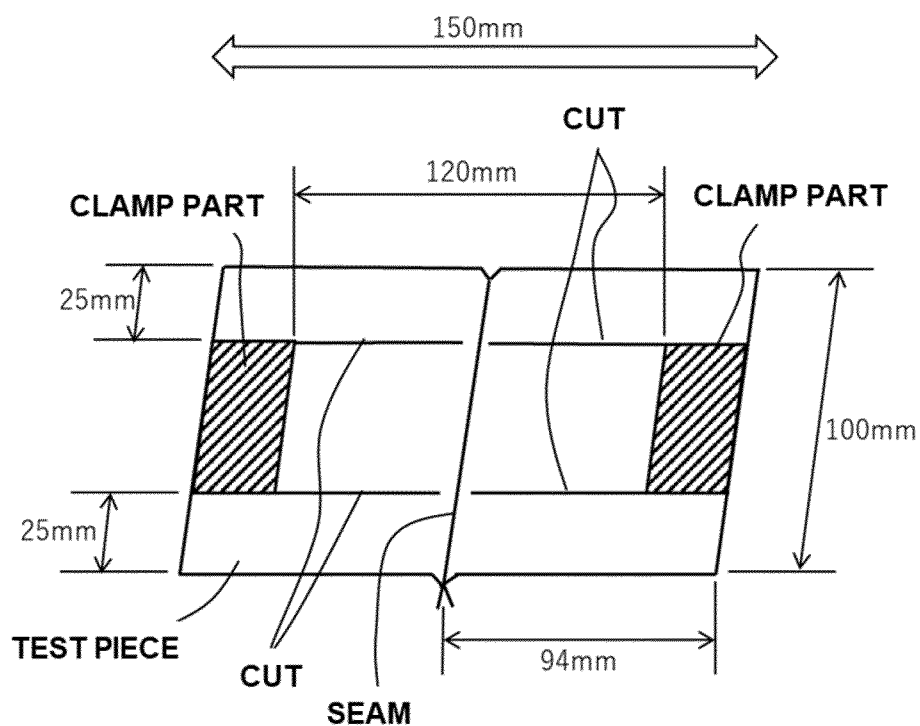


FIG. 8

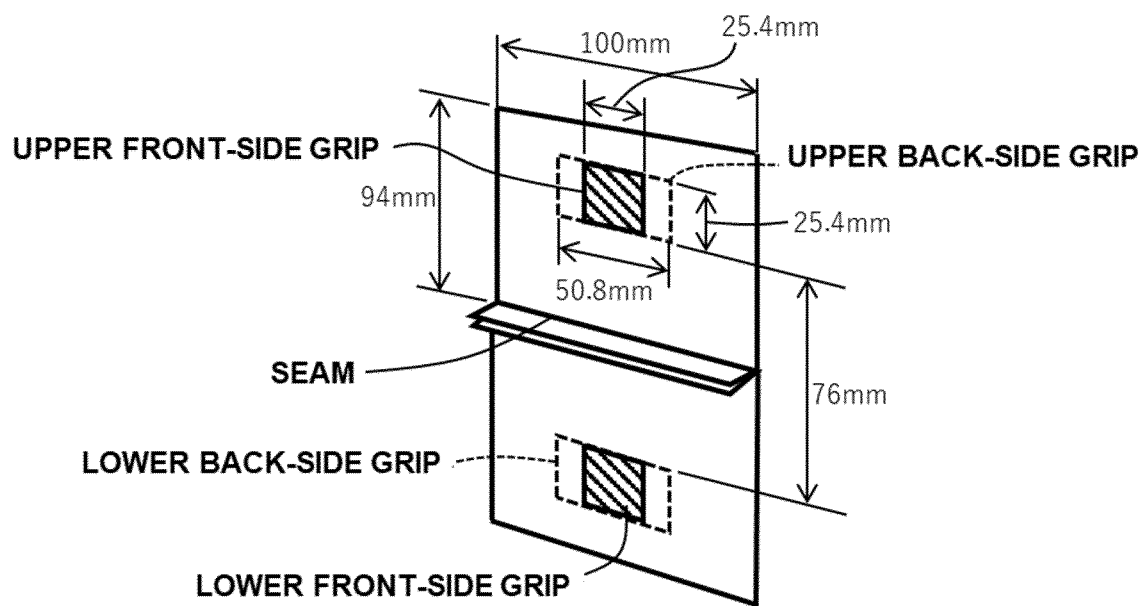


FIG. 9

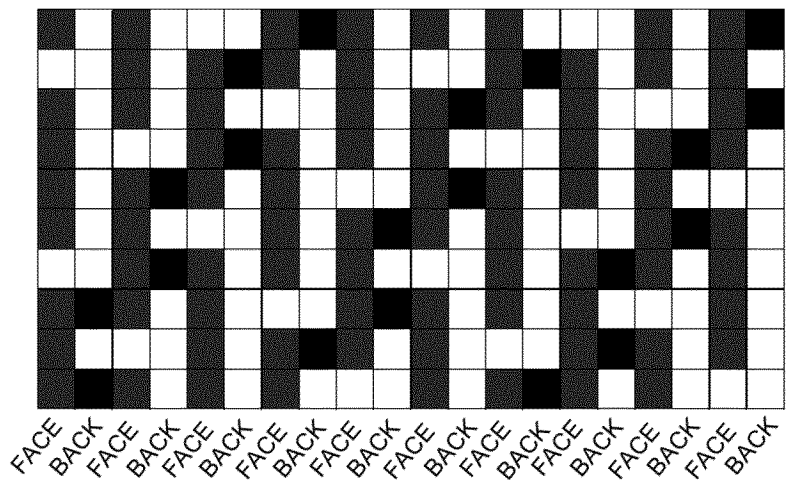


FIG. 10

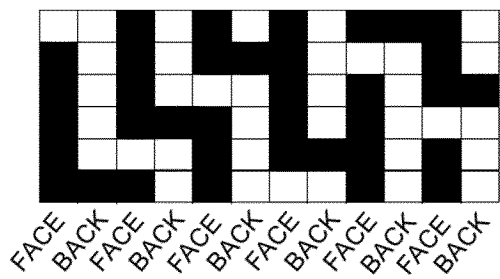


FIG. 11

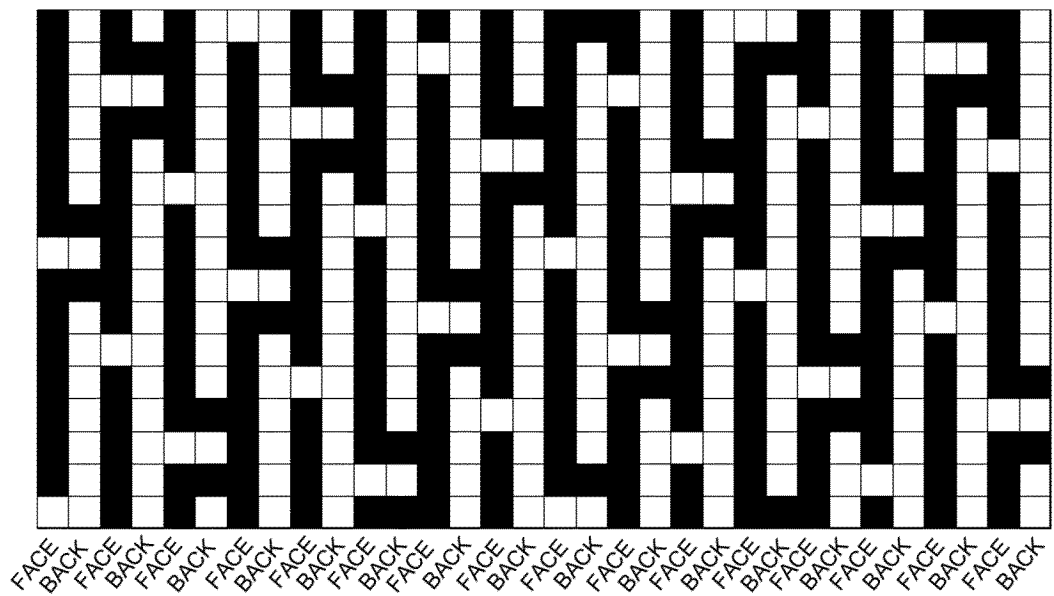


FIG. 12

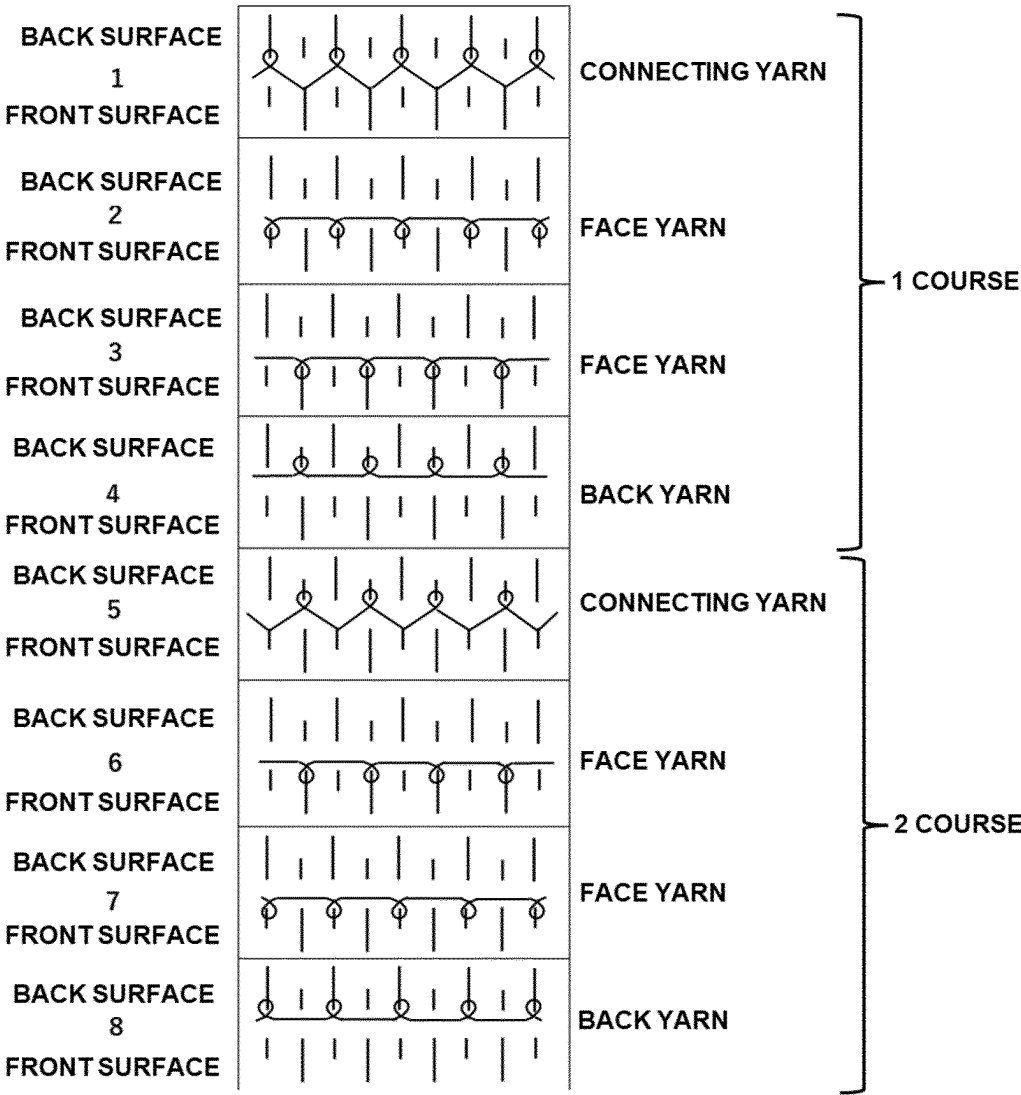
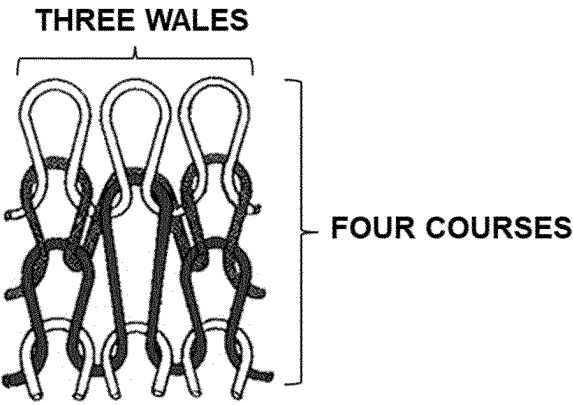


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/017074

A. CLASSIFICATION OF SUBJECT MATTER

D06N 3/00(2006.01)i; **D06N 3/14**(2006.01)i
FI: D06N3/00; D06N3/14

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)

D03D1/00-27/18, D04B1/00-1/28, D04B21/00-21/20, D06N1/00-7/06

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 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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

JSTPlus/JMEDPlus/JST7580 (JDreamIII)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2016/098324 A1 (SEIREN CO LTD) 23 June 2016 (2016-06-23) example 5, fig. 4	1-4, 6-10
Y	JP 63-135570 A (UNITIKA LTD) 07 June 1988 (1988-06-07) example 2	1, 2, 5-10
Y	JP 02-277890 A (TEIJIN CORDLEY LTD) 14 November 1990 (1990-11-14) p. 1, lower right column, lines 2-4, examples	1-10
Y	JP 2013-147758 A (TB KAWASHIMA CO LTD) 01 August 2013 (2013-08-01) paragraphs [0001], [0022], examples	1-10
Y	JP 03-080914 B2 (TORAY INDUSTRIES) 26 December 1991 (1991-12-26) claims, p. 1, lower right column, lines 3-6, examples	8, 9
Y	JP 2014-156668 A (KURARAY CO LTD) 28 August 2014 (2014-08-28) [0006]	8, 9
Y	JP 58-065076 A (ASAHI KASEI TEXTILE KK) 18 April 1983 (1983-04-18) examples	10



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Date of the actual completion of the international search

04 July 2023

Date of mailing of the international search report

18 July 2023

Name and mailing address of the ISA/JP

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Telephone No.

INTERNATIONAL SEARCH REPORT

International application No

PCT/JP2023/017074

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2022-030903 A (KYOWA LEATHER CLOTH) 18 February 2022 (2022-02-18)	1-10

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/017074

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO	2016/098324	A1	23 June 2016	US 2017/0342658 A1 example 5, fig. 4 EP 3235946 A1 CN 107109784 A	
JP	63-135570	A	07 June 1988	(Family: none)	
JP	02-277890	A	14 November 1990	(Family: none)	
JP	2013-147758	A	01 August 2013	(Family: none)	
JP	03-080914	B2	26 December 1991	(Family: none)	
JP	2014-156668	A	28 August 2014	(Family: none)	
JP	58-065076	A	18 April 1983	(Family: none)	
JP	2022-030903	A	18 February 2022	(Family: none)	

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Patent documents cited in the description

- JP 2022027095 A [0004]
- JP 2013147758 A [0004]
- JP 2019112744 A [0004]