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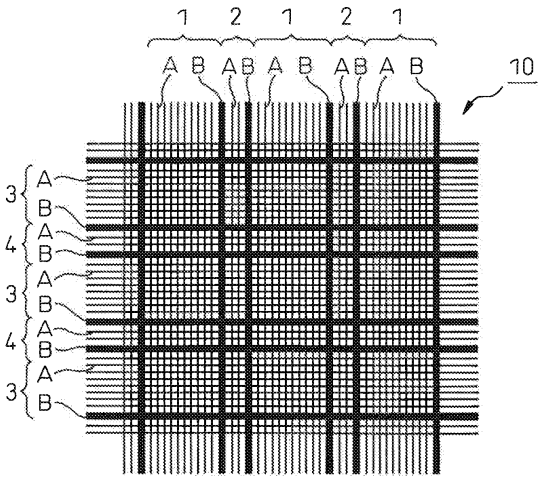
(54) FABRIC MATERIAL FOR SPORTS

(57) The fabric material useful for sports equipment such paragliders, hanggliders and yacht sails is a composite fabric comprising a substrate fabric comprising a woven polyester fiber fabric and an impregnation-adhered layer formed on the substrate fabric and comprising a silicone-copolymerized urethane resin, wherein the substrate fabric has a basis mass of 20-80 g/m^2, the impregnation-adhered layer is in an amount of 5-40% by mass based on the mass of the substrate fabric, and the composite fabric has a basis mass of 21-100 g/m^2 and an air permeability of 1.0 ml/cm^2/s or less.

Fig.1



EP 2 184 399 A1

Description

Technical Field

[0001] The present invention relates to a fabric material for sports equipment. More particularly the present invention relates to a fabric material for use in sports equipment that utilize wind, such as a paraglider, hangglider, yacht sail, spinnaker, kiteboarding and stuntkite.

Background Art

[0002] Recently, there is a growing trend of enjoying sports as a hobby. The activities have become multifarious and recently leisure type sports, for example, marine sports and sky sports, have become very popular. Goods for such marine sports and sky sports include yacht sails, spinnakers, paragliders, hanggliders, kiteboarding etc., and fiber-based fabrics are used in them. Conventional fiber materials for such sports equipment have used nylon fibers because they are light weight, have a high degree of strength and the like. Since such fabrics for sports equipment are used outdoors for a long period of time, demands are increasing for high resistance to weathering, and utilization of polyester fibers, which have excellent resistance to weathering compared to nylon fibers, are gaining popularity. Patent document 1 proposes fabrics for sports equipment that utilize polyester fibers, and Patent document 2 proposes fabric materials for sports equipment that utilize woven fabrics of a ripstop structure using a polyester fabric to which a silicone resin and a polyurethane resin have been adhered.

[0003] However, for such fabrics for sports equipment, not only resistance to weathering, but enhanced tear resistance and abrasion resistance are desired, and in the case of woven fabrics that undergo a resin treatment, enhanced tear resistance is specifically desired.

[0004] Furthermore, Patent document 3 proposes fabrics that have undergone water repellent treatment as a pre-treatment for the urethane resin treatment in order to enhance tear resistance. Studies have confirmed that water repellent treatment prior to urethane resin treatment makes fibers slippery and can enhance tear resistance, but it can often form adhesion spots of the urethane resin and thereby variation in tear resistance may become great.

[0005]

Patent document 1: Japanese Patent No. 2653919
Patent document 2: Japanese Unexamined Patent Publication (Kokai) No. 2005-97787
Patent document 3: Japanese Examined Patent Publication (Kokoku) No. 4-59139

Disclosure of the Invention

[0006] It is an object of the present invention to provide a fabric material for wind-utilizing sports equipment having excellent tear resistance, in which a silicone-copolymerized urethane resin has been impregnation-adhered to a woven fabric comprising polyester fiber as the main component.

[0007] After intensive and extensive research on resins to be adhered on fabric for sports equipment, the inventor of the present invention has found that the use of a silicone-copolymerized urethane resin cannot only exhibit excellent tear resistance, but can enhance abrasion resistance, and based on this finding, has completed the present invention.

[0008] The fabric material for sports equipment of the present invention comprises a composite fabric comprising:

a substrate fabric comprising a woven fabric containing polyester fibers as a main component and
an impregnation-adhered layer impregnation-adhered to the substrate fabric and containing a silicone-copolymerized urethane resin as a main component,
wherein
the substrate fabric has a basis mass of 20-80 g/m^2,
the impregnation-adhered layer is in amount of 5-40% by mass based on the mass of the substrate fabric, and
the composite fabric has a basis mass of 21-100 g/m^2, and
an air permeability of 1.0 ml/cm^2/s or less.

[0009] In the fabric material for sports equipment of the present invention, the silicone-copolymerized urethane resin preferably comprises a silicone-copolymerized polycarbonate urethane resin.

In the fabric material for sports equipment of the present invention, the substrate fabric preferably has a tear resistance of 29.42 N (3.0 kgf) or more.

In the fabric material for sports equipment of the present invention, the substrate fabric preferably has a tear resistance of 294.1 N (30 kgf)/5 cm or more, an elongation of 10% or more and an abrasion resistance of 75 times or more.

In the fabric material for sports equipment of the present invention, preferably, the woven fabric for the substrate comprises a plurality of warps and wefts, each comprising a plurality of principal polyester yarns A and woven fabric-reinforcing polyester thick yarns B having a linear density (unit: dtex) of 2 to 5 times the linear density (unit: dtex) of the principal yarns A, and, in a yarn arrangement pattern composed of each of the warp and weft yarns, one of the thick yarns B is arranged per 2 to 50 of the above principal polyester yarns A arranged in parallel adjacent to each other, and thereby a check-patterned reinforcing structure is formed in the woven fabric for substrate fabric.

In the fabric material for sports equipment of the present invention, the cross sectional profile of the polyester fiber preferably has a flat shape in which 2 to 6 circles are connected along the major axis in a manner such that parts of the circles overlap with each other.

[0010] The fabric material for sports equipment of the present invention has an excellent tensile strength and abrasion resistance and can provide fabric materials for sports equipment that utilize wind, such as paragliders, yacht sails, kiteboarding and the like. Brief Explanation of the Drawings

[0011] [Fig. 1] Fig. 1 is a structure diagram showing the weaving structure of an exemplary woven fabric used in the substrate fabric of the fabric material for sports equipment of the present invention.

[Fig. 2] Fig. 2 illustrates the shape of cross sections that are preferred for a polyester woven fabric contained in the substrate fabric of the fabric material for sports equipment of the present invention, in which (a) is a cross-sectional view showing an example of the shape of a flat concavo-convex cross section in which two circles are connected along the major axis in a manner such that parts of the circles overlap with each other, (b) a cross-sectional view showing an example of the shape of a flat concavo-convex cross section in which three circles are connected along the major axis in a manner such that parts of the circles overlap with each other, (c) a cross-sectional view showing an example of the shape of a flat concavo-convex cross section in which four circles are connected along the major axis in a manner such that parts of the circles overlap with each other, (d) a cross-sectional view showing an example of the shape of a flat concavo-convex cross section in which five circles are connected along the major axis in a manner such that parts of the circles overlap each other, and (e) a cross-sectional view showing an example of the shape of a flat concavo-convex cross section in which six circles are connected along the major axis in a manner such that parts of the circles overlap each other.

Best Mode for Carrying out the Invention

[0012] The fabric material for sports equipment of the present invention comprises a substrate fabric comprising a woven fabric containing polyester fibers as a main component and a silicone-copolymerized urethane resin layer impregnation-adhered to the substrate fabric. The polyester fibers for the substrate fabric are preferably formed from a polyester comprising an aromatic dicarboxylic acid component including as a principal component, terephthalic acid and/or naphthalene dicarboxylic acid and a glycol component including, as a principal component, ethylene glycol, 1,3-propanediol and/or tetramethylene glycol. Preferred polymers for the fibers usable in the present invention include polyethylene terephthalate, polybuthylene terephthalate, polytrimethylene terephthalate, polyethylene naththalate and the like. These polyester polymers may contain, as the copolymerizing component, one or more of isophthalic acid, adipic acid, oxobenzoic acid, diethylene glycol, propylene glycol, trimellitic acid, pentaerythritol and the like.

The polyester fibers for the substrate fabric optionally contain additives such a stabilizer, a coloring agent and an antistatic agent.

[0013] The total linear density (total fineness) of the polyester fiber yarn of the present invention is preferably 15 to 300 dtex, more preferably 20 to 200 dtex, and more preferably 30 to 170 dtex. If the total linear density of the polyester fiber yarn is less than 15 dtex, the mechanical strength of the resultant woven fabric therefrom may be inferior and the performance of the resultant fabric material for sports equipment may not be satisfactory, and on the other hand if the total linear density of the polyester fiber yarn is greater than 300 dtex, mass the resultant fabric may become too heavy, which is unsuitable for sports equipment. The linear density in dtex of the individual fibers (hereinafter abbreviated to as DPF) for use in the present invention is preferably 1.5 to 3.5 dtex. If DPF is less than 1.5 dtex, an inconvenience may occur that a fabric material made of this fiber may be excessively soft and easy to break, and if DPF is greater than 3.5 dtex, a fabric material made of this fiber may be excessively rough and rigid.

[0014] The tensile strength and ultimate elongation of the polyester fibers for use in the substrate fabric of the fabric material of the present invention may preferably be 4.8 cN/dtex or more and 10% or more, respectively, and more preferably 5.0 to 15.0 cN/dtex and 10 to 30%, respectively. Generally, polyester fibers having a higher tensile strength tend to have a lower ultimate elongation. When the ultimate elongation of the polyester fibers is less than 10%, even if the tensile strength of the polyester fibers is 4.8 cN/dtex or more, the sports equipment, such as a spinnaker produced using the polyester fibers, may rapidly be filled with wind, and when faced with high wind pressure, the equipment may immediately deform (elongate) and the performance of absorbing and utilizing the wind energy becomes insufficient, rendering it easy to break. When the tensile strength of the polyester fiber is less than 4.8 cN/dtex, even if the tensile elongation of the polyester fiber is 10% or more, the resultant fabric material comprising the polyester fibers tends to

break easily when faced with sudden high wind pressure.

[0015] While there is no limitation on the weave structure of a woven fabric for use in the substrate fabric of the fabric material of the present invention, the woven fabric preferably has a check-patterned reinforcing weave structure.

The check-patterned reinforcing weave structure for the present invention comprises principal fiber yarns A and woven fabric-reinforcing thick yarns B, in which the linear density of said thick yarns B is 2 to 5-times that of the principal yarns A, and in the pattern of yarn arrangement of each of the warps and wefts, preferably one of the thick yarns B is arranged per 2 to 50 of the principal polyester yarns A arranged in parallel adjacent to each other, and thereby a check-patterned reinforcing structure is formed in the woven fabric for the substrate fabric.

[0016] Fig. 1 shows an example of the weave structure of the substrate fabric having a check-patterned reinforcing weave structure of the fabric material of the present invention. In the yarn arrangement pattern of the warps of a substrate fabric 10 of the fabric material of the present invention shown in Fig. 1, a repeating warp arrangement unit 1 is composed of 10 principal fiber yarns A and one thick yarn B, and on its adjacent right, a repeating warp arrangement unit 2 is composed of two principal fiber yarns A and one thick yarn B, with these repeating arrangement warp units 1 and 2 being alternately repeated. In the yarn arrangement pattern of the wefts, a repeating wefts arrangement unit 3 is composed of eight principal fiber yarns A and one thick yarn B, and beneath it one thick yarn B is repeated to form a repeating arrangement weft unit 4, with this weft arrangement unit 3 and 4 being alternately repeated. Since the warps and the wefts are interwoven as shown in Fig. 1, thick yarns B are regularly arranged for each predetermined number of principal yarns A in the warps and the wefts comprising a multitude of principal yarns A, thereby forming a check-patterned reinforcing weave structure.

[0017] Each thick yarn B may be a composite yarn comprising 2 to 5 principal yarns A as mentioned above. By being regularly woven in the direction of warps and wefts of the weave structure of the substrate fabric, the thick yarns B serve as a reinforcement for the resulting woven fabric, and exhibit a massive resistance effect against the deformation and breaking of the woven fabric.

[0018] If the linear density of the fiber in the thick yarns B is less than twice that of the principal yarn A, the reinforcing effect of the thick yarns B becomes insufficient, and if it becomes greater than five times, the reinforcing effect of said thick yarns B may become higher but the flexibility of the resulting woven fabric tends to decrease. If the number of the principal yarns A arranged in between two thick yarns B is less than two, the two thick yarns B may behave as when those composite yarns were used, thereby reducing the flexibility of the resulting woven fabric, and the performance against wind pressure of sports equipment made of a fabric material having the woven fabric as the substrate fabric may become insufficient.

[0019] If the number of the principal yarns A arranged in between two thick yarns B is greater than 50, spacing between the two thick yarns B becomes too large, and thus the cooperative action of the two thick yarns B with each other may decrease and thereby its reinforcing effect on the woven fabric is insufficient. In the woven fabric of a polyester fiber for use in the present invention, the mass ratio of the thick yarns B to the entire yarn mass is preferably be 5 to 50%. If it is less than 5%, the woven fabric-reinforcing effect by the thick yarns becomes insufficient, and if it is greater than 50%, the hand and appearance of the resulting woven fabric may be inferior.

[0020] In the fabric material of the present invention, it is necessary to lower the air permeability of the fabric material by impregnating the substrate fabric comprising a polyester fiber woven fabric with a resin. In order to use sports equipment made of the fabric material of the present invention without breaking even when it catches the wind and faces a high wind pressure, the fabric per se must be appropriately stretchable. Thus, a resin to be applied to the substrate fabric is preferably a resin capable of maintaining the stretching property, and is preferably selected from urethane resins in terms of versatility, economy, workability etc. When a resin such as an acrylic resin and a vinyl chloride resin is used, the resultant fabric material may has a low air permeability can, but the fabric material per se becomes rigid, and thus when it catches the wind and faces a high wind pressure, the stretchability of the fabric per se becomes small and may break up, which is not desirable.

[0021] Urethane resins include ether-type urethane resins, ester type urethane resins, the carbonate type urethane resins, etc. When these urethane resins are to be used, it is becoming more apparent, a favorable tear resistance cannot be obtained without applying a water repellent treatment thereto prior to the resin treatment. After intensive and extensive research of the invention of the present invention on the urethane resins for use in the present invention, the inventor of the present invention has found that the use of a silicone-copolymerized polycarbonate urethane resin obviates the need of a pretreatment prior to the application of the urethane resin and a high tear resistance can be obtained. Furthermore, by using such a resin, the abrasion resistance of the fabric material can be enhanced.

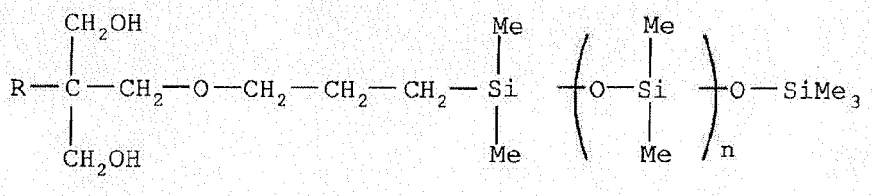
[0022] The silicone-copolymerized polycarbonate polyurethane resin is a modified polycarbonate urethane resin by copolymerizing a silicone compound, specifically an organopolysiloxane.

The polycarbonate urethane resin component can be prepared by a condensation reaction of a polycarbonate diol, with an organic polyisocyanate, an alkylene diol and a diamine compound. As the polycarbonate diol, there can be mentioned 1,6-hexylcarbonate diol, polyhexamethylenecarbonate diol, polytetramethylenecarbonate diol, polypentamethylenecarbonate diol, polyheptamethylenecarbonate diol, etc. Among them, 1,6-hexylcarbonate diol is preferred. As the organic

polyisocyanate, there can be mentioned aliphatic or alicyclic diisocyanates, for example, dicyclohexylmethane 4,4',-diisocyanate, hexamethylene diisocyanate, isophorone diisocyanate, bis(isocyanatemethyl)cyclohexane and lysine isocyanate, and aromatic diisocyanates, for example, 2,4-tolylene diisocyanate, 2,6-tolylene diisocyanate, 4,4'-diphenylmethane diisocyanate, 2,4'-diphenylmethane diisocyanate, P-phenylene diisocyanate, tolydine diisocyanate, 1,5-naphthalene diisocyanate and xylene diisocyanate. Among them, dicyclohexylmethane-4,4'-diisocyanate is preferred. As the alkylene diol, there can be mentioned 1,6-hexanediol, 1,4-butanediol, 1,5-pentanediol, etc. Among them, 1,6-hexanediol is preferred. As the diamine compound, there can be mentioned isophorone diamine, tolylene diamine, tetramethylhexamethylene diamine, hexamethylene diamine, etc. Among them, isophorone diamine is preferred.

In this condensation reaction, a silicone compound, preferably a organopolysiloxane compound, having a molecular weight of 1,000 to 12,000, can be copolymerized. The silicone compound preferably has two - CH_2OH group (a primary alcohol residue) on one terminal group, and the other terminal group is preferably nonreactive, and for example, a compound having the following chemical structure is preferably employed,

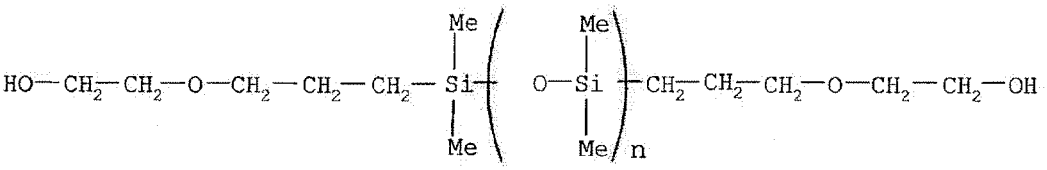
[Chemical 1]



wherein, R represents an alkyl group, n represents an integer of 2 to 130, and Me represents a methyl group.

[0023] In the silicone compound of the above-mentioned formula, the terminal group on the left terminal has two -CH_2OH groups (primary alcohol residues), and the terminal group -$SiMe_3$ on the right terminal is a nonreactive group. In the copolymerized silicone compound in which both terminal groups are a primary alcohol residue, when, for example, the following silicone compound:

[Chemical 2]



is used, the tear resistance of the resulting fabric material may be insufficient.

[0024] In the silicone-copolymerized polycarbonate polyurethane resin for use in the present invention, the content of the silicone-copolymerized component is preferably 3 to 15% by mass relative to the amount of the polycarbonate-based polyurethane resin component, and more preferably 5 to 10% by mass. The molecular weight of the silicone-copolymerized polycarbonate polyurethane resin is preferably 30,000 to 500,000 and more preferably 50,000 to 350,000. In the silicone-copolymerized polycarbonate polyurethane resin, if the content of the silicone component is less than 3% by mass, the mechanical strength, specifically the abrasion resistance, of the resulting fabric material may be insufficient, and if it exceeds 15% by mass, the friction resistance of the fabric material may become low and thus slipping may easily occur between the fabrics, leading to an inconvenience of bad winding. If the molecular weight of the silicone-copolymerized polycarbonate polyurethane resin is less than 30,000, an inconvenience that the tear resistance cannot be fully enhanced may occur, and if it exceeds 500,000, the viscosity becomes high, which may cause an inconvenience of a reduced impregnating ability.

[0025] In order to maintain the breaking strength and tear resistance of the fabric material at appropriate levels, the basis mass of the substrate woven fabric in the fabric material of the present invention is preferably 20 to 80 g/m^2, and more preferably 30 to 75 g/m^2. If the basis mass of the substrate woven fabric is less than 20 g/m^2, a sufficient breaking strength may not be obtained and it may easily break in a high wind pressure. If it exceeds 80 g/m^2, the basis mass of the fabric may become excessive since the amount adhered of the resin may increase in proportion to the mass of the woven fabric to a certain extent, and thus not only the gliding performance of the sports equipment obtained may be reduced but also it becomes inconvenient to carry.

[0026] In the fabric material of the present invention, the amount of the resin adhered to the substrate fabric is preferably 5 to 40% by mass, more preferably 10 to 35% by mass, relative to the mass of the substrate woven fabric. If the amount of the resin adhered to the substrate woven fabric is less than 5%, while the tear resistance of the resulting fabric material may increase, the air permeability of the fabric material cannot be sufficiently reduced, and the performance of the fabric material of catching the wind and utilizing the wind pressure becomes insufficient, and in the case of kiteboading and paragliders, for example, the gliding performance may decrease, which is dangerous, and in the case of spinnakers, its performance of efficiently utilizing the wind may decrease. On the other hand, if the amount of the resin adhered to the substrate fabric exceeds 40% by mass, the basis mass of the resulting fabric material may become excessive, markedly reducing its handling performance, which is undesirable.

[0027] If the mass of the fabric material of the present invention becomes excessive, not only the gliding performance of the resulting sports equipment may decrease but also it becomes inconvenient to carry, and in the case of a fabric material for spinnaker, the excessive mass of the fabric material may markedly deteriorate its handling performance. However, if the mass of the fabric becomes excessively small, the breaking strength and tear resistance of said fabric material may become insufficient. Thus, the basis mass of the fabric of the present invention is preferably 20 to 100 g/m^2, and more preferably 30 to 80 g/m^2.

[0028] In order to prevent the tearing of the fabric material of the present invention after repeated uses, the tear resistance must be 29.42 N (3.0 kgf) or more, and preferably 39.2 N (4.0 kgf) to 98.0 N (10.0 kgf). If the tear resistance is less than 29.42 N (3.0 kgf), the resultant sports equipment made of said fabric material is likely to be torn, when it is gliding for kiteboarding, and when it catches the wind and faces a high wind pressure for the spinnaker, for example.

[0029] The tensile strength and ultimate elongation of the fabric material of the present invention are required to be 294.1 N (30 kgf)/5 cm and 10% or more, respectively, and preferably 400 to 700 N/5 cm and 10 to 25%, respectively. Generally, the breaking strength and elongation of the fabric material are vary depending on the structure of the woven fabric, the presence or absence of resin treatment, but if the tensile strength increase, the ultimate elongation tends to decrease. In cases where the ultimate elongation is less than 10% even if the tensile resistance is 294.1 N/5 cm or more, the toughness of the fabric material may become insufficient, and thus there will be a high risk of breaking at a stretch when the sports equipment made of the fabric material suddenly catches the wind and faces a high wind pressure. On the other hand, if the tensile strength is less than 294.1 N/5 cm, the sports equipment made of the fabric material, due to its low tensile strength, may easily break when it faces a high wind pressure. Thus, it is important to satisfy both a tensile strength of 294.1 N/5cm or more and an ultimate elongation of 10% or more in order to enhance the resistance to bursting of the fabric material.

[0030] Furthermore, the air permeability of the fabric material of the present invention is required to be 1.0 $ml/cm^2/s$ or less, preferably be 0.1 $ml/cm^2/s$ or less, and more preferably 0.01 $ml/cm^2/s$ or less. If the air permeability of the fabric material exceeds 1.0 $ml/cm^2/s$, the ability of said fabric material of catching the wind and utilizing the wind pressure becomes insufficient, and in the case of kiteboarding and paraglider, for example, the gliding performance may decrease, which is dangerous, and in the case of spkinnaker, the function of efficiently utilizing the wind may decrease.

[0031] Furthermore, the abrasion resistance of the fabric material of the present invention must be 75 times of abrasions or more and more preferably 100 times or more in order to avoid tearing and breaking during repeated uses. If the abrasion resistance is less than 75 times, there will be a high risk of breaking at a stretch from the abraded portion when the sports equipment made of the fabric material suddenly catches the wind and faces a high wind pressure.

[0032] In the production of the fabric material of the present invention, the method of imparting a urethane resin to the substrate woven fabric includes, but not limited to, an impregnating method or a coating method. Alternatively, both of the impregnating method and the coating method may be applied. In any event, it is necessary that the urethane resin sufficiently permeate into the inside of the substrate woven fabric and impregnation-adhere to the fabric, so as to impart to the resulting fabric material satisfactory physical properties, such as tensile strength, tear resistance, abrasion resistance and air permeability.

The urethane resin may be impregnation-attached at a liquid form to the substrate woven fabric, whereupon the liquid resin may be aqueous or nonaqueous.

[0033] The cross sectional profile of the polyester fibers contained in the substrate woven fabric of the present invention is not specifically limited, and may take various forms, such as regular circular form or irregular form, for example a polygonal form, such as a triangular, tetragonal or hexagonal form, oval or flat form or a shape having two or more protrusions. Among these variant form, the flat form may be preferred, and in this case, the flatness, namely a ratio of the maximum length of the major axis to the minimum length of the minor axis, is preferably 3 to 6, and more preferably 3 to 4. Among these flat form of the cross sectional profile, a flat concavo-convex form in which 2 to 6, more preferably 3 to 5 circles are connected to each other along the major axis of the cross section with parts of the circles overlapping with each other, is preferable. When the number of circles connected is 2 to 6, such a flat form has 2 to 6 convex parts and 1 to 5 concave parts on one side with respect to the major axis, and these convex parts and the concave parts form a symmetrical shape on both sides relative to the major axis. If the number of circles connected to each other in such a flat cross sectional form is 2 to 6, the difference between the cross-sectional area and the area of a circle having the

major axis as the diameter becomes great, and the air permeability of the resulting woven fabric becomes appropriately small. On the other hand, if the number of circles connected to each other is 7 or more, the filament-formability in the melt-spinning of fibers having such a cross-sectional profile becomes low, and may cause a problem that staining spots may easily form on the yarn having a flat concavo-convex cross-sectional profile.

[0034] In the above-mentioned flat concavo-convex cross-sectional profile, the diameters of circles connected with each other are preferably equal, and a ratio, W_1/W_2, of the width W_1 measured to be perpendicular to the major axis, of the convex part to the width W_2 of the concave part symmetrical to each other relative to the major axis is preferably 1.1 : 3.0, and more preferably 1.1 : 2.0. Furthermore, when the diameters of the above circles connected with each other are different, the maximum diameter may preferably be 1 to 5 times that of the minimum diameter, and preferably 1 to 2 times.

Examples

[0035] The present invention will be further explained by the following examples. The physical properties described in the examples were measured in the following manners.

(1) Tear resistance

It was measured according to JIS L 1096-1999 8.15.1, method A-1 (single tongue method). However, the tension speed was set at 10 cm/min.

(2) Tensile strength and ultimate elongation

In accordance with JIS L 1096-1999 8.12.1, method A (strip method) the tensile strength and ultimate elongation at break were determined, with a distance of 10 cm between the clamps of the test strip a width of 5 cm of the test strip, and an elongation rate of 10 cm/min.

(3) Air permeability

It was measured according to JIS L 1096-1999 8.27.1, method A (the Frazir Type method).

(4) Abrasion resistance

It was measured according to JIS L 1096-1999 8.17.1, method A (universal type flat surface method). The pressure load was set at 4.45 N, the air pressure at 2.76×10^4 Pa and the abrasive paper P600-Cw was used.

(5) Level dyeing property

On the uniformity of the appearance of the dyed woven fabric material, an organoleptic test was conducted by three panelists and classification was carried out as follows:

Class	Appearance of the dyed material
3 (Excellent)	Uniformly died and no dye spots are observed
2 (Good)	Partly dye spots observed
1 (Bad)	Overall dye spots observed

Example 1

[0036] Using a polyethylene terephthalate multifilament yarns (Trade mark: "TETORON" manufactured by Teijin Fibers Ltd., a tensile strength of 5.8 cN/dtex, an ultimate elongation of 25%) comprising 20 filaments having a circular cross sectional profile and a total linear density of 44 dtex, the following woven fabric was produced: The weaving structure is plain weave, the weave density is 110 yarns/25.4 mm for the warps and 93 yarns/25.4 mm for the wefts, and in each of warp and weft weaving structure units, 18 polyethylene terephthalate multifilament yarns having the total linear density of 44 dtex, and one thick yarn that was obtained by combining three of the 44 dtex multifilament yarns was sequentially arranged. The woven fabric obtained had a basis mass of 42 g/m^2.

After continually scouring this woven fabric at 96°C, it was pre-heat set at 180°C. Then it was dyed using a circular dyeing machine at a temperature of 130°C, dried at 120°C, and calendered on one surface of at 150°C.

Subsequently, a resin treatment solution having the composition indicated in Table 1 was applied to the woven fabric using an impregnation method, and dried at 120°C and heat-treated at 160°C to obtain a fabric material. The basis mass of the resultant fabric material was 48 g/m^2. The test results are shown in Table 6.

[Table 1]

[0037]

Table 1

Chemicals and resin used	Amount used (parts)
Silicone-copolymerized polycarbonate-polyurethane resin	100
DMF	30
MEK	30
Crosslinking agent	3.5
Antitacking agent	3

[Note]

[0038] Silicone-copolymerized polyurethane resin: LUCKSKIN US-2384 (trade mark, manufactured by SEIKOH CHEMICALS CO., LTD.)
DMF: Dimethylformamide, solvent
MEK: Methyl ethyl ketone, solvent
Crosslinking agent: CORONATE HL (trade mark, manufactured by NIPPON POLYURETHANE INDUSTRY CO., LTD.)
Antitacking agent: Additive No. 5 (trade mark, manufactured by DATNTPPON INK AND CHEMICALS, INC.)

Example 2

[0039] In Example 2, a resin treatment solution having the composition indicated in Table 2 was prepared, and coated on one surface of the same woven fabric obtained as in Example 1, and heat-treated at 120°C to obtain a fabric material. The basis mass of the fabric material obtained was 52 g/m^2. The test results are shown in Table 6.

[Table 2]

[0040]

Table 2

Chemicals and resin used	Amount used (parts)
Silicone-copolymerized polycarbonate polyurethane resin	100
DMF	10
Crosslinking agent	3.5
Antitacking agent	3

[Note]

[0041] Silicone-copolymerized polyurethane resin: LUCKSKIN US-2384 (trade mark, manufactured by SEIKOH CHEMICALS CO., LTD.)
DMF: Dimethylformamide, solvent
MEK: Methyl ethyl ketone, solvent
Crosslinking agent: CORONATE HL (trade mark, manufactured by NIPPON POLYURETHANE INDUSTRY CO., LTD.)
Antitacking agent: Additive No. 5 (trade mark, manufactured by DAINIPPON INK AND CHEMICALS, INC.)

Example 3

[0042] In Example 3, using polyethylene terephthalate multifilament yarns (Trade name "TETORON" manufactured by Teijin Fibers Ltd., a tensile strength of 5.8 cN/dtex, an ultimate elongation of 25%) comprising 20 filaments having a total linear density 44 dtex, the following woven fabric was produced: The weave density is 166 yearns/25.4 mm for the warps and 93 yarns/25.4 mm, for the weft, in the weaving structure unit of the warps, 10 polyethylene terephthalate multifilament yarns having the 44 dtex, one thick yarn obtained by combining four of the 44 dtex multifilament yarns, two 44 dtex multifilament yarns, and one thick yarn obtained by combining four of the 44 dtex multifilament yarns were sequentially arranged. In the weaving structure unit of the wefts 8 polyethylene terephthalate multifilament yarns having

a total linear density of 44 dtex, one thick yarn obtained by combining four of the 44 dtex multifilament yarns, two of the 44 dtex multifilament yarns, and one thick multifilament yarn obtained by combining four of the 44 dtex multifilament yarns were sequentially arranged. The basis mass of the substrate woven fabric was 59 g/m^2. The basis mass of the fabric material was 66 g/m^2. The test results are shown in Table 6.

Example 4

[0043] In Example 4, a fabric material was produced by the same procedures as in Example 2, except that the same woven fabric as in Example 3 was used. The basis mass of the fabric material obtained was 70 g/m^2. The test results are shown in Table 6.

Example 5

[0044] In Example 5, a fabric material was produced by the same procedures as in Example 2. However, the woven fabric for substrate fabric was produced in the following manner. Using a polyethylene terephthalate multifilament yarn (Trade name "TETORON" manufactured by Teijin Fibers Ltd., a tensile strength of 5.7 cN/dtex, an ultimate elongation of 25%) comprising 36 filaments having a circular cross sectional profile and a total linear density of 84 dtex, the following woven fabric was produced: The weave density was 80 yarns/inch for the warps, and 80 yarns/25.4 mm for the wefts, and in each of weaving structure unit of the warps and the wefts, 20 polyethylene terephthalate multifilament yarns having a total linear density of 84 dtex, one thick multifilament yarn obtained by combining three of the 84 dtex multifilament yarns, two of the 84 dtex multifilament yarns, and one thick multifilament yarn obtained by combining three of the above 84 dtex multifilament yarns were sequentially arranged. The resultant woven fabric had a basis mass of 75 g/m^2. The basis mass of the fabric material obtained was 85 g/m^2. The test results are shown in Table 6.

Example 6

[0045] In Example 6, a woven fabric was produced by the same procedures as in Example 3, and the resultant woven fabric was subjected to the treatment similar to Example 2. However, the amount adhered of the resin by one-slide coating was adjusted to be three times that in Example 4. The woven fabric obtained had a basis mass of 81 g/m^2. The test results are shown in Table 6.

Comparative Example 1

[0046] In Comparative Example 1, using a polyethylene terephthalate multifilament yarn (Trade name "TETORON" manufactured by Teijin Fibers Ltd., a tensile strength of 5.8 cN/dtex, an ultimate elongation of 25%) comprising 20 multifilaments having a circular cross sectional profile and a total linear density of 44 dtex, the following woven fabric was produced: The weaving structure is plain weave, the weave density is 110 yarns/25.4 mm for the warps and 93 yarns/25.4 mm for the wefts, and in each of weaving structure unit of the warps and the wefts, 18 polyethylene terephthalate multifilament yarns having a total linear density of 44 dtex, and one thick multifilament yarn that was obtained by combining three of the 44 dtex multifilament yarns were sequentially arranged. The woven fabric obtained had a basis mass of 42 g/m^2.
After this woven fabric was continually scoured at 96°C, it was pre-heat set at 180°C. Then it was dyed by using a circular dyeing machine at a temperature of 130°C, dried at 120°C, and then calendered on one surface thereof at 150°C.
Subsequently, as a pretreatment for the urethane resin treatment, a resin treatment solution having the composition indicated in Table 3 was prepared, and, applied to the woven fabric using an impregnation method. Then, the resin treated fabric was dried and heat-treated.

[Table 3]

[0047]

Table 3

Chemicals and resin used	Amount used (g/l)
Water repellent	50
Penetrant	30

[Note]

[0048] Water repellent: ASAHIGUARD AG-710, manufactured by ASAHI GLASS CO., LTD
Penetrant: Isopropyl alcohol (IPA)

[0049] Then, a resin treatment solution having the composition indicated in Table 4 was prepared, applied to the pretreated woven fabric using an impregnation method, dried and heat-treated in the manner similar to Example 1 to obtain a resin-treated fabric.

[Table 4]

[0050]

Table 4

Chemicals and resin used	Amount used (parts)
Ester type urethane resin	100
DMF	30
MEK	30
Crosslinking agent	3.5
Antitacking agent	3

[Note]

[0051] Ester-type urethane resin: LUCKSKIN US-1468 (trade mark, manufactured by SEIKOH CHEMICALS CO., LID.)
DMF: Dimethylformamide, solvent
MEK: Methyl ethyl ketone, solvent
Crosslinking agent: CORONATE HL (trade mark, manufactured by NIPPON POLYURETHANE INDUSTRY CO., LID.)
Antitacking agent : Additive No.5 (trade mark, manufactured by NIPPON POLYURETHANE INDUSTRY CO., LTD.)

[0052] Finally, a resin finish solution having the composition indicated in Table 5 was prepared, and applied to the resin-treated fabric material by a one-side coating, and heat-treated at 120°C to obtain a fabric material. The resultant fabric material had a basis mass of 51 g/m^2. The test results are shown in Table 6.

[Table 5]

[0053]

Table 5

Chemicals and resin used	Amount used (parts)
Ester-based urethane resin	100
DMF	10
Crosslinking agent	3.5
Antitacking agent	3

[Note]

[0054] Ester-type urethane resin: LUCKSKIN US-1468 (trade mark, manufactured by SEIKOH CHEMICALS CO., LTD.)
DMF: Dimethylformamide, solvent
Crosslinking agent: CORONATE HL (trade mark, manufactured by NIPPON POLYURETHANE INDUSTRY CO., LTD.)
Antitacking agent: Additive No. 5 (trade mark, manufactured by DAINIPPON INK AND CHEMICALS, INC.)

Comparative Example 2

[0055] In Comparative Example 2, a fabric material was produced in the manner similar to Comparative Example 1. However, a woven fabric for substrate fabric was produced in the following manner. Using a polyethylene terephthalate multifilament yarns (Trade name "TETORON" manufactured by Teijin Fibers Ltd., a tensile strength of 5.8 cN/dtex, an ultimate elongation of 25%) comprising 20 filaments and having a total linear density of 44 dtex, the following woven fabric was produced: The weaving structure is plain weave, the weave density is 110 yarns/25.4 mm for the warp and 110 yarns/25.4 mm for the wefts, and each of weaving structure unit of the warps and the wefts was formed by sequentially arranging 20 polyethylene terephthalate multifilament yarns having a total linear density of 44 dtex, one thick multifilament yarn obtained by combining three of the 44 dtex multifilament yarns, two of the 44 dtex multifilament yarns, and one thick multifilament yarn obtained by combining three of the 44 dtex multifilament yarns. The woven fabric obtained had a basis mass of 49 g/m^2. The test results are shown in Table 6.

Comparative Example 3

[0056] In Comparative Example 3, a fabric material was produced in the manner similar to Comparative Example 1. However, a woven fabric for substrate fabric was produced in the following manner. Using a polyethylene terephthalate multifilament yarns (trade name "TETORON" manufactured by Teijin Fibers Ltd., a tensile strength of 5.7 cN/dtex, an ultimate elongation of 25%) comprising 20 filaments and having a total linear density of 44 dtex, the following woven fabric was produced: The weaving structure is plain weave, the weave density is 80 yarns/inch for the warps and 80 yarns/inch for the wefts, and each of weaving structure unit of the warps and the wefts was formed by sequentially arranging 20 polyethylene terephthalate multifilament yarns having a total linear density of 84 dtex, one thick multifilament yarn obtained by combining three of the 84 dtex multifilament yarns, two of the 84 dtex multifilament yarns, and one thick multifilament yarn obtained by combining three of the 84 dtex multifilament yarns. The woven fabric obtained had a basis mass of 75 g/m^2. The fabric material obtained had a basis mass of 85 g/m^2. The test results are shown in Table 6.

Example 7

[0057] A fabric material was produced in the manner similar to Example 1. However, in stead of the polyester multifilament yarns having a circular cross sectional profile used in the production of a woven fabric for substrate fabric, a polyethylene terephthalate multifilament yarns (Trade name "TETORON" manufactured by Teijin Fibers Ltd., a tensile strength of 5.8 cN/dtex, an ultimate elongation of 23%) comprising 12 filaments having a total linear density of 33 dtex and a flat concavo-convex cross sectional profile (flatness: 3.5, and W_1/W_2: 1.4) having three protruding parts per side relative to the major axis as shown in Fig. 2-(c) was used. The woven fabric obtained had a basis mass of 35 g/m^2. The test results are shown in Table 6.

Example 8

[0058] A fabric material was produced in the manner similar to Example 7. However, in the production of a woven fabric for substrate fabric, in stead of the polyester multifilament yarns having a circular cross sectional profile, a polyester multifilament yarn (total linear density: 84 dtex, the number of filaments: 36, having a flat cross sectional profile (flatness: 3.4, and W_1/W_2: 1.4) as shown in Fig. 2-(c) was used. In the production of a woven fabric for substrate fabric, the weave structure was plain weave, and the density of the warps was 80 yarns/25.4 mm, that of the wefts was 80 yarns/25.4 mm, and in each of the meaning structures of the warps and wefts, one yarn formed by combining four of the polyester multifilament yarns was arranged per each 18 of the polyester multifilament yarns. The woven fabric obtained had a basis mass of 75 g/m^2. The test results for the fabric material are shown in Table 6.

Example 9

[0059] A fabric material was produced in the manner similar to Example 7. However, the polyester multifilament yarns having a flat concavo-convex cross sectional profile as shown in Fig. 2-(c) was replaced by that having the cross sectional profile (flatness: 3.1, and W_1/W_2: 1.6) as shown in Fig. 2-(b). The test results of for the fabric material are shown in Table 6.

Example 10

[0060] A fabric material was produced in the manner similar to Example 7. However, the polyester multifilament yarn having a flat concavo-convex cross sectional profile as shown in Fig. 2-(c) was replaced by that having a cross sectional profile (flatness: 4.6, and W_1/W_2: 1.4) as shown in Fig. 2-(d). The test results for the fabric material obtained are shown

in Table 6.

Example 11

[0061] A fabric material was produced in the manner similar to Example 7. However, the polyester multifilament yarn having a cross sectional profile as shown in Fig. 2-(c) was replaced by that having the cross sectional profile (flatness: 8.5, and W_1/W_2: 1.2) as shown in Fig. 2-(e). The test results for the fabric material obtained are shown in Table 6.

Comparative Example 5

[0062] In Comparative Example 5, a fabric material was produced in the manner similar to Example 1. However, the woven fabric for substrate fabric was calendered on one surface thereof. The composition of a resin treatment solution shown in Table 1 was changed to as follows:

MEK	60 parts by mass
U135	100 parts by mass
ST90	40 parts by mass
Crosslinking agent	40 parts by weight

[Note]

[0063] U135: trade mark, polyurethane resin, manufactured by SEIKOH CHEMICALS CO., LTD.
ST90: trade mark, silicone resin
Crosslinking agent: CORONATE HL (trade mark)
The test results for the fabric material obtained are shown in Table 6.

[Table 6]

[0064]

Table 6

Examples	Pretreatment	Urethane resin *	Basis mass of woven fabric (g/m²)	Basis mass of fabric material (g/m²)	Amount of urethane resin (mass %)	Tensile strength (kgf/5 cm)		Ultimate elongation (%)		Tear resistance (kgf)		Air-permeability (ml/cm²/sec.)	Abrasion resistance (Number of times of abrasion)	Level dyeing (class)
						Warp	Weft	Warp	Weft	Warp	Weft			
Example 1	None	N*1	41	48	17	45	43	20	22	6.8	6.2	0.3	85	3
Example 2	None	N	41	52	27	48	40	22	19	5.2	5.4	0.02	100	3
Example 3	None	N	59	66	15	68	52	22	20	7.0	7.2	0.5	200	3
Example 4	None	N	59	71	20	62	52	22	21	6.0	6.2	0.02	390	3
Example 5	None	N	75	85	13	110	100	24	26	8.0	8.5	0.5	100	3
Example 6	None	N	59	80	36	67	58	20	20	3.5	3.5	0.02	600	3
Comparative Example 1	Yes	S*2	41	52	27	50	42	20	23	2.2	2.6	0.02	65	3
Comparative Example 2	Yes	S	41	48	17	52	50	24	26	3.3	3.5	0.5	50	3
Comparative Example 3	Yes	S	75	85	13	110	100	24	27	6.0	6.2	0.5	50	3
Comparative Example 4	None	N*1	75	108	43	70	60	24	25	4.0	4.5	0.02	700	3
Example 7	None	N	35	45	10	50	52	22	20	7.0	7.2	0.01	50	3
Example 8	None	N	75	85	10	50	52	22	20	7.0	7.2	0.01	50	3
Example 9	None	N	35	45	10	50	52	22	20	7.0	7.2	0.01	50	3
Example 10	None	N	35	45	10	50	52	22	20	7.0	7.2	0.01	50	3
Example 11	None	N	35	45	10	50	52	22	20	7.0	7.2	0.01	50	1
Comparative Example 5	None	S*2	41	52	27	50	42	20	23	2.5	2.6	0.02	70	3

Note: *1 Silicone-copolymerized polycarbonate urethane resin
*2 Ester urethane resin

Industrial Applicability

[0065] Since the fabric material of the present invention has an excellent mechanical strength such as tear resistance, tensile strength and abrasion resistance, a low air permeability, and an appropriate basis mass, it is useful for sports equipment such as paraglider, hangglider, yacht sail, spinnaker, kiteboarding and stuntkite, and has a high industrial applicability.

Claims

1. A fabric material for sports equipment comprising a composite fabric comprising:

   a substrate fabric comprising a woven fabric containing polyester fibers as a main component and
   an impregnation-adhered layer impregnation-adhered to the substrate fabric and containing a silicone-copolymerized urethane resin as a main component,
   wherein
   the substrate fabric has a basis mass of 20-80 g/m^2,
   the impregnation-adhered layer is in an amount of 5-40% by mass based on the mass of the substrate fabric, and
   the composite fabric has a basis mass of 21-100 g/m^2, and an air permeability of 1.0 ml/cm^2/s or less.

2. fabric material according to claim 1, wherein the silicone-copolymerized urethane resin comprises a silicone-copolymerized polycarbonate urethane resin.

3. The fabric material according to claims 1,
   wherein the substrate fabric has a tear resistance of 29.42 N (3.0 kgf)/5 cm or more.

4. The fabric material according to claim 1,
   wherein the substrate fabric has a tear resistance of 294.1 N (30 kgf)/5 cm or more, an ultimate elongation of 10% or more and an abrasion resistance of 75 times of abrasions or more.

5. The fabric material according to any one of claims 1 to 4, wherein
   the woven fabric for the substrate fabric comprises a plurality of warps and wefts, each comprising a plurality of principal polyester fiber yarns A and woven fabric-reinforcing polyester fiber thick yarns B having a linear density (unit: dtex) of 2 to 5 times the linear density (unit: dtex) of the principal yarns A, and, in the yarn arrangement patterns composed of each of the warp and weft yarns, one of the polyester fiber thick yarn B is arranged per 2 to 50 of the principal polyester fiber yarns A arranged in parallel adjacent to each other, and thereby a cheek-patterned reinforcing structure is formed in the woven fabric for the substrate fabric.

6. The fabric material according to any one of claims 1 to 4, wherein the polyester fibers have a cross sectional profile having flat shape in which 2 to 6 circles are connected along the major axis to each other in a manner such that parts of the circles overlap with each other.

Fig.1

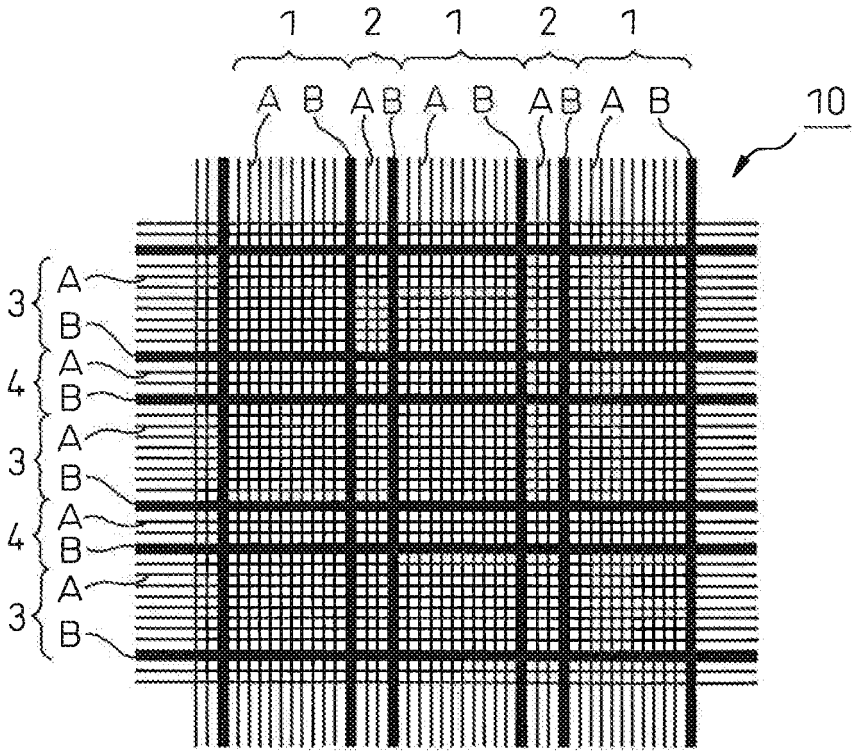
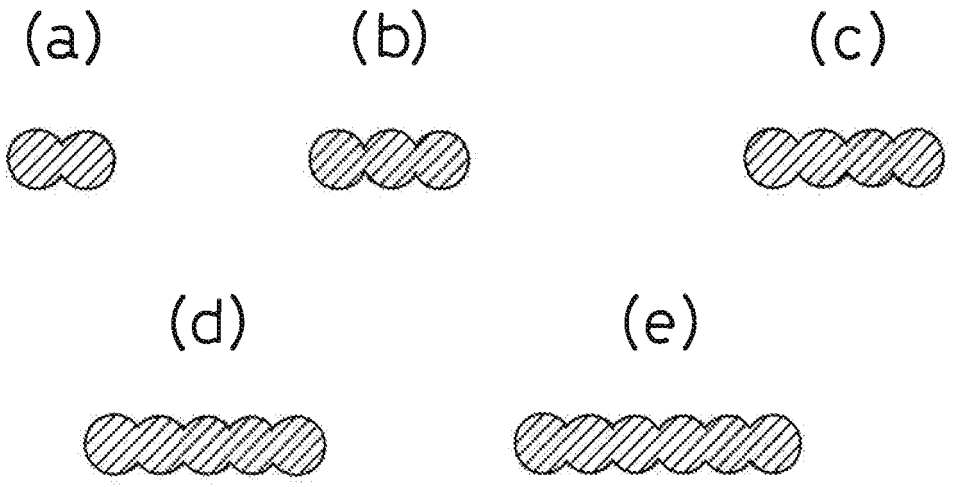


Fig.2



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/068088

A. CLASSIFICATION OF SUBJECT MATTER
D06M15/564(2006.01)i, *D03D1/00*(2006.01)i, *D06M15/643*(2006.01)i, *D06M101/32*(2006.01)n

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)
D06M13/00-15/715, D03D1/00-27/18

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 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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 1993/001338 A1 (Teijin Ltd.), 21 January, 1993 (21.01.93), Claims; page 5, lines 9 to 14; page 6, line 19 to page 7, line 2; examples & EP 552374 A1 & US 5273813 A & KR 1997/0008878 A	1-6
Y	JP 2006-63466 A (Teijin Techno Products Ltd.), 09 March, 2006 (09.03.06), Claims; Par. Nos. [0001], [0018], [0037] (Family: none)	1-6
Y	JP 2-41475 A (Teijin Ltd.), 09 February, 1990 (09.02.90), Claim 2; page 2, lower left column, lines 2 to 4, 8 to 19; Effects of the Invention (Family: none)	1,3-5

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

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Date of the actual completion of the international search	Date of mailing of the international search report
11 November, 2008 (11.11.08)	25 November, 2008 (25.11.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/068088

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 10-298874 A (Achilles Corp.), 10 November, 1998 (10.11.98), Claim 2; Par. Nos. [0015], [0023] (Family: none)	2
Y	JP 2004-52191 A (Teijin Fibers Ltd.), 19 February, 2004 (19.02.04), Claims; Par. No. [0012]; Fig. 1 & EP 1524343 A1 & US 2005/176323 A1 & WO 2004/009889 A1 & CN 1585841 A	6

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2653919 B **[0005]**
- JP 2005097787 A **[0005]**
- JP 4059139 B **[0005]**