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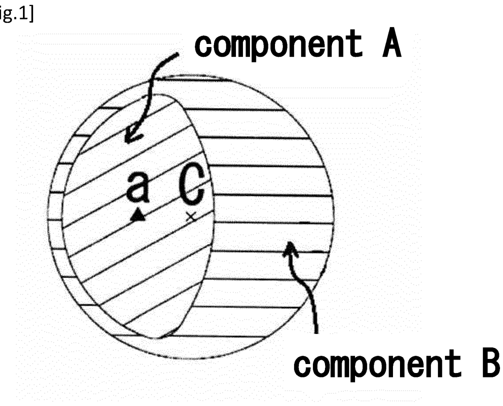
(54) **ECCENTRIC CORE-SHEATH COMPOSITE FALSE TWISTED YARN AND WOVEN/KNITTED FABRIC USING SAME**

(57) Provided is an eccentric core-sheath composite false-twisted yarn, in which, in a cross-section of a composite fiber composed of two polymers that are a component A and a component B, the component A is completely covered with the component B, a ratio S/D of a minimum thickness S of a thickness of the component B covering the component A to a fiber diameter D is 0.01 to 0.1, a peripheral length of a fiber at a portion where a thickness is 1.05 times or less the minimum thickness S is 1/3 or more of a peripheral length of the entire fiber, a difference in modification degree between the single yarns is 0.2 or more, and a crimping rate is 30% or more.

[Fig.1]



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Description

TECHNICAL FIELD

[0001] The present invention relates to an eccentric core-sheath composite false-twisted yarn and a woven/knitted fabric using the same.

BACKGROUND ART

[0002] Fibers made of thermoplastic polymers such as polyesters and polyamides have various excellent properties including mechanical properties and dimensional stability. Therefore, they are widely used in various fields such as apparel, interior, vehicle interior, and industrial materials. On the other hand, as the applications of fibers have diversified, the required characteristics have also diversified.

[0003] Particularly in recent years, there has been demanded to curb a feeling of restraint during wearing fibers in apparel have been required to have less restraint feeling and reflect movement better, and thus the demand for stretch performance is high, and various methods have been proposed for imparting stretchability to the raw yarn that makes up woven/knitted fabrics. For example, there is a method in which polyurethane-based fibers having rubber elasticity are mixed into a woven fabric to impart stretchability. However, there are challenges that color fastness is poor, discoloration and color transfer are likely to occur, and polyurethane may break due to deterioration in strength due to friction during wearing.

[0004] As a method not using polyurethane, for example, Patent Document 1 proposes a potentially crimpable composite fiber using a composite fiber obtained by bonding polymers of two components having a viscosity difference to a side-by-side mold.

[0005] Patent Document 2 proposes a woven/knitted fabric in which a component A is completely covered with a component B in a cross section of a composite fiber composed of two polymers, i.e. the component A and the component B, and the minimum thickness is defined to have both stretchability and wear resistance.

[0006] Patent Document 3 proposes an eccentric core-sheath composite false-twisted yarn in which a component A is completely covered with a component B in a cross section of a composite fiber composed of two polymers i.e. the component A and the component B, and the minimum thickness is defined; and a woven/knitted fabric thereof.

PRIOR ART DOCUMENT

PATENT DOCUMENTS

[0007]

Patent Document 1: Japanese Patent Laid-open Publication No. 9-157941
Patent Document 2: WO 2018/110523
Patent Document 3: Japanese Patent Laid-open Publication No. 2019-214798

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0008] For example, by using the potentially crimpable composite fiber as described in Patent Document 1, the fibers will become greatly and continuously curved toward a highly shrinkable component after the heat treatment to form a three-dimensional spiral structure. Therefore, the structure expands and contracts like a spring, so that stretchability can be imparted to the woven/knitted fabric, but in this present method, since the structure is a simple side-by-side bonding structure, there is a problem that peeling occurs at the interface due to friction or impact, and the woven/knitted fabric quality deteriorates due to bleaching (forming partially white streaks) or fluffing.

[0009] Further, the method as described in Patent Document 2 considers only the stretched yarn, and does not consider the wear resistance when elongated assuming actual wearing.

[0010] Moreover, the woven/knitted fabric as described in Patent Document 3 has good wear resistance, but it is necessary to improve wear resistance when elongated assuming actual wearing.

[0011] As described above, various woven/knitted fabrics have been proposed in order to obtain stretchability, but it is desired that wear resistance be further imparted for extension in a highly-mobile region such as the elbow or knee where a problem easily occurs in actual wearing.

[0012] An object of the present invention is to provide an eccentric core-sheath composite false-twisted yarn capable of providing a woven/knitted fabric that eliminates wear resistance when elongated, which has been a problem of a conventional high-stretch woven fabric, and is soft and has excellent plumpness, and a woven/knitted fabric using the same.

SOLUTIONS TO THE PROBLEMS

[0013] In order to solve such problems, an eccentric core-sheath composite false-twisted yarn of the present invention and a woven/knitted fabric using the same have the following configurations.

(1) An eccentric core-sheath composite false-twisted yarn, including a multifilament composed of a single yarn in which, in a cross-section of a composite fiber composed of two polymers that are a component A and a component B, the component A is completely covered with the component B, a ratio S/D of a minimum thickness S of a thickness of the component B covering the component A to a fiber diameter D is 0.01 to 0.1, and a peripheral length of a fiber at a portion where a thickness is 1.05 times or less the minimum thickness S is 1/3 or more of a peripheral length of the entire fiber, in which a difference in modification degree between the single yarns is 0.2 or more, and a crimping rate is 30% or more.
(2) The eccentric core-sheath composite false-twisted yarn as set forth in (1), in which a residual torque is 30 T/M or more.
(3) A woven/knitted fabric using the eccentric core-sheath composite false-twisted yarn as set forth in (1) or (2) .
(4) The woven/knitted fabric as set forth in (3), in which a KES surface roughness is 10 um or less.
(5) The woven/knitted fabric as set forth in (3) or (4), in which wear resistance at 10% elongation is grade 3 or higher.

EFFECTS OF THE INVENTION

[0014] By using the eccentric core-sheath composite false-twisted yarn of the present invention, it is possible to obtain a woven/knitted fabric having high stretch performance, excellent wear resistance when elongated, and an excellent soft and plump texture. This woven/knitted fabric can be applied to a wide range of fields including apparel and apparel materials, and can be efficiently manufactured at low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 shows one example of an eccentric core-sheath composite fiber of the present invention, and is a fiber cross-section illustrating the position of the center-of-gravity in the fiber cross-section.
Fig. 2 shows a fiber cross-section illustrating a fiber diameter (D) and a minimum thickness (S) in a fiber cross-section of the eccentric core-sheath composite fiber and the composite yarn of the present invention.

EMBODIMENTS OF THE INVENTION

[0016] Hereinafter, the present invention will be described in detail together with desirable embodiments.
[0017] In the eccentric core-sheath composite false-twisted yarn of the present invention, a fiber cross-section is composed of two polymers, i.e. a component A and a component B. As the polymer, a fiber-forming thermoplastic polymer is suitably used, and a combination of polymers that generate a shrinkage difference when subjected to a heat treatment is also suitably used. With regard to this, a combination of polymers having a difference in melt viscosity of 10 Pa•s or more and having different molecular weights or compositions is preferable.
[0018] Suitable polymers for achieving the object of the present invention include polyethylene terephthalate, polyethylene naphthalate, polybutylene terephthalate, polytrimethylene terephthalate, polyamide, polylactic acid, thermoplastic polyurethane, and polyphenylene sulfide. It is also possible to use a high-molecular-weight polymer as the component A and a low-molecular-weight polymer as the component B shown in Fig. 1 by changing their molecular weights, or use one component as a homopolymer and the other component as a copolymer.
[0019] Examples of combinations having different polymer compositions include various combinations of polybutylene terephthalate/polyethylene terephthalate, polytrimethylene terephthalate/polyethylene terephthalate, thermoplastic polyurethane/polyethylene terephthalate, and polytrimethylene terephthalate/polybutylene terephthalate as the component A/the component B. In these combinations, good bulkiness can be obtained due to the spiral structure.
[0020] In particular, polyester, polyamide, polyethylene and polypropylene are preferably used, among which polyester is more preferable due to its mechanical characteristics. Examples of the polyester as used herein include polyethylene terephthalate, polybutylene terephthalate, polypropylene terephthalate; a product obtained by copolymerizing a dicar-

boxylic acid component, a diol component or an oxycarboxylic acid component with polyethylene terephthalate, polybutylene terephthalate, or polypropylene terephthalate; or a product obtained by blending these polyesters. In these polymers, to the extent of not impairing the effects of the present invention, matting agents such as titanium oxide, flame retardants, lubricants, antioxidants, inorganic fine particles and organic compounds such as coloring pigments and carbon black can be included as necessary.

[0021] The composite area ratio between the component A and the component B in the fiber cross-section in the eccentric core-sheath composite false-twisted yarn of the present invention can achieve a fine spiral structure by increasing the proportion of the high-shrinkable component as the component A in view of the crimp development. Further, since it is necessary to have excellent physical properties for an eccentric core-sheath composite false-twisted yarn, the ratio between the components is preferably in the range of component A : component B = 70 : 30 to 30 : 70 (area ratio), and more preferably in the range of 65 : 35 to 45 : 55.

[0022] The eccentric core-sheath composite false-twisted yarn of the present invention is of an eccentric core-sheath type in which, in a cross-section of a composite fiber composed of two polymers, the two polymers are present in a bonded state without being substantially separated, and the component A is completely covered with the component B. The eccentricity in the present invention refers to that the position of the center-of-gravity of the component A polymer is different from the center of the composite fiber-cross section in the composite fiber cross-section, and will be described with reference to Fig. 1. In Fig. 1, a portion with horizontal hatching is the component B, a portion with 30-degree-inclined hatching (right-upward oblique line) is the component A, the center-of-gravity of the component A in the composite fiber cross-section is the center-of-gravity a, and the center-of-gravity of the composite fiber cross-section is the center-of-gravity C. In the present invention, since the center-of-gravity a and the center-of-gravity C of the cross-section of the composite fiber are separated from each other, the fiber can be greatly curved toward the high-shrinkable component after the heat treatment. Accordingly, as the composite fiber continues to be curved in the fiber-axis direction, the fiber has a three-dimensional spiral structure, and good crimps are developed by applying false twisting. The further apart the centers of gravity, the better the crimping and the better the stretch performance.

[0023] In the present invention, since the component A is completely covered with the component B, the composite fibers are less likely to be delaminated at the interface even when friction or impact is applied to the woven/knitted fabric, and wear resistance can be improved. In the conventional simple side-by-side bonding structure, bleaching and/or fluffing due to interfacial peeling easily occur.

[0024] In the case of a side-by-side type composite yarn, there is a problem that spinning operability is deteriorated as the single yarn fineness is reduced. However, the structure in which the component A is completely covered with the component B improves the spinnability and makes the single yarn fineness thinner than 1.5 dtex.

[0025] In the eccentric core-sheath composite false-twisted yarn of the present invention, when the ratio S/D of the thickness S that minimizes the thickness of the component B covering the component A to the fiber diameter (diameter of the composite fiber) D is 0.01 to 0.1, deterioration of woven/knitted fabric quality due to fluff can be suppressed, and stretch performance can be obtained. It is preferably 0.02 to 0.08.

[0026] This will be explained in more detail using the fiber cross-section shown in Fig. 2. The thinnest portion of the component B has the minimum thickness S.

[0027] Furthermore, in the single yarn in the present invention, a peripheral length of a fiber at a portion where a thickness is 1.05 times or less the minimum thickness S is 1/3 or more of a peripheral length of the entire composite fiber. This means that the component A exists along the contour of the fiber, and as compared with the conventional eccentric core-sheath yarn having the same area ratio, in the present invention, the center-of-gravity positions of the respective components are spaced further apart in the fiber cross-section, and fine spirals are formed to exhibit good crimps. More preferably, when the peripheral length of the fiber in a portion having a thickness within 1.05 times the minimum thickness S is 2/5 or more of the peripheral length of the entire fiber, good stretch performance is obtained without unevenness of crimps. The upper limit is not particularly limited, but is usually 4/5 or less.

[0028] Furthermore, in the present invention, the cross-section of the fiber discharged from the spinneret, that is, the single yarn, can be arbitrarily selected from a round shape, a triangular shape, a flat shape, a hexagonal shape, an octagonal shape or a daruma shape, but a round shape is preferable in order to obtain high stretchability.

[0029] The eccentric core-sheath composite false-twisted yarn of the present invention has a difference in modification degree between single yarns of 0.2 or more. The single yarn-modification is a value calculated by dividing a circumscribed circle diameter of a single fiber cross-section by an inscribed circle diameter, and the difference in modification degree between single yarns is an index of variation in modification degree of the eccentric core-sheath composite false-twisted yarn. In the false-twisted yarn composed of a single polymer, there is no large difference in crimp even if the modification degree of the single yarn varies by false twisting, but in the eccentric core-sheath composite false-twisted yarn, the single yarn having a large modification degree has coarse crimp, and the single yarn having a small modification degree has fine crimp. The eccentric core-sheath composite false-twisted yarn of the present invention has been found to have improved wear resistance when elongated by mixing a single yarn having a large modification degree and a single yarn having a small modification degree.

[0030] In other words, when the woven/knitted fabric is stretched, the coarsely crimped single yarns with a high modification degree are fully stretched, and the single yarns with a low modification degree and fine crimps come out to the surface of the woven/knitted fabric. Therefore, single yarns with a low modification degree wear out. On the other hand, at the time of recovery from elongation thereafter, the crimp of the single yarn having a small modification degree is strongly recovered, and the crimp enters the inside of the central portion of the eccentric core-sheath composite false-twisted yarn. Consequently, a single yarn having a high modification that is not worn out appears on the surface of the woven/knitted fabric, so that the actually worn portion is less visible, and the change in appearance due to wear is also reduced.

[0031] With the eccentric core-sheath composite false-twisted yarn of the present invention, the wear resistance when elongated can be improved due to the difference in modification degree between single yarns being made 0.2 or more. The upper limit is not particularly limited, but is preferably 3.0 or less from the viewpoint of woven/knitted fabric surface quality. A more preferable difference in modification degree between single yarns is 0.3 to 2.0. When the difference in the modification degree between the single yarns is less than 0.2, appearance defects such as discoloration of the eccentric core-sheath composite false-twisted yarn due to wear when elongated of the woven/knitted fabric occur.

[0032] When the crimping rate of the eccentric core-sheath composite false-twisted yarn of the present invention is 30% or more, high stretchability can be imparted to the woven/knitted fabric. If the crimping rate is less than 30%, stretchability cannot be imparted to the woven/knitted fabric. It is more preferably 35% to 65%.

[0033] The eccentric core-sheath composite false-twisted yarn of the present invention preferably has a residual torque of 30 T/M or more. The large twist of the single yarn of the eccentric core-sheath composite false-twisted yarn is preferable because the single yarn is easily twisted when the woven/knitted fabric is subjected to an external force in a compression direction during wear, so that the outermost surface of the woven/knitted fabric to be worn is easily replaced, and the change in appearance after wear is less noticeable. A more preferred residual torque range is 50 to 150 T/m.

[0034] In general, a composite fiber having a three-dimensional spiral structure tends to have a low residual torque, but when the number of interlacing is 30/m or more, the torques in a convergence portion are superimposed, and the residual torque can be 30 T/M or more.

[0035] The number of interlacing of the eccentric core-sheath composite false-twisted yarn of the present invention is preferably 30 to 150/m. When the number of interlacing is within the above range, coarsely crimped single yarns with a large modification degree are likely to come out on the surface of the woven/knitted fabric when not stretched, and changes in appearance due to wear are reduced. A more preferable range of the number of interlacing is 30 to 100/m.

[0036] The eccentric core-sheath composite false-twisted yarn of the present invention preferably has a single yarn fineness of 1.5 dtex or less. Since the wear surface of one single yarn is also reduced, the change in appearance after wear is less noticeable, which is preferable. The lower limit is not particularly limited, but is preferably 0.5 dtex or more from the viewpoint of strength.

[0037] The eccentric core-sheath composite false-twisted yarn of the present invention and at least one other fibers (the same eccentric core-sheath composite false-twisted yarn may be used) may be mixed and used. In the mixed filament yarn, the ratio of the eccentric core-sheath composite false-twisted yarn of the present invention is preferably in the range of 20 to 80%.

[0038] The woven/knitted fabric of the present invention is a woven/knitted fabric made or woven using the core-sheath composite false-twisted yarn as at least a part thereof. The woven/knitted fabric of the present invention preferably has an elongation rate of 15% or more under a load of 1.5 kgf in at least either the warp direction or the weft direction. This performance is achieved by the high stretchability of the core-sheath composite false-twisted yarn of the present invention, and when the elongation rate is 15% or more, it is possible to obtain a woven/knitted fabric in which movement is hardly hindered, which can be used not only in sportswear but also in slacks, business shirts, casual shirts, and jackets. More preferably, the elongation rate is 20% or more.

[0039] The woven/knitted fabric of the present invention preferably has a KES surface roughness of 10 um or less. In the present invention, the KES surface roughness is a numerical value of surface roughness measured using an automated surface tester (KESFB4). A load of 50 g in a vertical direction including a metal friction element is applied, the friction element is brought into contact with a test piece with a force of 10 g by the contact pressure of the spring, and the test piece is moved back and forth by 30 mm to measure the variation in the surface roughness of the test piece. Consequently, the contact surface upon wear becomes large, the amount of wear on the woven/knitted fabric is dispersed, and the wear becomes less noticeable, which is preferable. A more preferable KES surface roughness is 3 um or less. The lower limit is not particularly limited, and the smaller the lower limit is, the better it is; it is preferably 0 μm.

[0040] In the wear resistance (hereinafter sometimes referred to as wear strength) of the woven/knitted fabric of the present invention, the wear strength defined by JIS L 1096 (2010) 8.19 Method E is preferably a discoloration grade 3 or higher in 3000 repetitions in the non-elongated state (normal state) and the elongated state. Conventionally, the wear strength is usually evaluated in a non-elongated state, but in clothing using a high stretch woven/knitted fabric, wear is large in a high-movable region such as a knee, an elbow, and a shoulder, and the wear strength often does not match the results from such wear strength measurement. As a result of intensive verification on the wear resistance of the high-stretchable woven/knitted fabric, it was found that the wear strength in the elongated state of the woven/knitted fabric has a correlation with the wear resistance in the high-movable region of the actual apparel. That is, if the wear strength at 10% elongation is grade 3 or higher in 3000 repetitions of JIS L 1096 (2010) 8.19 Method E, the wear durability can be improved, giving more preferable highly stretchable garments having excellent wear resistance. The wear strength is more preferably grade 3.5 or higher in both the non-elongated state and the elongated state.

[0041] Next, a preferred method for producing the eccentric core-sheath composite false-twisted yarn and the woven/knitted fabric of the present invention will be described. In spinning the original yarn of the eccentric core-sheath composite false-twisted yarn of the present invention, it is preferable to spin a highly-oriented unstretched yarn. The cross-section can be further deformed and the difference in the modification degree between the single yarns can be increased by winding the highly-oriented unstretched yarn and then performing stretching simultaneous false twisting. A preferred spinning speed is 2500 to 3500 m/min.

[0042] The spinneret used may have any of common internal structures so long as the spinneret renders stable spinning with respect to quality and operation, but it is important that the component B completely covers the component A as shown in Fig. 1. By forming the cross-section of the present invention, it is possible to suppress discharge line bending (kneading) caused by a flow velocity difference between two polymers at the time of spinneret discharge. Further, in the case of the conventional simple bonding structure (side-by-side structure), it is likely that there was a difference in the stress balance applied to each polymer at the time of thinning on the spinning line after spinneret discharge, and unevenness was generated in elongation deformation, which became apparent as unevenness of fineness, and the U% increased. This tendency is very remarkable when the fineness is reduced by combining polymers having a large viscosity difference or narrowing the discharge amount, but in the present invention, the stress is balanced in the fiber cross-section and unevenness of fineness can be suppressed by covering one polymer with the other polymer. Furthermore, it has also been found that when a high-molecular-weight polymer is used as the component A and a low-molecular-weight polymer is used as the component B and the component B completely covers the component A, high-speed yarn making stability is excellent. This is an advantageous effect that the low-molecular-weight polymer is disposed on the outer side so that the high-molecular-weight polymer easily follows elongation deformation after spinneret discharge.

[0043] Any condition can be selected as the false-twisting condition of the eccentric core-sheath composite false-twisted yarn of the present invention. As the twister, any of a spindle type, a friction disc type, and a belt nip type may be used, but a friction disc type and a belt nip type that enable false twisting at a high speed are preferable.

[0044] The false twisting may be performed by a pre-stretching false-twisting method or a stretching simultaneous false-twisting method, and the stretching simultaneous false-twisting method can further deform the cross-section and increase the difference in modification degree between single yarns, which is preferable. In the case of the pre-stretching false-twisting method, a false twisting method is preferable in which low-magnification heat treatment stretching is performed with a hot pin to impart thickness unevenness to a single yarn, thereby locally generating a yarn length difference of the single yarn.

[0045] When the false twisting temperature is 170 to 220°C in the case of a contact heater, a high crimping rate can be obtained, and the cross-section can be greatly deformed to increase the difference in modification degree between single yarns, which is preferable.

[0046] Regarding the number of false-twists, when the false-twisting coefficient (number of false-twists (T/M) $\times$ fineness (dtex) $^{0.5}$) is in the range of 27,000 to 33,000, a high crimping rate can be obtained, and the cross-section can be greatly deformed to increase the difference in modification degree between single yarns, which is preferable.

[0047] In addition, interlacing can be optionally applied by an interlace nozzle before and after false twisting. In consideration of cost, the interlacing pressure is preferably 0.1 to 0.6 (MPa). It is more preferably 0.2 to 0.4 (MPa).

[0048] Although a higher yarn processing speed is preferred because of higher productivity, the yarn processing speed is preferably 300 to 900 (m/min) in consideration of stable processability.

[0049] In the eccentric core-sheath composite false-twisted yarn of the present invention, actual twisting may be imparted according to the application of the woven/knitted fabric. As the twisting method, a conventional method may be used, and the twisting conditions may be appropriately selected.

[0050] The eccentric core-sheath composite false-twisted yarn of the present invention produced in this manner can be formed into a woven or knitted fabric using a known weaving method and knitting method to form the woven/knitted fabric of the present invention. Any known structure can be applied as the woven or knitted structure. In the present invention, the woven and knitted fabrics are collectively referred to as a "woven/knitted fabric". The woven/knitted fabric of the present invention is not limited to any structure or density.

[0051] Examples of the loom used for weaving include, but are not particularly limited to, looms such as ordinary looms, rapier looms, water jet looms, and air jet looms that are generally used. As the woven structure, any design such as flat, twill, and satin can be made.

[0052] In the knitting, a commercially available knitting machine such as a circular knitting machine, a tricot machine, and a Raschel machine can be used. When the eccentric core-sheath composite false-twisted yarn of the present invention is used for at least a part of the knitting yarn, it is preferable to perform knitting by optimizing each tension. As the knitting pattern, any design such as plain stitch, smooth, punch, rib, and half patterns can be made.

[0053] Next, the dyeing processing to be preferably performed on the woven/knitted fabric using the eccentric core-sheath composite false-twisted yarn of the present invention will be described. The dyeing step is not particularly limited and can be employed. Among them, in order to sufficiently develop false-twisted crimps, it is preferable that the relaxation heat treatment is relaxation processing at 120°C or higher to impart a fir effect to the woven/knitted fabric.

[0054] In order to suppress washing shrinkage, the intermediate set temperature is preferably 170°C or more and 210°C or less. By setting the intermediate setting temperature within the above preferable range, it is possible to prevent the filament from being fused.

[0055] In the present invention, the woven or knitted fabric may be subjected to alkali weight reduction in terms of obtaining a soft texture, but the weight reduction rate is preferably 15% or less.

[0056] In addition, the woven/knitted fabric of the present invention may be subjected to conventional water-absorbing finishing, water-repellent finishing, ultraviolet shielding finishing, softening finishing, or alternatively, various treatments to impart functions such as antibacterial agents, antiviral agents, deodorants, insect repellents, and retroreflective agents, to the extent not departing from the gist of prevent invention.

EXAMPLES

[0057] Hereinafter, the eccentric core-sheath composite false-twisted yarn of the present invention and a woven/knitted fabric thereof will be specifically described with reference to Examples, but the present invention is not particularly limited thereto. The following evaluations were performed for Examples and Comparative Examples.

(1) Fineness

[0058] A skein was produced by using a skein winder having a frame circumference of 1.0 m and rotating it 100 times, and the fineness was measured according to the following formula.

Finesess (dtex) = 100 rotation skein weight (g) $\times$ 100.

(2) Elongation

[0059] A sample was measured with a tensile tester "Tensilon" (TENSILON) UCT-100 manufactured by ORIENTEC CORPORATION under a constant rate extension condition shown in JIS L 1013 (2010) 8.5.1 "Standard Time Test". At this time, the gripping interval was 20 cm, the tensile speed was 20 cm/min, and the number of tests was 10.

[0060] The breaking elongation was determined from the elongation at the point showing the maximum strength in an SS curve.

(3) Minimum Thickness S and Fiber Diameter D

[0061] Multifilaments composed of an eccentric core-sheath composite false-twisted yarn were embedded in an embedding agent such as an epoxy resin, and an image was taken at a magnification at which 10 or more fibers (points) could be observed with a transmission electron microscope (TEM) in a cross-section in a direction perpendicular to the fiber direction. At this time, when metal dyeing is performed, the contrast of the joint portion between the component A and the component B can be clarified using the dyeing difference between the polymers. With the presence of the joint portion, it can be confirmed that the eccentric core-sheath composite fiber has two components. A value obtained by setting a circle circumscribing a cross-section of a single yarn of 10 eccentric core-sheath composite fibers (points) randomly extracted in the same image from each photographed image and measuring the circumscribed circle diameter corresponds to the fiber diameter D in the present invention. The circle circumscribing the cross-section is a perfect circle circumscribing the cross-section in the direction perpendicular to the fiber axis from the 2D captured image, and the circumscribed circle diameter means the diameter of the perfect circle circumscribing the cross-section most frequently at two or more points. A value obtained by measuring the minimum thickness of the component B covering the component A for 10 fibers (points) using an image obtained by measuring the fiber diameter D corresponds to the minimum thickness S in the present invention. The fiber diameter D and the minimum thickness S were measured with the unit of μm, and rounded off to the second decimal place. A simple number average value of the measured values and the ratio (S/D) thereof was obtained for the images of 10 points where the above operations were photographed. The ratio ("S ratio (%)" in Table 1) of the perimeter of the fiber of the portion having a thickness within 1.05 times the minimum thickness S to the total perimeter of the composite fiber was obtained by rounding off the simple number-average value of the values measured for the images of 10 points to the first decimal place. It should be noted that the image photographed as described above and the image were obtained using image analysis software "WinROOF 2015" manufactured by MITANI CORPORATION.

(4) Single-Yarn Modification Degree, Difference in Modification Degree between Single Yarns

[0062] An arbitrary single fiber cross-section of the eccentric core-sheath composite false-twisted yarn was twodimensionally photographed in the same manner as in the fiber diameter D described above, the diameter of the circumscribed circle corresponding to the diameter of the circumscribed circle of the single fiber and the diameter of the inscribed circle that is the diameter of the perfect circle inscribed in the single fiber were measured. From these results, the modification degree = circumscribed circle diameter/inscribed circle diameter was calculated, and the average value of all single fibers in the same fiber cross-section of the eccentric core-sheath composite false-twisted yarn was calculated. This operation was repeated at five arbitrary points in the cross-section of the same eccentric core-sheath composite false-twisted yarn to measure the modification degree, and the average value thereof was taken as the single-yarn modification degree.

[0063] In addition, the difference between the average value of five values having a large single-yarn modification degree and the average value of five values having a small single-yarn modification degree in any fiber cross-section of the eccentric core-sheath composite false-twisted yarn was defined as a difference in modification degree between single yarns, and the average value of five values was defined as a difference in modification degree between single yarns of the false-twisted yarn.

(5) Interlacing Degree

[0064] The interlacing degree was the number of interlaced parts per 1 m under a tension of 0.1 cN/dtex. When a non-interlaced part of the yarn was pierced with a pin under a tension of 0.02 cN/dtex and the pin was moved up and down in the longitudinal direction of the yarn with a tension of 0.1 cN/dtex over 1 m of the yarn, the part where the pin was moved with no resistance was defined as the non-interlaced part and the moved distance was recorded, while the part where the pin stopped was defined as the interlaced part. This operation was repeated 30 times, and the interlacing degree per 1 m was calculated from the average value of the distances of the non-interlaced parts.

(6) Crimping Rate

[0065] The yarn was wound 10 times on a skein winder having a peripheral length of 0.8 m under a tension of 90 mg/dtex to form a skein, then hung on a bar having a diameter of 2 cm or less, and left for about 24 hours. The skein was wrapped in gauze, treated with hot water at 90°C for 20 minutes under a non-tensioned state, and then hung on a bar having a diameter of 2 cm or less and left for about 12 hours. One end of the skein after being left to stand was hooked, an initial load and a measurement load were applied to the other end, and the skein was suspended in water and left to stand for 2 minutes. The initial load (g) at this time was 2 mg/dtex, the measurement load (g) was 90 mg/dtex, and the water temperature was 20 + 2°C. The length of the inner side of the skein that had been left was measured and designated as L. The measurement load was removed, and only under the initial load the skein was left for another 2 minutes. The length of the inner side of the skein that had been left was measured and designated as L1. The percentage of crimp was determined by the following formula. This operation was repeated five times, and the average value was determined.

$$\text{Crimping rate } (\%) = \{(L - L1)/L\} \times 100.$$

(7) Residual Torque

[0066] An eccentric core-sheath composite false-twisted yarn of about 75 cm was stretched horizontally, and an initial load of 0.02 mN/dtex was suspended at the central portion, and then both ends were drawn. The yarn started to rotate due to the residual torque, but was held as it was until the initial load stopped to obtain a twisted yarn. The number of twisted yarns having a length of 25 cm under a load of 1 mN/dtex was measured with a twist detector. The obtained number of twists (T/25 cm) was multiplied by 4 to obtain a torque (T/m).

(8) Stretch Rate

[0067] According to Method B under JIS L 1096 (2010), the elongation rate under a load of 1.5 kgf (14.7 N) was measured. This elongation rate was used as a metric of stretchability.

(9) Wear Strength (When Non-elongated and Elongated)

[0068] In the wear strength when non-elongated, discoloration at the time of 3000 repetitions of wear was evaluated using a pressing load for apparel according to JIS L 1096 Method E (2010, Martindale Method).

[0069] In regard to the wear strength when elongated, a fabric was set in a state of being elongated by 10% in the direction of use of the eccentric core-sheath composite false-twisted yarn, and with the same other conditions as in JIS L 1096 8.19 Method E (2010, Martindale Method), discoloration at the number of wear repetitions of 3000 was evaluated using a pressing load for apparel.

(10) KES Surface Roughness (SMD)

[0070] SMD was measured using an automated surface tester ("KESFB4-AUTO-A" manufactured by KATO TECH CO., LTD.). A 20-cm square test piece was placed in the tester. A load of 50 g in a vertical direction including a metal friction element was applied, the friction element was brought into contact with a test piece with a force of 10 g by the contact pressure of the spring, and the test piece was moved back and forth by 30 mm to measure the variation in the surface roughness of the test piece. The measurement was performed five times in each of two directions of WARP and WEFT, and the average value thereof was taken as SMD. SMD indicates a variation in surface roughness, and it can be determined that there is unevenness due to the protrusion as the value is larger.

(11) Plumpness

[0071] In the plumpness of the woven/knitted fabric created in Examples, the answer that was most frequently given by 30 randomly selected evaluators was taken as the result. When the numbers of answers were the same, a lower grade was adopted. "⊙" and "◦" were determined to be acceptable.

⊙: Very large plumpness is felt when holding the woven/knitted fabric.
o: Large plumpness is felt when holding the woven/knitted fabric.
△: The woven/knitted fabric lacks plumpness when held.
×: Hardness is felt when holding the woven/knitted fabric.

[Example 1]

[0072] Polybutylene terephthalate (PBT melt viscosity: 160 Pa•s) was used as the polymer component A, polyethylene terephthalate (PET melt viscosity: 140 Pa•s) was used as the polymer component B, a weight composite ratio of the polymer component A and the polymer component B was set to 50/50, and the polymer component A and the polymer component B were introduced into a spinneret for eccentric core-sheath composite yarn having 48 discharge holes. Each polymer was joined inside a spinneret to form an eccentric core-sheath composite form in which the polymer of the polymer component A was contained in the polymer of the polymer component B, and spinning was performed from the spinneret at a spinning speed of 3000 (m/min) to obtain a highly-oriented unstretched yarn having a fineness of 95 dtex, 48 filaments and an elongation of 152%. In the spinning of Example 1, a distribution plate spinneret was used so as to obtain the eccentric core-sheath composite fiber shown in Fig. 1.

[0073] Next, using a friction false-twisting machine (ATF 12, manufactured by TMT Machinery Co., Ltd.), the highly-oriented unstretched yarn was fed from a feed roller, and subjected to stretching and false twisting at a processing speed of 500 m/min, a stretching ratio of 1.6 times, a heater temperature of 180°C, and a false-twisting coefficient of 29,000. Thereafter, interlacing was performed at an interlacing pressure of 0.2 MPa to obtain an eccentric core-sheath composite false-twisted yarn having a fineness of 60 dtex, a crimping rate of 47%, a residual torque of 65 T/m, the number of interlacing of 40/m, the single-yarn modification degree of 1.8, and a difference in modification degree between single yarns of 1.4. The S/D ratio in the fiber cross-section was 0.02, and the ratio of the length of the portion (hereinafter, sometimes referred to as a "minimum thickness portion") having a thickness within 1.05 times the minimum thickness S to the circumferential length of the entire eccentric core-sheath composite false-twisted yarn (sometimes referred to as "S ratio") was 40%.

[0074] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 175 yarns/2.54 cm, weft: 125 yarns/2.54 cm). The obtained woven fabric had an elongation rate of 26% by warp and 30% by weft, and was very excellent in stretchability. In addition, the KES surface roughness was 1.4 μm, the wear resistance (when non-elongated) was grade 4.5, and the wear resistance (when elongated) was grade 4, and thus the stretch woven fabric was very excellent in wear resistance and also excellent in plumpness.

[Example 2]

[0075] With the same manner as in Example 1, an eccentric core-sheath composite form was produced in which the polymer of the polymer component A was contained in the polymer of the polymer component B, and spinning was performed from the spinneret at a spinning speed of 3600 (m/min) to obtain a highly-oriented unstretched yarn having a fineness of 80 dtex, 48 filaments and an elongation of 115%.

[0076] Next, using a friction false-twisting machine (ATF 12, manufactured by TMT Machinery Co., Ltd.), the highly-oriented unstretched yarn was fed from a feed roller, and subjected to stretching and false twisting at a processing speed of 500 m/min, a stretching ratio of 1.3 times, a heater temperature of 170°C, and a false twist coefficient of 27,000 to obtain an eccentric core-sheath composite false-twisted yarn having a fineness of 60 dtex, a crimping rate of 34%, a residual torque of 26 T/m, the number of interlacing of 0/m, the single-yarn modification degree of 1.3, and a difference in modification degree between single yarns of 0.4. The S/D ratio in the fiber cross-section was 0.1, and the length of the minimum thickness portion accounted for 35% of the circumferential length of the entire eccentric core-sheath composite false-twisted yarn.

[0077] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 170 yarns/2.54 cm, weft: 120 yarns/2.54 cm). The obtained woven fabric had an elongation rate of 17% by warp and 19% by weft, and was excellent in stretchability. In addition, the KES surface roughness was 4.3 μm, the wear resistance (when non-elongated) was grade 4.5, and the wear resistance (when elongated) was grade 3, and thus the stretch woven fabric was excellent in wear resistance and also excellent in plumpness.

[Example 3]

[0078] Polytrimetylene terephthalate (3GT melt viscosity: 170 Pa•s) was used as the polymer component A, polyethylene terephthalate (PET melt viscosity: 140 Pa•s) was used as the polymer component B, a weight composite ratio of the polymer component A and the polymer component B was set to 50/50, and the polymer component A and the polymer component B were introduced into a spinneret for eccentric core-sheath composite false-twisted yarn having 48 discharge holes. Each polymer was joined inside a spinneret to form an eccentric core-sheath composite form in which the polymer of the polymer component A was contained in the polymer of the polymer component B, and spinning was performed from the spinneret at a spinning speed of 3000 (m/min) to obtain a highly-oriented unstretched yarn having a fineness of 95 dtex, 48 filaments and an elongation of 150%. In the spinning of Example 3, a distribution plate spinneret was used so as to obtain the eccentric core-sheath composite fiber shown in Fig. 1.

[0079] Next, using a friction false-twisting machine (ATF 12, manufactured by TMT Machinery Co., Ltd.), the highly-oriented unstretched yarn was fed from a feed roller, and subjected to stretching and false twisting at a processing speed of 500 m/min, a stretching ratio of 1.6 times, a heater temperature of 180°C, and a false-twisting coefficient of 31,000. Thereafter, interlacing was performed at an interlacing pressure of 0.3 Mpa to obtain an eccentric core-sheath composite false-twisted yarn having a fineness of 60 dtex, a crimping rate of 54%, a residual torque of 90 T/m, the number of interlacing of 62/m, the single-yarn modification degree of 1.9, and a difference in modification degree between single yarns of 1.6. The S/D ratio in the fiber cross-section was 0.02, and the length of the minimum thickness portion accounted for 40% of the circumferential length of the entire eccentric core-sheath composite false-twisted yarn.

[0080] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 178 yarns/2.54 cm, weft: 128 yarns/2.54 cm). The obtained woven fabric had an elongation rate of 29% by warp and 33% by weft, and was very excellent in stretchability. In addition, the KES surface roughness was 2.1 μm, the wear resistance (when non-elongated) was grade 4.5, and the wear resistance (when elongated) was grade 4, and thus the stretch woven fabric was very excellent in wear resistance and also excellent in plumpness.

[Example 4]

[0081] Using the same polymers A and B as in Example 1, the weight composite ratio of the polymer component A and the polymer component B was set to 50/50, and the polymer A and the polymer B were caused to flow into a spinneret for eccentric core-sheath composite false-twisted yarn having 72 discharge holes. Each polymer was joined inside a spinneret to form an eccentric core-sheath composite form in which the polymer of the polymer component A was contained in the polymer of the polymer component B, and spinning was performed from the spinneret at a spinning speed of 3000 (m/min) to obtain a highly-oriented unstretched yarn having a fineness of 95 dtex, 72 filaments and an elongation of 147%. In the spinning of Example 4, a distribution plate spinneret was used so as to obtain the eccentric core-sheath composite fiber shown in Fig. 1.

[0082] Next, using a friction false-twisting machine (ATF 12, manufactured by TMT Machinery Co., Ltd.), the highly-oriented unstretched yarn was fed from a feed roller, and subjected to stretching and false twisting at a processing speed of 500 m/min, a stretching ratio of 1.6 times, a heater temperature of 180°C, and a false-twisting coefficient of 28,000. Thereafter, interlacing was performed at an interlacing pressure of 0.2 Mpa to obtain an eccentric core-sheath composite false-twisted yarn having a fineness of 60 dtex, a crimping rate of 38%, a residual torque of 38 T/m, the number of interlacing of 34/m, the single-yarn modification degree of 1.4, and a difference in modification degree between single yarns of 0.7. The S/D ratio in the fiber cross-section was 0.02, and the length of the minimum thickness portion accounted for 40% of the circumferential length of the entire eccentric core-sheath composite false-twisted yarn.

[0083] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 173 yarns/2.54 cm, weft: 123 yarns/2.54 cm). The obtained woven fabric had an elongation rate of 22% by warp and 24% by weft, and was very excellent in stretchability. In addition, the KES surface roughness was 2.7 μm, the wear resistance (when non-elongated) was grade 4.5, and the wear resistance (when elongated) was grade 3.5, and thus the stretch woven fabric was very excellent in wear resistance and also excellent in plumpness.

[Example 5]

[0084] A highly-oriented unstretched yarn was obtained in the same manner as in Example 1.

[0085] Next, using a friction false-twisting machine (ATF 12, manufactured by TMT Machinery Co., Ltd.), the highly-oriented unstretched yarn was fed from a feed roller, and subjected to pre-low ratio stretching at a hot pin temperature of 80°C and a pre-stretching ratio of 1.3 times. Thereafter, the yarns were subjected to pre-low ratio stretching at a processing speed of 500 m/min, a stretching ratio of 1.2 times, a heater temperature of 180°C, and a false-twisting coefficient of 29,000, and then, interlacing was performed at an interlacing pressure of 0.25 MPa to obtain an eccentric core-sheath composite false-twisted yarn having a fineness of 60 dtex, a crimping rate of 37%, a residual torque of 83 T/m, the number of interlacing of 64/m, the single-yarn modification degree of 2.0, and a difference in modification degree between single yarns of 1.9. The S/D ratio in the fiber cross-section was 0.02, and the length of the minimum thickness portion accounted for 40% of the circumferential length of the entire eccentric core-sheath composite false-twisted yarn.

[0086] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 173 yarns/2.54 cm, weft: 122 yarns/2.54 cm). The obtained woven fabric had an elongation rate of 21% by warp and 24% by weft, and was excellent in stretchability. In addition, the KES surface roughness was 2.8 μm, the wear resistance (when non-elongated) was grade 4.5, and the wear resistance (when elongated) was grade 4, and thus the stretch woven fabric was very excellent in wear resistance and also excellent in plumpness.

[Comparative Example 1]

[0087] A highly-oriented unstretched yarn was obtained in the same manner as in Example 1.

[0088] Thereafter, a stretching heat treatment was performed at 140°C and a stretching ratio of 1.6 times, and interlacing was then performed at an interlacing pressure of 0.2 MPa to obtain an eccentric core-sheath composite yarn having a fineness of 60 dtex, a crimping rate of 20%, a residual torque of 1 T/m, a number of interlacing of 17/m, the single-yarn modification degree of 1.0, and a difference in modification degree between single yarns of 0. The S/D ratio in the fiber cross-section was 0.02, and the length of the minimum thickness portion accounted for 40% of the circumferential length of the entire eccentric core-sheath composite yarn.

[0089] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 160 yarns/2.54 cm, weft: 109 yarns/2.54 cm). The obtained woven fabric had a slightly poor elongation rate of 10% by warp and 12% by weft. In addition, the KES surface roughness was 7.6 μm, the wear resistance (when non-elongated) was grade 4, and the wear resistance (when elongated) was grade 2, and thus the stretch woven fabric was poor in wear resistance and also slightly poor in plumpness.

[Comparative Example 2]

[0090] A highly-oriented unstretched yarn was obtained in the same manner as in Example 1, and then subjected to a stretching heat treatment at 130°C and a stretching ratio of 1.55.

[0091] Next, using a friction false-twisting machine (ATF 12, manufactured by TMT Machinery Co., Ltd.), the unstretched yarn was fed from a feed roller, and subjected to false twisting at a processing speed of 500 m/min, a stretching ratio of 1.0 times, a heater temperature of 160°C, and a false-twisting coefficient of 28,000. Thereafter, interlacing was performed at an interlacing pressure of 0.2 MPa to obtain an eccentric core-sheath composite false-twisted yarn having a fineness of 60 dtex, a crimping rate of 36%, a residual torque of 55 T/m, the number of interlacing of 38/m, the single-yarn modification degree of 1.2, and a difference in modification degree between single yarns of 0.1. The S/D ratio in the fiber cross-section was 0.02, and the length of the minimum thickness portion accounted for 40% of the circumferential length of the entire eccentric core-sheath composite false-twisted yarn.

[0092] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 172 yarns/2.54 cm, weft: 121 yarns/2.54 cm). The obtained woven fabric had an elongation rate of 21% by warp and 23% by weft and was excellent in stretchability, but had a KES surface roughness of 10.5 μm, wear resistance (when non-elongated) of grade 4, and wear resistance (when elongated) of grade 2; thus, it was a stretch woven fabric insufficient in wear resistance when elongated.

[Comparative Example 3]

[0093] Using the same polymers as in Example 1, the weight composite ratio of the polymer component A and the polymer component B was set to 50/50, and the polymer A and the polymer B were caused to flow into a spinneret for side-by-side bonding with 48 discharge holes. Each polymer was spun from a spinneret at a spinning speed of 3000 (m/min) to obtain a highly-oriented unstretched yarn having a fineness of 95 dtex, 48 filaments and an elongation of 150%.

[0094] Next, using a friction false-twisting machine (ATF 12, manufactured by TMT Machinery Co., Ltd.), the highly-oriented unstretched yarn was fed from a feed roller, and subjected to stretching and false twisting at a processing speed of 500 m/min, a stretching ratio of 1.6 times, a heater temperature of 180°C, and a false twist coefficient of 29,000 to obtain an eccentric core-sheath composite false-twisted yarn having a fineness of 60 dtex, a crimping rate of 46%, a residual torque of 25 T/m, the number of interlacing of 0/m, the single-yarn modification degree of 1.8, and a difference in modification degree between single yarns of 1.3.

[0095] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 175 yarns/2.54 cm, weft: 124 yarns/2.54 cm). The obtained woven fabric had an elongation rate of 26% by warp and 28% by weft and was very excellent in stretchability, but had a KES surface roughness of 5.2 μm, wear resistance (when non-elongated) of grade 2.5, and wear resistance (when elongated) of grade 1.5; thus, it was insufficient in wear resistance.

[Comparative Example 4]

[0096] Polybutylene terephthalate (PBT melt viscosity: 160 Pa•s) was used as the polymer component A, polyethylene terephthalate (PET melt viscosity: 140 Pa•s) was used as the polymer component B, a weight composite ratio of the polymer component A and the polymer component B was set to 50/50, and the polymer component A and the polymer component B were introduced into a spinneret for eccentric core-sheath composite yarn having 48 discharge holes. Each polymer was joined inside a spinneret to form an eccentric core-sheath composite form in which the polymer of the polymer component A was contained in the polymer of the polymer component B, and spinning was performed from the spinneret at a spinning speed of 300 (m/min) to obtain a highly-oriented unstretched yarn having a fineness of 95 dtex, 48 filaments and an elongation of 150%. In the spinning of Example 1, a distribution plate spinneret was used so as to obtain the eccentric core-sheath composite fiber shown in Fig. 1.

[0097] Next, using a friction false-twisting machine (ATF 12, manufactured by TMT Machinery Co., Ltd.), the highly-oriented unstretched yarn was fed from a feed roller, and subjected to stretching and false twisting at a processing speed of 500 m/min, a stretching ratio of 1.6 times, a heater temperature of 170°C, and a false twist coefficient of 27,000 to obtain an eccentric core-sheath composite false-twisted yarn having a fineness of 58 dtex, a crimping rate of 31%, a residual torque of 18 T/m, the number of interlacing of 0/m, the single-yarn modification degree of 1.3, and a difference in modification degree between single yarns of 0.1. The S/D ratio in the fiber cross-section was 0.25, and the length of the minimum thickness portion accounted for 30% of the circumferential length of the entire eccentric core-sheath composite false-twisted yarn.

[0098] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 163 yarns/2.54 cm, weft: 112 yarns/2.54 cm). The obtained woven fabric had an elongation rate of 15% by warp and 16% by weft, which means that it had stretchability. Meanwhile, the KES surface roughness was 11.6 um, the wear resistance (when non-elongated) was grade 4, and the wear resistance (when elongated) was grade 2.5, and thus the stretch woven fabric had poor wear resistance.

[Comparative Example 5]

[0099] Polybutylene terephthalate (PBT melt viscosity: 160 Pa•s) was used as the polymer component A, polyethylene terephthalate (PET melt viscosity: 140 Pa•s) was used as the polymer component B, a weight composite ratio of the polymer component A and the polymer component B was set to 50/50, and polyethylene terephthalate copolymerized with 0.3 mol% of 5-sodium sulfoisophthalic acid was used as a single fiber and discharged from a discharge hole. The shape of the discharge hole is circular for both the composite yarn and the single yarn, and the number of discharge holes is 24 for the composite fiber and 48 for the single fiber. Each polymer was joined inside a spinneret to form an eccentric core-sheath composite form in which the polymer of the polymer component A was contained in the polymer of the polymer component B and a composite form composed of single fibers, and they were spun from the spinneret at a spinning speed of 3400 (m/min) to obtain a highly-oriented unstretched yarn having a fineness of 140 dtex, 72 filaments and an elongation of 150%.

[0100] Next, using a friction false-twisting machine (ATF 12, manufactured by TMT Machinery Co., Ltd.), the highly-oriented unstretched yarn was fed from a feed roller, and subjected to stretching and false twisting at a processing speed of 100 m/min, a stretching ratio of 1.4 times, a heater temperature of 170°C, and a false twist coefficient of 28,000 to obtain an eccentric core-sheath composite false-twisted yarn having a fineness of 100 dtex, a crimping rate of 30%, a residual torque of 21 T/m, the number of interlacing of 0/m, the single-yarn modification degree of 1.4, and a difference in modification degree between single yarns of 0.1. The S/D ratio in the composite fiber cross-section was 0.02, and the length of the minimum thickness portion accounted for 40% of the circumferential length of the entire eccentric core-sheath composite false-twisted yarn.

[0101] Thereafter, using the above-mentioned yarns as warps and wefts, the woven fabric was woven into a plain weave fabric by an air jet loom, and then the obtained woven fabric was subjected to continuous scouring for expansion at 98°C, liquid flow relaxation at 120°C, intermediate setting at 180°C, dyeing at 130°C, and finishing at 160°C to obtain a product having a processing density (warp: 135 yarns/2.54 cm, weft: 95 yarns/2.54 cm). The obtained woven fabric had an elongation rate of 15% by warp and 17% by weft, which means that it had stretchability. Meanwhile, the KES surface roughness was 13.5 um, the wear resistance (when non-elongated) was grade 4, and the wear resistance (when elongated) was grade 2.5, and thus the stretch woven fabric had slightly poor wear resistance.

[Table 1-1]

Item		Example 1	Example 2	Example 3	Example 4	Example 5
Raw Yarn	Polymer Component A	PBT	PBT	3GT	PBT	PBT
	Polymer Component B	PET	PET	PET	PET	PET
	Cross-section	Eccentric core-sheath	Eccentric core-sheath	Eccentric core-sheath	Eccentric core-sheath	Eccentric core-sheath
	Weight Composite Ratio (A : B)	50:50	50:50	50:50	50:50	50:50
	Single Fiber	-	-	-	-	-
	Elongation (%)	152	115	150	147	152

(continued)

Item		Example 1	Example 2	Example 3	Example 4	Example 5
Textured Yarn	Processing Method	Stretching with false twisting	Stretching with false twisting	Stretching with false twisting	Stretching with false twisting	Pre-low ratio stretching & false twisting
	Fineness (dtex)	60	60	60	60	60
	Number of Filaments	48	48	48	72	48
	Crimping Rate (%)	47	34	54	38	37
	Residual Torque (T/m)	65	26	90	38	83
	Number of Interlacing (/m)	40	0	62	34	64
	Single-yarn Modification Degree (-)	1.8	1.3	1.9	1.4	2.0
	Difference in Modification Degree between Single Yarns (-)	1.4	0.4	1.6	0.7	1.9
	S/D (-)	0.02	0.1	0.02	0.02	0.02
	S Ratio (%)	40	35	40	40	40
Cloth	Stretch Rate (%) (Warp × Weft)	26 × 30	17 × 19	29 × 33	22 × 24	21 × 24
	Surface Roughness (μm)	1.4	4.3	2.1	2.7	2.8
	Wear Resistance (When Non-elongated) (Grade)	4.5	4.5	4.5	4.5	4.5
	Wear Resistance (When Elongated) (Grade)	4	3	4	3.5	4
	Texture (Plumpness)	◎	○	◎	○	◎

[Table 1-2]

Item		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5
Raw Yarn	Polymer Component A	PBT	PBT	PBT	PBT	PBT
	Polymer Component B	PET	PET	PET	PET	PET
	Cross-section	Eccentric core-sheath	Eccentric core-sheath	Bonding	Eccentric core-sheath	Eccentric core-sheath
	Weight Composite Ratio (A : B)	50:50	50:50	50:50	50:50	50:50
	Single Fiber	-	-	-	-	Copolymerized PET
	Elongation (%)	152	40	150	120	150

(continued)

Item		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5
Textured Yarn	Processing Method	Stretching	False twisting	Stretching with false twisting	Stretching with false twisting	Stretching with false twisting
	Fineness (dtex)	60	60	60	58	100
	Number of Filaments	48	48	48	48	72
	Crimping Rate (%)	20	36	46	31	30
	Residual Torque (T/m)	1	55	25	18	21
	Number of Interlacing (1m)	17	38	0	0	0
	Single-yarn Modification Degree (-)	1.0	1.2	1.8	1. 3	1.4
	Difference in Modification Degree between Single Yarns (-)	0.0	0.1	1.3	0.1	0.1
	S/D (-)	0.02	0.02	-	0.25	0.02
	S Ratio (%)	40	40	-	30	40
Cloth	Stretch Rate (%) (Warp × Weft)	10 × 12	21 × 23	26 × 28	15 × 16	15 × 17
	Surface Roughness (μm)	7.6	10.5	5.2	11.6	13.5
	Wear Resistance (When Non-elongated) (Grade)	4	4	2.5	4	4
	Wear Resistance (When Elongated) (Grade)	2	2	1.5	2.5	2.5
	Texture (Plumpness)	△	○	○	○	○

DESCRIPTION OF REFERENCE SIGNS

[0102]

a: Center-of-gravity of component A in composite fiber cross-section

C: Center-of-gravity of composite fiber cross-section

S: Minimum thickness of component B

D: Fiber diameter

Claims

1. An eccentric core-sheath composite false-twisted yarn, comprising a multifilament composed of a single yarn in which, in a cross-section of a composite fiber composed of two polymers that are a component A and a component B, the component A is completely covered with the component B, a ratio S/D of a minimum thickness S of a thickness of the component B covering the component A to a fiber diameter D is 0.01 to 0.1, and a peripheral length of a fiber at a portion where a thickness is 1.05 times or less the minimum thickness S is 1/3 or more of a peripheral length of the entire fiber, wherein a difference in modification degree between the single yarns is 0.2 or more, and a crimping rate is 30% or more.

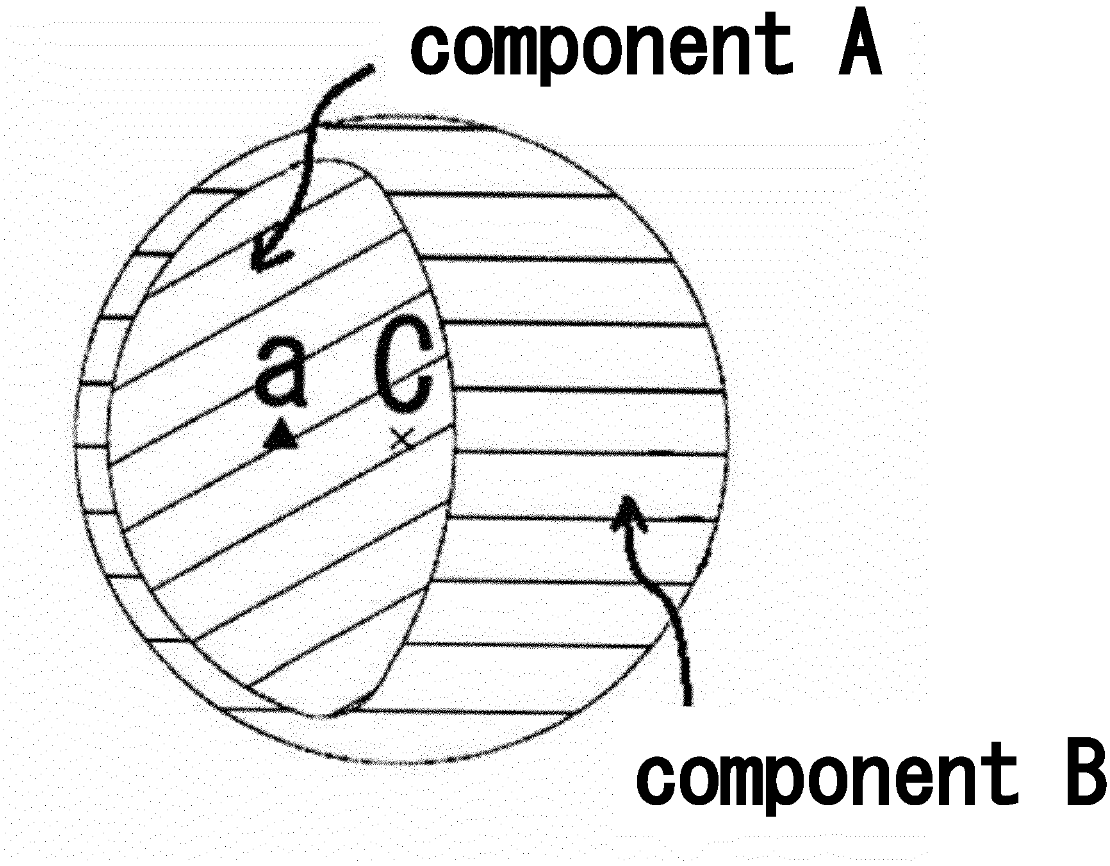
2. The eccentric core-sheath composite false-twisted yarn according to claim 1, wherein a residual torque is 30 T/M or more.

3. A woven/knitted fabric using the eccentric core-sheath composite false-twisted yarn according to claim 1 or 2.

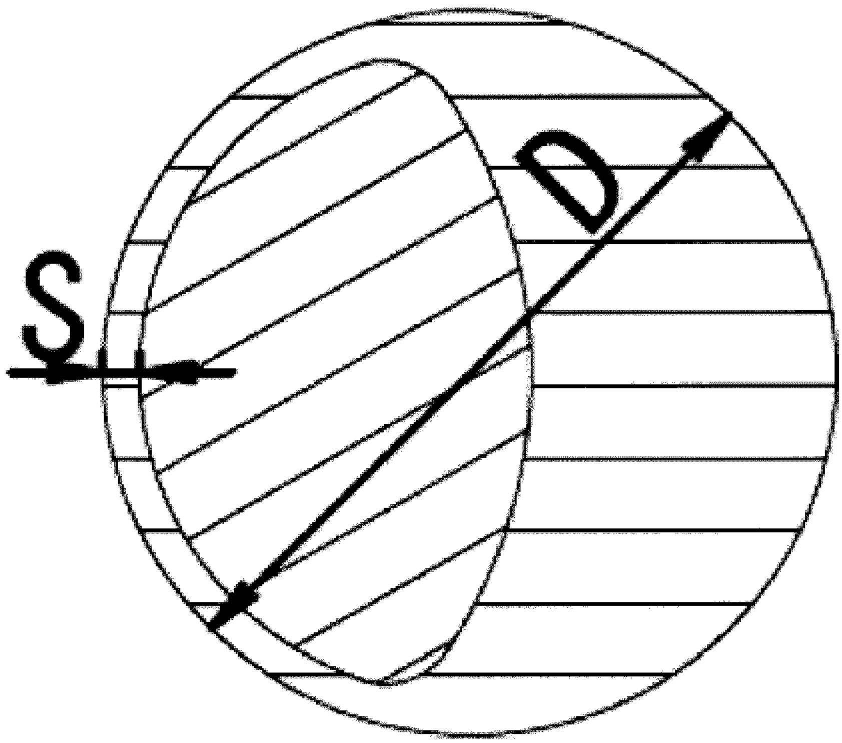
4. The woven/knitted fabric according to claim 3, wherein a KES surface roughness is 10 μm or less.

5. The woven/knitted fabric according to claim 3, wherein wear resistance at 10% elongation is grade 3 or higher.

[Fig.1]



[Fig.2]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/040598

A. CLASSIFICATION OF SUBJECT MATTER

D02G 1/18(2006.01)i; ***D01F 8/04***(2006.01)i; ***D03D 15/283***(2021.01)i; ***D03D 15/292***(2021.01)i; ***D03D 15/37***(2021.01)i; ***D03D 15/41***(2021.01)i; ***D03D 15/49***(2021.01)i
FI: D02G1/18; D03D15/37; D03D15/49 200; D03D15/41; D03D15/283; D03D15/292; D01F8/04 Z

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)

D02G1/00-3/48; D01F8/00-8/18; D03D1/00-27/18

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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.
Y	WO 2018/110523 A1 (TORAY INDUSTRIES, INC) 21 June 2018 (2018-06-21) claims 1, 4, paragraphs [0001]-[0002], [0039]-[0067], [0078]-[0099], example 27, fig. 2, 3	1-5
Y	JP 2020-105682 A (TORAY INDUSTRIES, INC) 09 July 2020 (2020-07-09) paragraphs [0007]-[0009], [0058]-[0061], example 1	1-5
Y	JP 2020-186503 A (UNITIKA TRADING CO LTD) 19 November 2020 (2020-11-19) paragraphs [0012], [0044]	2
Y	WO 2020/213395 A1 (TEIJIN FRONTIER CO., LTD.) 22 October 2020 (2020-10-22) claims, paragraphs [0008]-[0010], [0031]-[0032]	4
A	JP 2002-339169 A (TORAY INDUSTRIES, INC) 27 November 2002 (2002-11-27) entire text	1-5
A	JP 44-21171 B2 (TOYO RAYON CO., LTD.) 10 September 1969 (1969-09-10) entire text	1-5

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
16 December 2022	**10 January 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/040598

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2020/110890 A1 (TEIJIN FRONTIER CO., LTD.) 04 June 2020 (2020-06-04) entire text	1-5
A	WO 2020/095861 A1 (TORAY INDUSTRIES, INC) 14 May 2020 (2020-05-14) entire text	1-5

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/040598

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2018/110523 A1	21 June 2018	US 2020/0087820 A1 claims 10, 13, 15, paragraphs [0001]-[0002], [0053]-[0083], [0095]-[0117], example 27, fig. 2, 3 EP 3556915 A1 CN 110088365 A KR 10-2019-0087462 A	
JP 2020-105682 A	09 July 2020	(Family: none)	
JP 2020-186503 A	19 November 2020	(Family: none)	
WO 2020/213395 A1	22 October 2020	US 2022/0170187 A1 claims, paragraphs [0009]-[0011], [0035]-[0036] EP 3957787 A1 KR 10-2021-0141761 A CN 113692461 A	
JP 2002-339169 A	27 November 2002	(Family: none)	
JP 44-21171 B2	10 September 1969	(Family: none)	
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- WO 2018110523 A **[0007]**
- JP 2019214798 A **[0007]**