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(54) WOVEN FABRIC

(57) An object of the present invention is to provide a woven fabric that hardly causes yarn slippage due to friction, is excellent in abrasion resistance, has a smooth surface, and is excellent in touch feeling. The present invention provides a woven fabric including a warp and a weft, at least one of the warp and the weft being at least partially a fiber (M) that is a monofilament 1, a fiber (N) crossing the fiber (M) being at least partially a multifilament 2, the woven fabric satisfying either one of the following (1) and (2):
(1) the monofilament 1 is fused to the multifilament 2, and the woven fabric satisfies both the following (A) and (B) :

$$1.0 \leq a/L \leq 1.5 \quad \cdots (A)$$

$$0.5 \leq h/b \leq 1.0 \quad \cdots (B);$$

and
(2) the monofilament 1 is not fused to the multifilament 2, and the woven fabric satisfies both the following (C) and (D) :

$$1.0 \leq a/L \leq 1.5 \quad \cdots (C)$$

$$0.7 \leq h/b \leq 1.0 \quad \cdots (D)$$

a: length of the multifilament 2 in a cross section thereof in a direction of woven fabric surface;
b: length of the multifilament 2 in a cross section thereof in a direction of woven fabric thickness;
L: center-to-center distance between filaments of the multifilament 2 adjacent across the fiber (M); and

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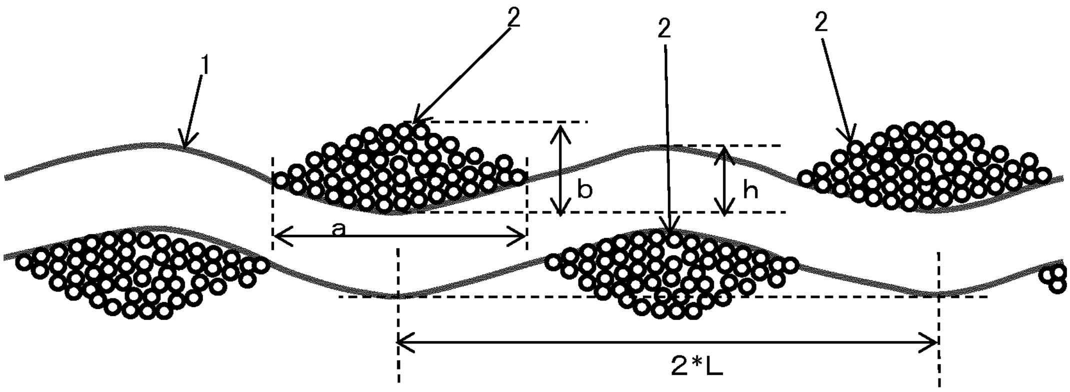
h: crimp height of the monofilament 1.

Fig.1



Description

TECHNICAL FIELD

[0001] The present invention relates to a woven fabric. More particularly, the present invention relates to a woven fabric that can be preferably used in shoes, work clothes, bags and the like, and that is excellent in abrasion resistance and touch feeling.

BACKGROUND ART

[0002] Various kinds of fabrics have been proposed in which either one of a warp and a weft is at least partially a monofilament, and a fiber crossing a fiber including the monofilament is at least partially a multifilament. For example, Patent Document 1 discloses a mesh body including a polypropylene multifilament as, for example, a warp, and a core-sheath composite polypropylene monofilament as a weft. The mesh body is obtained by melting the core-sheath composite polypropylene monofilament with the sheath melting temperature set at a temperature higher than the core melting temperature, weaving the warp and weft, and heating the resultant to melt the polypropylene in the sheath section for fixing the warp and the weft together.
[0003] Moreover, Patent Document 2 discloses an abrasion-resistant woven fabric for a skin material that has a soft texture, including a polytrimethylene terephthalate multifilament as a weft and a polytrimethylene terephthalate monofilament as a warp (Example 6 of Patent Document 3).
[0004] In addition to the above, Patent Document 3 proposes, as a fabric improved in abrasion resistance, a fabric including a core-sheath composite fiber. The core-sheath composite fiber contains a polymer forming a core section and a polymer in a sheath section, which has a melting point lower than that of the polymer in the core section, and the sheath section is thermally fused to fix the fiber filaments together, so that the fabric is suppressed in the occurrence of yarn slippage.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0005]

Patent Document 1: Japanese Patent Laid-open Publication No. 11-200178
Patent Document 2: Japanese Patent Laid-open Publication No. 2002-201548
Patent Document 3: Japanese Patent Laid-open Publication No. 2010-236116

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] Conventionally, in fabric products such as shoes, work clothes, and bags, fabrics are layered, or processed fabrics having a coating of a synthetic rubber or the like, or artificial leather coated with urethane or the like is used in cuffs, protrusions, and corners that are frequently rubbed in order to resist repeated friction. Either of the methods has problems that the resultant fabric product is thick and heavy, low in air permeability, and poor in touch feeling, and that the cost increases due to such processing. Therefore, a fabric that is excellent in abrasion resistance and touch feeling, and also has lightweight properties and air permeability has been desired.
[0007] Since the woven fabric disclosed in Patent Document 1 is intended for construction work, Patent Document 1 does not consider the touch feeling of the woven fabric, and does not disclose any specific structure of a woven fabric good in touch feeling.
[0008] Moreover, although Patent Document 2 describes, about the woven fabric for a skin material disclosed therein, physical properties of the polytrimethylene terephthalate fiber and the elastic recovery of the woven fabric, the document is silent on any simple evaluation index in the actual weaving. It is impossible to obtain a woven fabric excellent in abrasion resistance and soft texture by carrying out the disclosure of Patent Document 2 as it is.
[0009] In the fabric disclosed in Patent Document 3, although the yarn slippage is suppressed due to the fused and fixed fiber filaments crossing each other and the fabric is improved in abrasion resistance, the fabric is poor in touch feeling since the fused and solidified fiber filament contacts another fiber filament that is rubbed thereon.
[0010] An object of the present invention is to solve the above-mentioned problems of the conventional techniques, and to provide a woven fabric that is excellent in abrasion resistance against repeated sliding, good in touch feeling,

and suitable for a fabric product.

SOLUTIONS TO THE PROBLEMS

[0011] A first invention that is made in order to solve the above-mentioned problems is
a woven fabric including a warp and a weft,
at least one of the warp and the weft being at least partially a fiber (M) that is a monofilament 1,
a fiber (N) crossing the fiber (M) being at least partially a multifilament 2,
the woven fabric satisfying either one of the following conditions (1) and (2) (the first invention):

[0012]

(1) the monofilament 1 is fused to the multifilament 2, and a multifilament coverage ratio a/L and a monofilament concealment ratio h/b satisfy both the formulae (A) and (B):

$$1.0 \leq a/L \leq 1.5 \quad \cdots \text{(A)}$$

$$0.5 \leq h/b \leq 1.0 \quad \cdots \text{(B)};$$

and

(2) the monofilament 1 is not fused to the multifilament 2, and the multifilament coverage ratio a/L and the monofilament concealment ratio h/b satisfy both the formulae (C) and (D) :

$$1.0 \leq a/L \leq 1.5 \quad \cdots \text{(C)}$$

$$0.7 \leq h/b \leq 1.0 \quad \cdots \text{(D)}$$

wherein a, b, L, and h each have the following meanings:

a: length of the multifilament 2 in a cross section thereof in a direction of woven fabric surface;
b: length of the multifilament 2 in a cross section thereof in a direction of woven fabric thickness;
L: center-to-center distance between filaments of the multifilament 2 adjacent across the fiber (M); and
h: crimp height of the monofilament 1.

[0013] In a more preferable aspect, in the woven fabric according to the first invention, the multifilament 2 has a cover factor of 800 or more and 1200 or less (a second invention).

[0014] In another preferable aspect, in the woven fabric according to either one of the above-mentioned inventions, the multifilament 2 has a twist coefficient of 0 or more and 10000 or less (a third invention).

[0015] In another preferable aspect, in the woven fabric according to any one of the above-mentioned inventions, the monofilament 1 has a flexural rigidity of 1 cN or more and 6 cN or less (a fourth invention).

[0016] In another preferable aspect, in the woven fabric according to any one of the above-mentioned inventions, the monofilament 1 is a core-sheath composite yarn in which a sheath component has a melting point that is at least 10°C lower than that of a core component (a fifth invention).

[0017] In another preferable aspect, the woven fabric according to any one of the above-mentioned inventions shows, in the abrasion test according to JIS L1096 (2010) 8.19.3, method C, a weight reduction after 4000 times less than 0.5 g, and no hole (a sixth invention).

[0018] In another preferable aspect, the woven fabric according to any one of the above-mentioned inventions has a mean friction coefficient MIU as a KES surface friction property value of 0.10 to 0.42, and a deviation of mean friction coefficient MMD of 0.01 to 0.07 (a seventh invention).

EFFECTS OF THE INVENTION

[0019] According to the first invention, it is possible to achieve a state in which the monofilament having an advantage of ensuring the abrasion resistance and the multifilament having an advantage of ensuring the touch feeling are suitably arranged, and a woven fabric excellent in abrasion resistance and touch feeling is provided. Further, the monofilament and the multifilament of the present invention are fused together to satisfy the above-mentioned condition (1), or are not fused together to satisfy the above-mentioned condition (2), so that the yarn slippage of the woven fabric is effectively suppressed, and the woven fabric is further improved in abrasion resistance. It is also possible to provide a woven fabric in which proper arrangement of the warp and weft is hardly disturbed, and which maintains a good touch feeling.

[0020] According to the second invention, a cover factor of the multifilament within the specific range gives an appropriate binding force between the warp and the weft, and maintains the crimp shape of the multifilament well. As a result, a woven fabric that is excellent in lightweight properties and durability, and is also good in touch feeling and air permeability is provided.

[0021] According to the third invention, a twist coefficient of the multifilament within the specific range easily gives a flat sectional shape of the multifilament, and ensures a large contact area with the monofilament. As a result, a large number of single yarns are in contact with the monofilament. Since the force applied to one single yarn is distributed, the single yarn breakage hardly occurs, and a woven fabric more excellent in abrasion resistance and good in touch feeling is provided.

[0022] According to the fourth invention, a flexural rigidity of the monofilament within the specific range can suppress the occurrence of yarn slippage due to a low flexural rigidity of the monofilament. At the same time, it is possible to prevent yarn slippage due to insufficient yarn binding force, which is caused by the deterioration of crimp shape maintaining performance due to an excessively high flexural rigidity, and to prevent the deterioration of abrasion resistance due to a low monofilament concealment ratio h/b.

[0023] According to the fifth invention, it is possible to easily provide a woven fabric excellent in abrasion resistance and touch feeling without the use of a fusing agent for fusing the warp and the weft together.

[0024] According to the sixth invention, it is possible to provide a woven fabric excellent in durability against friction in fabric products such as shoes, work clothes, and bags.

[0025] According to the seventh invention, it is possible to provide a woven fabric having a smooth surface and good in touch feeling in fabric products such as shoes, work clothes, and bags.

[0026] As described above, since the woven fabric of the present invention is excellent in abrasion resistance and good in touch feeling, the woven fabric can be suitably used alone in fabric products to be worn, such as shoes, work clothes, and bags, and personal fabric products. Moreover, the application of the woven fabric is not limited to the above, and the woven fabric can be used in various fabric products for which abrasion resistance and soft tactile sensation are required, such as a skin material for a vehicle seat.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 is a schematic cross-sectional view of a woven fabric that gives an outline of measurement sites for obtaining a multifilament coverage ratio and a monofilament concealment ratio.

Fig. 2 is a schematic cross-sectional view for illustrating the definitions of the length a of the multifilament in a cross section thereof in a direction of woven fabric surface, and the length b of the multifilament in a cross section thereof in a direction of woven fabric thickness, in the case where the woven fabric has a plain weave structure.

Fig. 3 is a schematic cross-sectional view for illustrating the definitions of the length a of the multifilament in a cross section thereof in a direction of woven fabric surface, and the length b of the multifilament in a cross section thereof in a direction of woven fabric thickness, in the case where the woven fabric has a 2/2 twill woven fabric structure.

Fig. 4 is a schematic cross-sectional view for illustrating the definitions of the center-to-center distance L between adjacent filaments of the multifilament, and the crimp height h of the monofilament, in the case where the woven fabric has a plain weave structure.

Fig. 5 is a schematic cross-sectional view for illustrating the definitions of the center-to-center distance L between adjacent filaments of the multifilament, and the crimp height h of the monofilament, in the case where the woven fabric has a 2/2 twill woven fabric structure.

EMBODIMENTS OF THE INVENTION

[0028] Hereinafter, the present invention will be described in detail.

[0029] The woven fabric of the present invention is a woven fabric including a warp and a weft, at least one of the warp and the weft being at least partially a fiber (M) that is a monofilament 1, a fiber (N) crossing the fiber (M) being at least partially a multifilament 2, the woven fabric satisfying either one of the following conditions (1) and (2):

[0030]

(1) the monofilament 1 is fused to the multifilament 2, and a multifilament coverage ratio a/L and a monofilament concealment ratio h/b satisfy both the formulae (A) and (B):

$$1.0 \leq a/L \leq 1.5 \quad \cdots (A)$$

$$0.5 \leq h/b \leq 1.0 \quad \cdots (B);$$

and
(2) the monofilament 1 is not fused to the multifilament 2, and the multifilament coverage ratio a/L and the monofilament concealment ratio h/b satisfy both the formulae (C) and (D) :

$$1.0 \leq a/L \leq 1.5 \quad \cdots (C)$$

$$0.7 \leq h/b \leq 1.0 \quad \cdots (D)$$

wherein a, b, L, and h each have the following meanings:

a: length of the multifilament 2 in a cross section thereof in a direction of woven fabric surface;
b: length of the multifilament 2 in a cross section thereof in a direction of woven fabric thickness;
L: center-to-center distance between filaments of the multifilament adjacent across the fiber (M); and
h: crimp height of the monofilament.

[0031] Detailed definitions of a, b, L, and h are as follows. In the following, the description will be made with reference to Figs. 1 to 5. Fig. 1 is a schematic cross-sectional view of a woven fabric that gives an outline of measurement sites for obtaining a multifilament coverage ratio and a monofilament concealment ratio. Fig. 1 shows a cut surface of the woven fabric that is obtained by cutting a multifilament 2, which crosses a fiber including a monofilament 1 included in a warp or a weft of the woven fabric, in a direction parallel to the longitudinal direction of the fiber including the monofilament 1.

[0032] Fig. 2 is a schematic cross-sectional view for illustrating the definitions of the length a of the multifilament 2 in a cross section thereof in a direction of woven fabric surface, and the length b of the multifilament 2 in a cross section thereof in a direction of woven fabric thickness, in the case where the woven fabric has a plain weave structure. The woven fabric is cut in the same direction as in Fig. 1.

[0033] Fig. 3 is a schematic cross-sectional view for illustrating the definitions of the length a of the multifilament 2 in a cross section thereof in a direction of woven fabric surface, and the length b of the multifilament 2 in a cross section thereof in a direction of woven fabric thickness, in the case where the woven fabric has a 2/2 twill woven fabric structure. The woven fabric is cut in the same direction as in Fig. 1 although the weave structure is different.

[0034] Fig. 4 is a schematic cross-sectional view for illustrating the definitions of the center-to-center distance L between adjacent filaments of the multifilament, and the crimp height h of the monofilament 1, in the case where the woven fabric has a plain weave structure. The woven fabric is cut in the same direction as in Fig. 1.

[0035] Fig. 5 is a schematic cross-sectional view for illustrating the definitions of the center-to-center distance L between adjacent filaments of the multifilament, and the crimp height h of the monofilament, in the case where the woven fabric has a 2/2 twill woven fabric structure. The woven fabric is cut in the same direction as in Fig. 3.

[0036] First, the lengths a and b will be described.

[0037] See Figs. 2 and 3. A rectangle is simulated, which surrounds a cross section of one filament of the multifilament 2, two parallel sides of which are in contact with the cross section of the filament of the multifilament 2, and the other two parallel sides of which lie in the thickness direction of the multifilament 2 and a direction perpendicular thereto (that is, the direction of the woven fabric surface) . The length of the side along the direction of the woven fabric surface is defined as the length a of the multifilament 2 in a cross section thereof in the direction of the woven fabric surface, and the length of the side along the direction perpendicular to the direction of the woven fabric surface is defined as the length b of the multifilament 2 in a cross section thereof in the direction of woven fabric thickness.

[0038] Then, L will be described.

[0039] See Figs. 4 and 5. In one filament of the monofilament 1 in contact with the multifilament in the thickness direction, a distance between two adjacent crimp apexes C1 and C2 is defined as 2*L, and a length of half of 2*L is defined as the center-to-center distance L between adjacent filaments of the multifilament.

[0040] Finally, h will be described.

[0041] See Figs. 4 and 5. A rectangle is formed with an upper side that is the line of the distance 2L between the adjacent crimp apexes C1 and C2 of one filament of the monofilament, and a line that is parallel to the upper side and is in contact with the bottom B of a multifilament (a point at which the multifilament is in contact with the monofilament in the direction of the woven fabric thickness). The height of the rectangle (the length of the side of the rectangle close to the thickness direction) is defined as the crimp height h of the monofilament.

[0042] As described above, the woven fabric of the present invention includes a warp and a weft, at least one of the warp and the weft is at least partially a fiber (M) including a monofilament 1, and a fiber (N) crossing the fiber (M) at least partially includes a multifilament 2. In particular, it is preferable that a fiber of either one of the warp and the weft be substantially a monofilament, and a fiber crossing the above-mentioned fiber be substantially a multifilament. The wording "substantially" means that a small amount of other fibers may be used in combination for design and other reasons. For example, up to 20% by mass, or up to 10% by mass of other fibers may be used in combination. That is, it is preferable that the fiber (M) include 80% by mass or more, more preferably 90% by mass or more of the monofilament 1. Further, it is preferable that the fiber (N) include 80% by mass or more, more preferably 90% by mass or more of the multifilament 2.

[0043] A multifilament is a bundle made of a plurality of fiber filaments. Since a multifilament has a single yarn diameter that is smaller than the total fineness, a multifilament exposed to the woven fabric surface can give a soft tactile sensation when being brought into contact with the skin. The single yarn of the multifilament, however, is easily broken due to abrasion. On the other hand, a monofilament is made of a single fiber filament, has a large single yarn diameter, and is hardly deformed in the fiber diameter even when crushed. Therefore, a monofilament exposed to the woven fabric surface tends to give a hard and rough texture of the surface when touched, but is hardly broken due to abrasion. The present invention provides a woven fabric having both abrasion resistance against repeated friction and a soft touch feeling by the use of fibers having these contradictory properties, adoption of the parameters of the monofilament concealment ratio and the multifilament coverage ratio, and optimization of both the parameters.

[0044] In the woven fabric of the present invention, when the multifilament coverage ratio a/L is 1.0 or more and 1.5 or less and the monofilament is fused to the multifilament, the monofilament concealment ratio h/b is 0.5 or more and 1.0 or less.

[0045] The multifilament coverage ratio a/L represents the ratio of exposure between the multifilament and the monofilament on the woven fabric surface. Since a monofilament has a large single yarn diameter, and is hardly deformed in the fiber diameter when being brought into contact with the skin, a monofilament tends to give a hard and rough texture of the surface when touched. When a/L is within the above-mentioned range, the surface of the woven fabric is covered with the multifilament 2 having a small single yarn diameter and a soft tactile sensation, the area of the exposed monofilament 1 is reduced, and a soft touch feeling can be obtained. If a/L is less than 1.0, the monofilament 1 contacts the skin too strongly, so that the woven fabric tends to be poor in touch feeling. On the other hand, if a/L is more than 1.5, the abraded surface cannot be supported by the crimp-shaped apex portions of the monofilament 1, and many single yarns of the multifilament 2 are abraded, so that the woven fabric tends to be poor in abrasion resistance. a/L is preferably from 1.2 to 1.4.

[0046] The monofilament concealment ratio h/b represents the ratio of exposure height between the multifilament 2 and the monofilament 1 in the direction of woven fabric thickness. Since the multifilament 2 has a small single yarn diameter and is easily broken due to abrasion, if b is too much larger than h, the woven fabric tends to be poor in abrasion resistance. When h/b is within the above-mentioned range, the abraded surface is supported by the crimp-shaped apex portions of the tough monofilament 1, the multifilament 2 is concealed in the valleys of the monofilament 1, and the multifilament 2 is protected from the abrasion. As a result, the woven fabric is excellent in abrasion resistance. When a surface of a woven fabric is rubbed, the diameter of the fiber bundle shape of the multifilament 2 is crushed to a certain extent by the load of rubbing. Therefore, when h/b is within the above-mentioned range, even if b is larger than h, it is possible to impart sufficient abrasion resistance and a soft touch feeling to the woven fabric. When the monofilament 1 is fused to the multifilament 2, if h/b is less than 0.5, the abraded surface cannot be supported by the crimp-shaped apex portions of the monofilament, and many single yarns of the multifilament 2 are abraded, so that the woven fabric tends to be poor in abrasion resistance. On the other hand, if h/b exceeds 1.0, the monofilament 1 contacts the skin too strongly, so that the woven fabric is poor in touch feeling. Therefore, when the monofilament 1 is fused to the multifilament 2, h/b is within the range of 0.5 to 1.0. h/b is preferably from 0.7 to 0.9.

[0047] The multifilament coverage ratio a/L and the monofilament concealment ratio h/b can be adjusted within the specific ranges by adjusting the degree of crimping through the adjustment and weaving of the filaments and thermal processing conditions after the weaving. As for the filaments, the material, intrinsic viscosity, fineness, stretch ratio, stretching temperature, relaxation ratio, relaxation temperature, cross-sectional shape, weaving density, and flexural rigidity of the monofilament, and the material, twist coefficient, fineness, weaving density, and flexural rigidity of the multifilament are adjusted. In the weaving, the warp tension and weft tension are adjusted. In the heat setting, the longitudinal shrinkage ratio and the transverse shrinkage ratio are adjusted. In addition, when the monofilament 1 is not fused to the multifilament 2, the force of binding the multifilament 2 is weaker than in the case where the monofilament 1 is fused to the multifilament 2, and many single yarns of the multifilament 2 are abraded during the rubbing. Thus, this case is disadvantageous in terms of abrasion resistance. Therefore, in addition to the multifilament coverage ratio a/L of 1.0 or more and 1.5 or less, the monofilament concealment ratio h/b is adjusted to 0.7 or more and 1.0 or less to avoid too small a concealment ratio. The monofilament concealment ratio is preferably from 0.8 to 0.9.

[0048] In the present invention, the warp or the weft including the multifilament preferably has a cover factor of 800 or more and 1200 or less, more preferably 1000 or more and 1200 or less. Herein, the cover factor is a value calculated as follows.

$$(\text{Cover factor}) = (\text{density: number of yarns}/2.54\ \text{cm}) \times \sqrt{(\text{fineness: dtex})}$$

[0049] If the cover factor of the multifilament is small, the binding force between the warp and the weft is insufficient, yarn slippage occurs during the abrasion, and desired durability is hardly obtained. On the other hand, if the cover factor of the multifilament is too large, the crimp shape of the monofilament tends to be flat, and as a result, desired durability is hardly obtained.

[0050] In the present invention, the material of the multifilament is not particularly limited, and polyethylene terephthalate, polybutylene terephthalate, polypropylene terephthalate, polyamides, polypropylene, polyethylene, polyphenylene sulfide, acrylic and the like can be suitably used as a base polymer. In particular, polyethylene terephthalate (PET) can be suitably used as a base polymer from the viewpoint of strength. If necessary, the base polymer can be used after being modified, for example, in the form of a copolymer with other components, or a composition containing other components. For example, a cation-dyeable polyester capable of being dyed with a cationic dye, which is obtained by introducing a sulfonic acid group into PET or the like, is suitable since it gives a multifilament excellent in strength and coloring properties. A suitable commercial product of such a cation-dyeable polyester yarn is, for example, LOCII manufactured by TORAY INDUSTRIES, INC.

[0051] The multifilament used in the present invention may include a twisted yarn, a false twisted yarn, a Taslan textured yarn, or an air textured yarn as long as the object of the present invention is not impaired. However, when a bulky multifilament including a Taslan textured yarn or an air textured yarn is used, care must be taken because the multifilament may be poor in abrasion resistance due to too large a length b of the multifilament in a cross section thereof in the direction of woven fabric thickness. Further, apart from the textured yarns, additives such as a flame retardant, an antistatic agent, a weathering agent, a pigment, and a matting agent may be mixed as other materials. A pre-dyed yarn that has been dyed in advance may also be used as the multifilament.

[0052] The single yarn fineness of the multifilament is desirably 1 dtex or more and 10 dtex or less, more desirably 2 dtex or more and 6 dtex or less. When the single yarn fineness of the multifilament is 1 dtex or more, the required flexural rigidity is easily ensured, and the crimp shape of one of the yarns is easily formed. When the single yarn fineness of the multifilament is 10 dtex or less, the multifilament hardly has a stiff touch feeling, and a soft texture is easily obtained.

[0053] The total fineness of the multifilament is desirably 100 dtex or more and 2000 dtex or less, more desirably 150 dtex or more and 1700 dtex or less, still more desirably 300 dtex or more and 1000 dtex or less. When the total fineness of the multifilament is 100 dtex or more, the required flexural rigidity is easily ensured. When the total fineness of the multifilament is 2000 dtex or less, handling in woven fabric production is easy.

[0054] A fiber yarn having a multifilament strength of 3.0 cN/dtex or more is preferably used from the viewpoint of the strength of the woven fabric. The condition of strength is preferably a high strength, and a fiber yarn having a strength within the range of 5.0 cN/dtex or more and 15.0 cN/dtex or less is practically more preferable.

[0055] In the present invention, the multifilament preferably has a twist coefficient of 0 or more and 10000 or less and is in a weakly twisted state, more preferably has a twist coefficient of 0 or more and 8500 or less. Herein, the twist coefficient is obtained by the following formula.

$$(\text{Twist coefficient}) = (\text{number of twists: T/m}) \times \sqrt{(\text{fineness: dtex})}$$

[0056] A twist coefficient of the multifilament within the above-mentioned range gives a multifilament having a flat cross-sectional shape. The multifilament has a large contact area with the monofilament crossing the multifilament, and a large number of single yarns are in contact with the monofilament. As a result, the force applied to the single yarns of the multifilament is distributed, so that single yarn breakage hardly occurs and the multifilament tends to be improved in abrasion resistance. In addition, the multifilament coverage ratio a/L is large, and the woven fabric is good in touch feeling. Conversely, if the twist coefficient of the multifilament is more than 10000, the range of yarns that can come into contact with the monofilament is narrow, and the number of single yarns that do not contact the monofilament is large, so that yarn slippage easily occurs and the multifilament tends to be poor in abrasion resistance.

[0057] When a woven fabric shows a weight reduction less than 0.5 g and no hole in the abrasion test, it is preferable because the woven fabric has desired durability, and a woven fabric with long life can be provided to users. The weight reduction is more preferably less than 0.4 g. If the weight reduction exceeds 0.5 g or a hole is generated in the abrasion test, the targeted durability cannot be obtained. The abrasion test herein is carried out according to JIS L1096 (2010) 8.19.3, method C (JIS Handbook 2013) by 4000 times of abrasion with a Taber abrasion tester under conditions of a load of 250 g, an abrasive wheel H-18, and a disc diameter of 100 mm.

[0058] The mean friction coefficient MIU as a KES surface friction property value represents the slipperiness of the sample surface. The larger the value is, the less slippery the surface is. The deviation of friction coefficient (MMD) represents the roughness and irregular texture of the sample surface. The larger the value is, the rougher the surface is. It is preferable that the woven fabric have a mean friction coefficient MIU as a KES surface friction property value of 0.10 to 0.42, and a deviation of mean friction coefficient MMD of 0.01 to 0.07. More preferably, the woven fabric has a mean friction coefficient MIU of 0.20 to 0.40, and a deviation of mean friction coefficient MMD of 0.02 to 0.065. Still more preferably, the woven fabric has a mean friction coefficient MIU of 0.25 to 0.38, and a deviation of mean friction coefficient MMD of 0.025 to 0.060.

[0059] In the present invention, the monofilament 1 preferably has a flexural rigidity of 1 cN or more and 6 cN or less. When the flexural rigidity of the monofilament 1 is 1 cN or more, the monofilament plays a role of a framework to prevent the occurrence of yarn slippage during the rubbing, and the monofilament is good in abrasion resistance. When the flexural rigidity is 6 cN or less, the monofilament is not too rigid and easily forms a crimp shape, so that a sufficient binding force of the yarn is obtained to prevent the occurrence of yarn slippage during the rubbing, or a high monofilament concealment ratio b/h gives good abrasion resistance.

[0060] In the present invention, the material of the monofilament is not particularly limited, and polyesters such as polyethylene terephthalate, polybutylene terephthalate, and polypropylene terephthalate, polyolefins such as polyamides, polypropylene, and polyethylene, polyphenylene sulfide, polyester elastomers, polysulfide elastomers, and polyurethane elastomers can be suitably used as a base polymer. However, when a material having a low flexural rigidity is used as a base polymer to form a monofilament, it is easy to form a desired crimp shape even when a thinner multifilament is used, and thus, a thinner and lighter woven fabric can be obtained. From such a viewpoint, an elastic yarn made from an elastomer such as a polyester elastomer, a polysulfide elastomer, or a polyurethane elastomer as a base polymer can be more suitably used, and an elastic yarn made from a polyester elastomer as a base polymer can be still more suitably used.

[0061] As the polyester elastomer, one having a hard segment and a soft segment in the molecular structure is preferable. The hard segment preferably includes, as a main constituent unit, an aromatic polyester unit mainly formed from an aromatic dicarboxylic acid or an ester-forming derivative thereof and a diol or an ester-forming derivative thereof. Meanwhile, the soft segment preferably includes, as a main constituent unit, an aliphatic polyether unit and/or an aliphatic polyester unit and a diol.

[0062] In general, of filaments made from the same polymer, a filament having a lower fineness tends to have a lower flexural rigidity, and a multifilament tends to have a lower flexural rigidity than a monofilament does if they have the same total fineness. A filament having a lower flexural rigidity tends to easily form crimps. In the present invention, from the viewpoint of maintaining an appropriate balance of crimps between the monofilament and the multifilament in a woven fabric to increase the binding force of the yarn, and of controlling the balance of exposure between the multifilament and the monofilament, the range of fineness of the monofilament is preferably 0.2 times or more and 1.5 times or less, more preferably 0.3 times or more and 1.0 time or less, still more preferably 0.4 times or more and 0.8 times or less the total fineness of the multifilament. When the fineness of the monofilament is 0.2 times or more the total fineness of the multifilament, the multifilament is easily bent due to the rigidity and tension of the monofilament. When the fineness of the monofilament is 1.5 times or less the total fineness of the multifilament, the monofilament is easily bent due to the rigidity and tension of the multifilament. As a result, crimps of both the yarns are easily formed in an appropriate balance.

[0063] In an embodiment of the present invention, when the woven fabric is required to have air permeability, the warp and the weft that constitute the woven fabric are preferably fused together to the extent that the air permeability is not impaired. When the warp and the weft are fused together, yarn slippage hardly occurs, and the woven fabric is improved in abrasion resistance. However, fusing the surface layer of the multifilament is not preferable because the soft touch feeling tends to be impaired.

[0064] The monofilament 1 may be a composite yarn such as a core-sheath composite yarn, or a non-composite yarn entirely made from a single material. In the case of fusing either one of a warp and a weft that is a monofilament with a multifilament used in at least a part of a warp or a weft other than the monofilament, it is preferable that the monofilament be a core-sheath composite yarn. In this case, it is desirable that the material that constitutes the sheath component of the monofilament have a melting point that is at least 10°C lower than that of the material that constitutes the core component of the monofilament. Usually, it is desirable that the entire sheath section of the monofilament be fused to the other yarn. However, if the sheath component of the monofilament has a melting point that is lower than the melting point of the core component of the monofilament + 10°C, when the heat setting temperature exceeds the melting point of the core component, the core component also melts during the heat setting, and the strength or the fused portion may decrease. It is to be noted that the monofilament that is the above-mentioned core-sheath composite yarn or a non-composite yarn can also be used when the yarns are not fused together.

[0065] When the monofilament has a core-sheath structure, the materials of the core component and the sheath component may be of the same kind or different from each other. However, it is preferable that the core component and the sheath component contain the same component, and it is more preferable that the core component and the sheath component are made from the same component, from the viewpoint of enhancing the adhesion between the core component and the sheath component. In particular, it is more preferable that each of the core component and the sheath component be a copolymer composed of a plurality of constituent components including common constituent components, and that the core component and the sheath component be different in the melting point due to different composition ratios or the like of the plurality of constituent components.

[0066] In particular, it is most preferable from the viewpoint of adhesion in the heat setting and yarn strength to employ a core-sheath composite fiber having a core component made from a polyester elastomer having a melting point of 190 to 250°C and a sheath component made from a polyester elastomer having a melting point of 140 to 190°C.

[0067] The basis weight of the woven fabric of the present invention is desirably within the range of 100 to 500 g/m^2, more desirably from 100 to 300 g/m^2, still more desirably from 100 to 200 g/m^2. When the basis weight is 100 g/m^2 or more, the required durability is easily obtained. On the other hand, when the basis weight is 500 g/m^2 or less, the advantages of light weight are easily obtained.

[0068] The woven fabric of the present invention can be basically produced by an ordinary method including, for example, 1) twisting of a multifilament, 2) weaving, and 3) heat treatment.

[0069] Although an effect is produced even without the heat treatment, it is more desirable to perform the heat treatment to fuse one of the yarns to the multifilament. When the woven fabric of the present invention is produced using a monofilament having a core-sheath structure in which the sheath section has a melting point that is at least 10°C lower than that of the core section, it is preferable that the heat treatment temperature be higher than the melting point of the sheath section and lower than the melting point of the core section. The heat treatment can be performed at a temperature of 150 to 220°C for 30 to 120 seconds, for example.

[0070] In an embodiment of the present invention, the woven fabric structure may be appropriately selected according to the application from the structures such as a plain weave structure, a twill weave structure, a satin weave structure, and a double weave structure combining these structures. The plain weave structure is preferable since the warp and the weft bind each other at many points, and the woven fabric hardly causes yarn slippage. The plain weave structure is also good in handling properties such as prevention of frays. Further, the weaving method and the loom to be used are not particularly limited as long as the woven fabric of the present invention can be obtained, and may be appropriately selected.

[0071] The weaving conditions for obtaining the woven fabric within the range defined in the present invention depend on the properties of the used fibers. For example, when focusing on the warp tension and the weft tension, it is difficult to limit the tensions within specific ranges since they vary depending on the properties of the used fibers and the combination thereof. However, these tensions act on the fibers mutually, have an effect on the crimp shapes of the warp and the weft, and thereby change the multifilament coverage ratio a/L and the monofilament concealment ratio h/b. When the warp tension is low or the weft tension is high, the warp crimp tends to be small and the weft crimp tends to be large. When the warp tension is high or the weft tension is low, the warp crimp tends to be large and the weft crimp tends to be small.

[0072] Since the longitudinal shrinkage ratio and the transverse shrinkage ratio in the heat setting also vary depending on the properties of the used fibers and the combination thereof, it is difficult to limit the shrinkage ratios within specific ranges in order to produce the woven fabric of the present invention. These shrinkage ratios act mutually, have an effect on the crimp shapes of the warp and the weft, and thereby change the multifilament coverage ratio a/L and the monofilament concealment ratio h/b. When the longitudinal shrinkage ratio is high or the transverse shrinkage ratio is low, the warp crimp tends to be small and the weft crimp tends to be large. Alternatively, when the longitudinal shrinkage ratio is low or the transverse shrinkage ratio is high, the warp crimp tends to be large and the weft crimp tends to be small.

[0073] Therefore, in selecting weaving conditions, the weaving conditions should be appropriately adjusted so that the crimp shapes of the weaving yarns fall within the ranges defined in the present invention in view of the properties of the used fibers and the combination thereof.

[0074] The woven fabric of an embodiment of the present invention can be used in applications such as skin materials for shoes, work clothes, fabrics for bags, members such as vehicle seat members and skin materials for shoes, members for sports balls such as balls of soccer and volleyball, adhesive tapes, base fabrics for nonwoven fabrics, interior members, members for inner layers of vehicles and housing, and materials for civil engineering.

EXAMPLES

[0075] In the following, the woven fabric of the present invention will be described with reference to the examples. Methods for measuring properties described in the examples are as follows.

1. Multifilament coverage ratio (hereinafter sometimes abbreviated as "coverage ratio")

[0076] From a woven fabric, a fiber (N) including a multifilament 2 crossing a fiber (M) including a monofilament 1 was cut off in a direction parallel to the direction of the fiber (M), and used as an observation sample. The sample was attached to a sample stand in a non-tensioned state, and an enlarged photograph was taken with a scanning electron microscope (SEM) at a magnification of 40. The length a (mm) of the multifilament 2 that crosses the monofilament 1 in a cross section thereof in a direction of woven fabric surface, and the center-to-center distance L (mm) between adjacent filaments of the multifilament were measured each at five positions. The multifilament coverage ratios (a/L) were determined according to the following formula, and the average thereof was calculated (see Fig. 1).

$$\text{Multifilament coverage ratio } (a/L) = a \div L$$

a: length of the multifilament 2 in a cross section thereof in a direction of woven fabric surface
L: center-to-center distance between filaments of the multifilament 2 adjacent across the fiber (M)

2. Monofilament concealment ratio (hereinafter sometimes abbreviated as "concealment ratio")

[0077] A cut sample was prepared in the same manner as in the case of measurement of the multifilament coverage ratio. Then, the sample was attached to a sample stand in a non-tensioned state, and an enlarged photograph was taken with a scanning electron microscope (SEM) at a magnification of 40. The length b (mm) of the multifilament 2 in a cross section thereof in a direction of woven fabric thickness, and the crimp height h (mm) of the monofilament were measured each at five positions. The multifilament coverage ratios (h/b) were determined according to the following formula, and the average thereof was calculated (see Fig. 1).

$$\text{Multifilament coverage ratio } (h/b) = h \div b$$

b: length of the multifilament 2 in a cross section thereof in a direction of woven fabric thickness
h: crimp height of the monofilament 1

3. Weaving density

[0078] According to JIS L1096: 2010 8.6.1, method A, five different positions on the woven fabric surface were observed with a magnifying glass, the numbers of warps and wefts in the section of 25.4 mm were counted, and the averages thereof were calculated.

4. Fineness

[0079] According to JIS L1013: 2010 8.3.1, method B, the fineness based on corrected mass was measured as the fineness.

5. Cover factor

[0080] The cover factor was calculated according to the following formula:

$$\text{cover factor} = (\text{weaving density: number of yarns/2.54 cm}) \times \sqrt{(\text{fineness: dtex})}.$$

6. Twist coefficient

[0081] According to JIS L1013: 2010 8.13.1, a sample was attached to a twist counter manufactured by Asano machine MFG. Co. with a length between grips of 50 cm under an initial load of 2.94 mN × display decitex, the number of twists was measured, and the obtained number was doubled to give the number of twists per meter. The twist coefficient was calculated according to the following formula.

$$\text{Twist coefficient} = (\text{number of twists: T/m}) \times \sqrt{(\text{fineness: dtex})}$$

7. Flexural rigidity of monofilament

[0082] Under two stainless steel rods each having a diameter of 2 mm horizontally placed at an interval of 10 mm, a monofilament cut into about 4 cm in length was set, and a J-shaped stainless steel hook having a diameter of 1 mm was suspended on the monofilament at the center of the two stainless steel rods. The stainless steel hook was pulled up at a speed of 50 mm/min with a TCM-200 type universal tensile and compression testing machine manufactured by MinebeaMitsumi Inc., and the flexural rigidity was evaluated based on the maximum stress generated during the pulling.

8. Whether the fiber was fused or not

[0083] A sample of 10 mm × 10 mm was collected, and the front and back surfaces of the woven fabric surface were observed with a scanning electron microscope (SEM) at a magnification of 100 to determine whether the fiber was fused or not.

9. Taber abrasion test

[0084] According to JIS L1096: 2010 8.19.3, method C, a sample was abraded 4000 times with a Taber abrasion tester under conditions of a load of 250 g, an abrasive wheel H-18, and a disc diameter of 100 mm, and then the sample was weighed. The weight difference (g) from the weight before the test was taken as the "weight reduction after 4000 times". For the judgment of rupture of the sample piece, a sample without hole was judged as A, and a sample with hole was judged as B. As a comprehensive judgment of abrasion resistance, a sample that showed a weight reduction after 4000 times less than 0.5 g and no hole was judged as acceptable, and others were judged as rejectable.

10. Evaluation of surface friction feeling and friction coefficient (MIU)

[0085] The measurement was performed 3 times for each of the two directions of warp and weft directions with a KES-SE friction tester manufactured by KATO TECH CO., LTD. under the conditions of a test stand moving speed of 1.00 mm/sec, a friction static load of 50 g, and a 10-mm square piano wire as an abrading material, and the average of the measured values was obtained. The formula for obtaining the friction coefficient (MIU) is as follows.

$MIU = (1/X) \int \mu dx$ (Integration range: 0 to X)
μ: Frictional force/force pressing the sample (50 gf)
x: Position on the sample surface
X: Movement distance (2 cm)

[0086] The friction coefficient (MIU) represents the slipperiness of the sample surface, and the larger the value is, the less slippery the surface is. For the judgment, a sample having a MIU of 0.40 or less was judged as A, a sample having a MIU more than 0.40 and 0.42 or less was judged as B, and a sample having a MIU more than 0.42 was judged as C.

11. Evaluation of surface friction feeling and deviation of friction coefficient (MMD)

[0087] The measurement was performed 3 times for each of the two directions of warp and weft directions with a KES-SE friction tester manufactured by KATO TECH CO., LTD. under the conditions of a test stand moving speed of 1.00 mm/sec, a friction static load of 50 g, and a 10-mm square piano wire as an abrading material, and the average of the measured values was obtained. The formula for obtaining the deviation of friction coefficient (MMD) is as follows.
[0088]

$MMD = (1/X) \int |\mu - \mu'| dx$ (integration range: 0 to X)
μ: Frictional force/force pressing the sample (50 gf)
x: Position on the sample surface
X: Movement distance (2 cm)
μ' : Average of μ

[0089] The deviation of friction coefficient (MMD) represents the roughness and irregular texture of the sample surface, and the larger the value is, the more rough the surface is. For the judgment, a sample having a MMD of 0.05 or less was judged as A, a sample having a MMD more than 0.05 and 0.07 or less was judged as B, and a sample having a MMD more than 0.07 was judged as C.

12. Basis weight

[0090] According to JIS L1096: 2010 8.3.2, method A, three samples of 200 mm × 200 mm were collected, the absolute dry masses of the samples were measured, the masses per 1 m^2 were calculated, and the average thereof was calculated.

(Examples 1 to 4 and Comparative Examples 1 to 4)

[0091] "Hytrel" (registered trademark) 6347 (melting point: 215°C) manufactured by DU PONT-TORAY CO., LTD., a thermoplastic polyester elastomer, was used as a core component, and "Hytrel" (registered trademark) 4056 (melting point: 153°C) was used as a sheath component. The pellets were dried, melted in separate extruders, weighed with a gear pump, poured into a composite pack, and fed into an extrusion machine. In this way, a 700 dtex monofilament elastic yarn having a core/sheath mass ratio of 70 : 30 was obtained. The elastic yarn had a flexural rigidity of 1.0 cN, and was used as the weft.
[0092] In addition, ten 167 dtex-48 filament cation-dyeable polyester yarns (LOCII manufactured by TORAY INDUSTRIES, INC.) were combined. The resultant 480 filament having a total fineness of 1670 dtex was twisted so as to have a twist coefficient of the warp as shown in Table 1. The resultant yarn was used as a warp. The plain weave fabric as shown in Table 1 was produced under the adjusted weaving conditions such as the warp tension. The obtained woven fabric was heat-treated with a pin tenter at a temperature of 180°C for 1 minute at the same inlet and outlet widths and 0% overfeed rate in the warp direction. Then, the woven fabric was dyed according to an ordinary cationic dye-dyeing method. In all of the finished woven fabrics, the polyester elastomer as the sheath component adhered and solidified at the intersection of the warp and the weft of the woven fabric. The warp density and weft density of the finished woven fabrics are as shown in Table 1.
[0093] As shown in Tables 2 and 3, Examples 1 to 4 are different from one another in one of the numerical values of weft density and twist coefficient of the warp, but the coverage ratio and concealment ratio were within the specific ranges, and the woven fabrics were excellent in abrasion resistance and had a soft touch feeling.
[0094] In addition, as shown in Tables 2 and 3, in Comparative Examples 1 to 4, the coverage ratio or the concealment ratio was not within the specific range, and the woven fabrics were inadequate in either of the abrasion resistance and touch feeling. Comparative Example 1 is an example of a case where the concealment ratio is too small. Although the obtained woven fabric had a soft touch feeling due to the flat shape of the warp and the high coverage ratio, the woven fabric was low in concealment ratio and poor in abrasion resistance. Comparative Example 2 is an example of a case where the concealment ratio is too large. The monofilament exposed to the surface, and the woven fabric had a hard touch feeling. In Comparative Example 3, since the coverage ratio was too small, the monofilament exposed to the surface, and the woven fabric had a hard touch feeling. Comparative Example 4 is also an example of a case where the coverage ratio is too small. The monofilament exposed to the surface, and the woven fabric had a hard touch feeling although it was excellent in abrasion resistance.

(Example 5)

[0095] "Hytrel" (registered trademark) 6347 (melting point: 215°C) manufactured by DU PONT-TORAY CO., LTD., a thermoplastic polyester elastomer, was prepared as a core component. In addition, "Hytrel" (registered trademark) 4056 (melting point: 153°C) was prepared as a sheath component. The pellets were dried, melted in separate extruders, weighed with a gear pump, poured into a composite pack, and fed into an extrusion machine. In this way, a 400 dtex monofilament elastic yarn having a core/sheath mass ratio of 70 : 30 was obtained. The elastic yarn had a flexural rigidity of 0.3 cN, and was used as the weft.

[0096] Five 167 dtex-48 filament cation-dyeable polyester yarns (LOCII manufactured by TORAY INDUSTRIES, INC.) were combined. The resultant 240 filament having a total fineness of 835 dtex was twisted so as to have a twist coefficient of the warp of 2890. The resultant yarn was used as a warp. The plain weave fabric as shown in Table 1 was produced under the adjusted weaving conditions such as the warp tension. The obtained woven fabric was heat-treated with a pin tenter at a temperature of 180°C for 1 minute at the same inlet and outlet widths and 0% overfeed rate in the warp direction. In the finished woven fabric, the polyester elastomer as the sheath component adhered and solidified at the intersection of the warp and the weft of the woven fabric. The warp density and weft density of the finished woven fabric are as shown in Table 1.

[0097] As shown in Tables 2 and 3, it was confirmed that in Example 5, the coverage ratio and concealment ratio were within the specific ranges, and the woven fabric was excellent in abrasion resistance and had a soft touch feeling.

(Examples 6 to 8 and Comparative Examples 5 and 6)

[0098] Pellets of "Hytrel" (registered trademark) 6347 (melting point: 215°C) manufactured by DU PONT-TORAY CO., LTD., a thermoplastic polyester elastomer, were dried. Then, the pellets were melted in an extruder, weighed with a gear pump, poured into a composite pack, and fed into an extrusion machine. In this way, a 700 dtex monofilament elastic yarn was obtained. The elastic yarn was used as a weft. In addition, ten 167 dtex-48 filament cation-dyeable polyester yarns (LOCII manufactured by TORAY INDUSTRIES, INC.) were combined as a warp. The resultant 480 filament having a total fineness of 1670 dtex was twisted so as to have a twist coefficient of the warp as shown in Table 1. The plain weave fabric as shown in Table 1 was produced under the adjusted weaving conditions such as the warp tension. The obtained woven fabric was heat-treated with a pin tenter at a temperature of 180°C for 1 minute at the same inlet and outlet widths and 0% overfeed rate in the warp direction. Then, the woven fabric was dyed according to an ordinary cationic dye-dyeing method. The warp density and weft density of the finished woven fabrics are as shown in Table 1. No fused portion was found in each of the yarns that constitute the finished woven fabrics.

[0099] As shown in Tables 2 and 3, it was confirmed that in Examples 6 to 8, the coverage ratio and concealment ratio were within the specific ranges, and the woven fabrics were excellent in abrasion resistance and had a soft touch feeling.

[0100] In Comparative Examples 5 and 6, since the woven fabrics were low in concealment ratio, they were poor in abrasion resistance.

(Comparative Example 7)

[0101] "Hytrel" (registered trademark) 6347 (melting point: 215°C) manufactured by DU PONT-TORAY CO., LTD., a thermoplastic polyester elastomer, was used as a core component. "Hytrel" (registered trademark) 4056 (melting point: 153°C) was used as a sheath component. The pellets were dried, melted in separate extruders, weighed with a gear pump, poured into a composite pack, and fed into an extrusion machine. In this way, a 700 dtex monofilament elastic yarn having a core/sheath mass ratio of 70 : 30 was obtained. The elastic yarn had a flexural rigidity of 1.0 cN, and was used as the weft.

[0102] A 288 filament high-strength polyester multifilament yarn (manufactured by TORAY INDUSTRIES, INC.) made from polyethylene terephthalate and having a total fineness of 1670 dtex was twisted so as to have a twist coefficient of the warp as shown in Table 1, and the resultant yarn was used. The plain weave fabric as shown in Table 1 was produced under the adjusted weaving conditions such as the warp tension, and at a weft density of 33 yarns/2.54 cm and a warp density of 25 yarns/2.54 cm. The obtained woven fabric was heat-treated with a pin tenter at a temperature of 180°C for 2 minutes at the same inlet and outlet widths and 0% overfeed rate in the warp direction with the woven fabric overfeed 20% only in the warp direction. In the finished woven fabric, the polyester elastomer as the sheath component adhered and solidified at the intersection of the warp and the weft of the woven fabric. The warp density and weft density of the finished woven fabric are as shown in Table 1.

[0103] In Comparative Example 7, since the coverage ratio was too small and the concealment ratio was too large, the woven fabric was excellent in abrasion resistance but had a hard touch feeling.

[Table 1]

[0104]

[Table 1]

	Warp fineness (dtex)	Weft fineness (dtex)	Warp density (number of yarns/ 2.54 cm)	Weft density (number of yarns/ 2.54 cm)	Twi st coefficient of warp	Cover factor of warp	Flexural rigidity of monofilament (cN)	Basis weight (g/m^2)
Example 1	1,670	700	29	39	8,173	1,185	1.0	352
Example 2	1,670	700	29	46	8,173	1,185	1.0	377
Example 3	1,670	700	29	38	0	1,185	1.0	347
Example 4	1,670	700	29	41	0	1,185	1.0	356
Example 5	835	400	41	50	3,034	1,170	0.3	258
Example 6	1,670	700	28	46	8,173	1,144	1.0	369
Example 7	1,670	700	28	41	0	1,144	1.0	348
Example 8	1, 670	700	28	42	8,173	1,144	1.0	355
Comparative Example 1	1,670	700	29	36	0	1,185	1.0	342
Comparative Example 2	1,670	700	29	42	2,861	1,185	1.0	361
Comparative Example 3	1,670	700	29	42	40.866	1,185	1.0	367
Comparative Example 4	1,670	700	29	49	40,866	1,185	1.0	388
Comparative Example 5	1,670	700	28	39	8,173	1,144	1.0	345
Comparative Example 6	1,670	700	28	38	0	1,144	1.0	339
Comparative Example 7	1,670	700	25	47	8,173	1,038	1.0	349

[Table 2]

[0105]

[Table 2]

	a (μm)	b (μm)	L (μm)	h (μm)	Coverage ratio a/L	Concealment ratio h/b	Whether fiber was fused or not
Example 1	870	250	865	130	1.0	0.5	Fused
Example 2	865	250	865	250	1.0	1.0	Fused
Example 3	1,300	165	870	80	1.5	0.5	Fused
Example 4	1,300	165	870	160	1.5	1.0	Fused
Example 5	525	180	410	160	1.3	0.9	Fused
Example 6	870	250	860	250	1.0	1.0	Not fused
Example 7	1,310	165	860	160	1.5	1.0	Not fused
Example 8	870	250	865	185	1.0	0.7	Not fused

(continued)

	a (μm)	b (μm)	L (μm)	h (μm)	Coverage ratio a/L	Concealment ratio h/b	Whether fiber was fused or not
Comparative Example 1	1,310	165	865	60	1.5	0.4	Fused
Comparative Example 2	1,250	170	860	185	1.5	1.1	Fused
Comparative Example 3	700	310	870	160	0.8	0.5	Fused
Comparative Example 4	700	310	860	305	0.8	1.0	Fused
Comparative Example 5	870	250	870	125	1.0	0.5	Not fused
Comparative Example 6	1,300	170	870	85	1.5	0.5	Not fused
Comparative Example 7	900	24 5	1,000	300	0.9	1.2	Fused

[Table 3]

[0106]

[Table 3]

	Abrasion resistance		Surface friction feeling			
	Weight reduction after 4000 times (g)	Judgment of rupture	MIU	Judgment	MMD	Judgment
Example 1	0.41	A	0.305	A	0.037	A
Example 2	0.20	A	0.389	A	0.062	B
Example 3	0.44	A	0.268	A	0.029	A
Example 4	0.32	A	0.341	A	0.047	A
Example 5	0.24	A	0.266	A	0.041	A
Example 6	0.28	A	0.392	A	0.065	B
Example 7	0.44	A	0.353	A	0.049	A
Example 8	0.42	A	0.343	A	0.048	A
Comparative Example 1	0.50	C	0.245	A	0.025	A
Comparative Example 2	0.30	A	0.421	C	0.051	B
Comparative Example 3	0.39	A	0.424	C	0.052	B
Comparative Example 4	0.19	A	0.473	C	0.070	C
Comparative Example 5	0.56	C	0.303	A	0.037	A
Comparative Example 6	0.59	C	0.269	A	0.030	A

(continued)

	Abrasion resistance		Surface friction feeling			
	Weight reduction after 4000 times (g)	Judgment of rupture	MIU	Judgment	MMD	Judgment
Comparative Example 7	0.17	A	0.501	C	0.071	C

[0107] As shown in Tables 1 to 3, it is understood that the woven fabric of the present invention is good in abrasion resistance and touch feeling.

DESCRIPTION OF REFERENCE SIGNS

[0108]

1: Monofilament
2: Multifilament
a: Length of multifilament 2 in cross section thereof in direction of woven fabric surface
b: Length of multifilament 2 in cross section thereof in direction of woven fabric thickness
L: Center-to-center distance between filaments of multifilament 2 adjacent across fiber (M)
h: Crimp height of monofilament 1
B: Bottom of multifilament
C1: Crimp apex
C2: Crimp apex

Claims

1. A woven fabric comprising a warp and a weft,
at least one of the warp and the weft being at least partially a fiber (M) that is a monofilament 1,
a fiber (N) crossing the fiber (M) being at least partially a multifilament 2,
the woven fabric satisfying either one of the following conditions (1) and (2):

(1) the monofilament 1 is fused to the multifilament 2, and a multifilament coverage ratio a/L and a monofilament concealment ratio h/b satisfy both the formulae (A) and (B):

$$1.0 \leq a/L \leq 1.5 \quad \cdots \text{(A)}$$

$$0.5 \leq h/b \leq 1.0 \quad \cdots \text{(B)};$$

and
(2) the monofilament 1 is not fused to the multifilament 2, and the multifilament coverage ratio a/L and the monofilament concealment ratio h/b satisfy both the formulae (C) and (D) :

$$1.0 \leq a/L \leq 1.5 \quad \cdots \text{(C)}$$

$$0.7 \leq h/b \leq 1.0 \quad \cdots \text{(D)}$$

wherein a, b, L, and h each have the following meanings:

a: length of the multifilament 2 in a cross section thereof in a direction of woven fabric surface;
b: length of the multifilament 2 in a cross section thereof in a direction of woven fabric thickness;

L: center-to-center distance between filaments of the multifilament 2 adjacent across the fiber (M); and
h: crimp height of the monofilament 1.

2. The woven fabric according to claim 1, wherein the multifilament 2 has a cover factor of 800 or more and 1200 or less.

3. The woven fabric according to either one of claims 1 and 2, wherein the multifilament 2 has a twist coefficient of 0 or more and 10000 or less.

4. The woven fabric according to any one of claims 1 to 3, wherein the monofilament 1 has a flexural rigidity of 1 cN or more and 6 cN or less.

5. The woven fabric according to any one of claims 1 to 4, wherein the monofilament 1 is a core-sheath composite yarn in which a sheath component has a melting point that is at least 10°C lower than that of a core component.

6. The woven fabric according to any one of claims 1 to 5, which shows, in the abrasion test according to JIS L1096 (2010) 8.19.3, method C, a weight reduction after 4000 times less than 0.5 g, and no hole.

7. The woven fabric according to any one of claims 1 to 6, having a mean friction coefficient MIU as a KES surface friction property value of 0.10 to 0.42, and a deviation of mean friction coefficient MMD of 0.01 to 0.07.

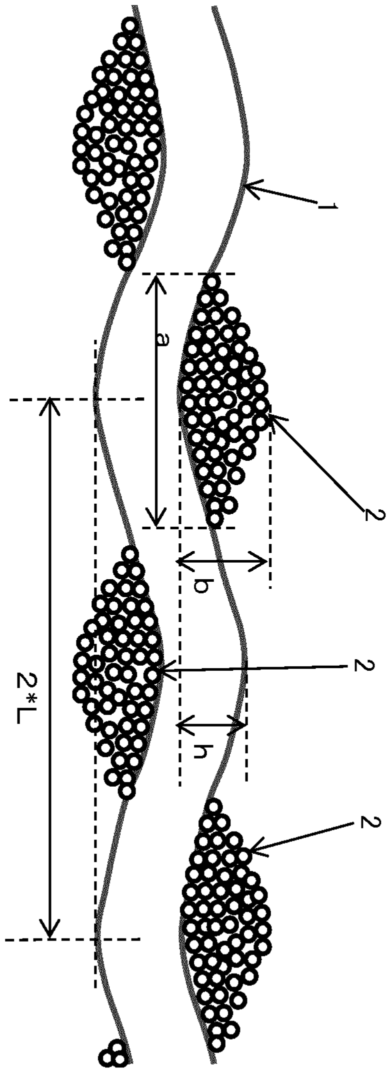


Fig.1

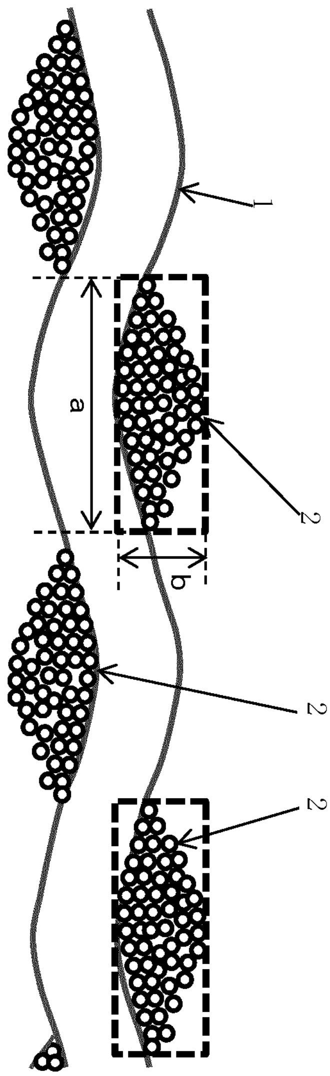


Fig.2

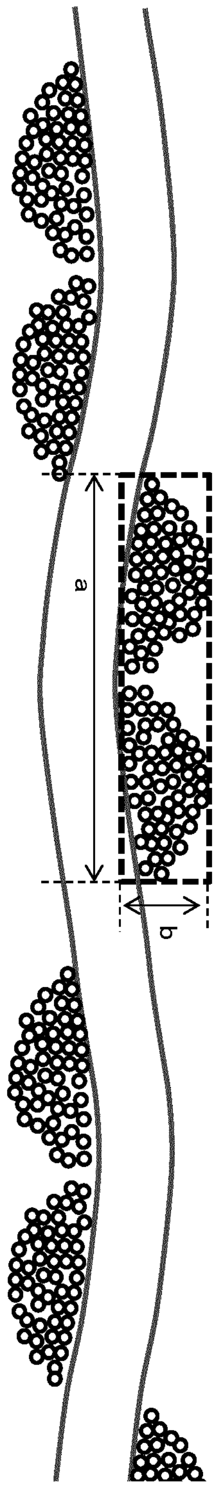
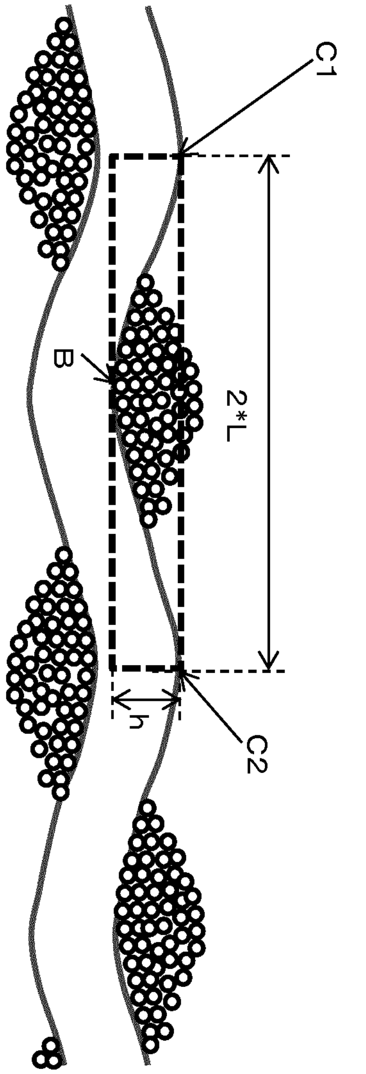


Fig.3

Fig.4



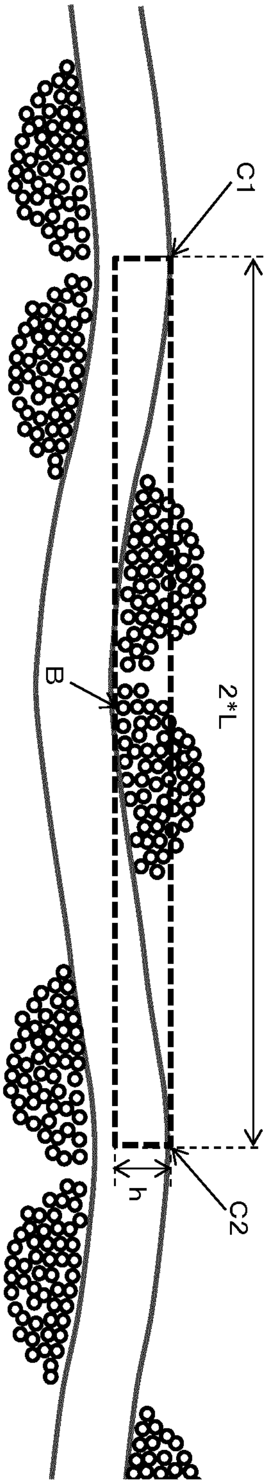


Fig.5

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2016/085908

A. CLASSIFICATION OF SUBJECT MATTER
D03D15/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D03D15/00

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2017
Kokai Jitsuyo Shinan Koho	1971-2017	Toroku Jitsuyo Shinan Koho	1994-2017

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-236116 A (Unitika Ltd.), 21 October 2010 (21.10.2010), claims 1, 2; paragraphs [0018], [0025]; example 1 (Family: none)	1-7
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 55944/1982(Laid-open No. 158672/1983) (Tokutaro KOMURO), 22 October 1983 (22.10.1983), claim 1; fig. 2 (Family: none)	1-7

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

* Special categories of cited documents:
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 February 2017 (20.02.17)	28 February 2017 (28.02.17)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/085908

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-131483 A (KB Seiren, Ltd.), 17 June 2010 (17.06.2010), claims 1, 2, 6, 8; fig. 2 (Family: none)	1-7
A	JP 2003-166145 A (Hagihara Industries Inc.), 13 June 2003 (13.06.2003), claim 1; paragraph [0018]; example 1 (Family: none)	1-7
A	JP 2001-55647 A (Toyobo Co., Ltd.), 27 February 2001 (27.02.2001), claim 1; example 1 (Family: none)	1-7
A	JP 1-298240 A (Gosen Co., Ltd.), 01 December 1989 (01.12.1989), claim 1 (Family: none)	1-7
A	JP 56-159164 A (Hiraoka & Co., Ltd.), 08 December 1981 (08.12.1981), claims 1, 6, 7; examples 1, 2 (Family: none)	1-7
A	JP 7-166476 A (Kanebo, Ltd.), 27 June 1995 (27.06.1995), claim 1; fig. 1 (Family: none)	1-7
A	JP 2003-171841 A (Toray Industries, Inc.), 20 June 2003 (20.06.2003), claims 1, 2; fig. 1 (Family: none)	1-7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 11200178 A **[0005]**
- JP 2002201548 A **[0005]**
- JP 2010236116 A **[0005]**