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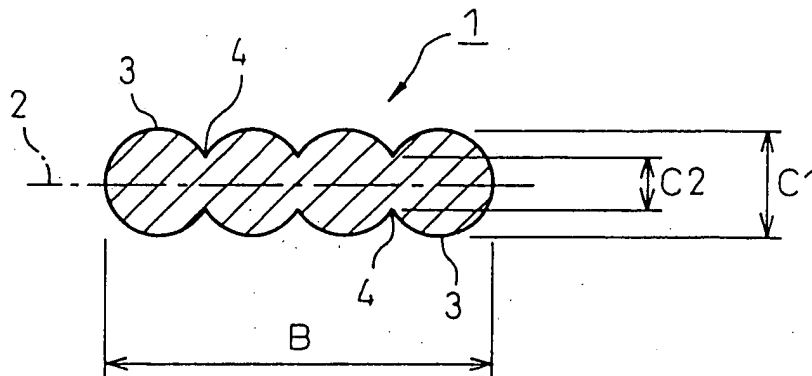
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(54) **FLAT MULTIFILAMENT-YARN TEXTILE**

(57) A flat multifilament yarn woven fabric having a low air permeability and excellent vision through-preventing property and water- or perspiration- absorbing property includes, as warp and/or weft yarns, multifilament yarns formed from a plurality of artificial individual filaments having a flat cross-sectional profile in which, on both the sides of a longitudinal center line of the profile, 3 or more projections projecting outward from the longitudinal center line and 2 or more constrictions

formed between the projections, per side of the profile are formed approximately in symmetry with respect to the longitudinal center line, and a degree of flatness of the profile represented by a ratio (B/C1) of a largest length B of the profile in the direction of the longitudinal center line to a largest width C1 of the profile in the direction of right angles to the longitudinal center line is 2 to 6, the woven fabric having a cover factor of 800 to 3500.

Fig.1



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Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a flat multifilament yarn woven fabric. More particularly, the present invention relates to a woven fabric comprising multifilament yarns constituted from a plurality of artificial individual filaments having a flat cross-sectional profile with two or more constrictions per side section, and exhibiting a soft hand, a practically high water absorption, abrasion resistance and vision through-prevention.

10 BACKGROUND ART

[0002] Currently, various types of poorly air-permeable woven fabrics are provided for sport cloths and uniform cloths. As the low air-permeability woven fabrics, high density woven fabrics formed from synthetic fibers, for example, polyester or polyamide fibers, and coated woven fabric in which a resin coating layer is formed on a woven fabric, and calendered woven fabrics, are known.

15 **[0003]** However, the high density woven fabrics, surface-coated and calendered woven fabrics usually have a low softness (a hard hand), and the surfaces of the fabrics exhibit a low resistance to abrasion (abrasion resistance, and thus these types of woven fabrics must be improved.

[0004] Synthetic fibers, for example, polyester and polyamide fibers have excellent physical and chemical properties and thus are practically used in various uses such as clothing and industrial uses. Particularly, the polyester fibers exhibit excellent mechanical strength, dimensional stability and an easy-care property, and thus various types of woven fabric formed from synthetic fibers, for example, polyester fibers, are used widely.

20 **[0005]** However, the woven fabrics formed from synthetic fibers such as polyester fibers have, in addition to the above-mentioned advantageous properties, a high transparency. Thus, when the high transparency synthetic fibers are formed into a fabric and the fabric is used as an upper garment a problem such that a garment worn under the upper garment, namely an undergarment, can be seen occurs.

25 **[0006]** As a means for solving the above-mentioned problem, it is known that inorganic fine particles, for example, titanium dioxide particles are distributed into the synthetic fibers. This means can cause the resultant synthetic fibers to exhibit an increased opacity and thus an enhanced see through-preventing property. However, the woven fabric formed from the opaque synthetic fibers still must have an increased weave density to prevent the transmission of light through gaps formed between the yarns from which the woven fabric is formed. This increase in the weave density causes a problem that the resultant woven fabric exhibits a decreased softness.

30 **[0007]** In the case of woven fabric for interior material, for example, curtains, both the vision through-preventing property (namely a property of preventing vision through of an articles and movement of people in the room, and light transmission must be high. However, usually, those properties are incompatible with each other and thus are extremely difficult to realize together.

[0008] For this reasons, usually, a thin lace curtain is arranged on the window side and a thick drape curtain is arranged on the room side, and in nighttime the drape curtain is closed, and in daytime the lace curtain is closed to satisfy both the requirements of vision through-prevention and of lighting. However, generally speaking, the thick drape curtain has an excellent vision through-prevention and a poor light-transmitting property, and the thin lace curtain has an insufficient vision through-preventing property not only in nighttime but also in daytime. Accordingly, it is necessary to solve this problem. To solve the problem, for example, a light-blocking curtain formed from a combined weave comprising polyester fiber yarns comprising a delustering agent, for example, titanium dioxide and black colored polyester fiber yarns containing a black-coloring pigment and capable of reflecting and absorbing the light, is disclosed in, for example, Japanese Patent No. 3167586; a mirror curtain formed from a woven or knitted fabric on both or one surface of which fabric sheen gloss yarns are arranged, and having a high prevention property of vision through from outside to inside of a room through the curtain, due to scattered light generated when light is irradiated to the sheen gloss surface of the fabric, and satisfactory light-transmitting property and air-permeability, is disclosed in, for example, Japanese Unexamined Patent Publication No. 2000-237,036; and a light-blocking fabric in which a black-colored light-shielding layer is formed on a surface of a fabric is disclosed in, for example, Japanese Unexamined Patent Publication No. 62-133,787.

40 **[0009]** The above-mentioned light-blocking fabric having a black-colored light-blocking layer formed on a fabric surface and light-blocking curtain have a problem that as the light-transmitting property is poor, the inside of the curtained room is dark and an oppressive atmosphere is created in the curtained room. Also, the light-transmitting property of the mirror curtain is high. However, the mirror curtain has a problem that the vision through-preventing property of the mirror curtain, particularly in night time, is insufficient, and the sheeting gloss yarns cause a garish gloss, on the mirror curtain, to be created.

55 **[0010]** As mentioned above, a woven fabric having both a sufficient light-transmitting property and an excellent vision

through-preventing property and usable in practice, has not yet been provided.

[0011] Further, the woven fabric made from synthetic fibers is disadvantageous in that the water-absorbing properties, especially perspiration-absorbing property of the synthetic fiber woven fabric is poorer than that of the woven fabric made from natural fibers, for example, cotton fibers.

5 [0012] As a means for enhancing the water-absorbing property and perspiration-absorbing property of the synthetic fiber woven fabric, a water absorption-enhancing method in which a hydrophilicizing agent is applied to the woven fabric is known. Also, in the use of, for example, lining clothes, sport clothes and uniform clothes, further enhanced water and perspiration-absorbing properties are required.

10 [0013] Under the above-mentioned circumstances, there is a strong demand of an artificial fiber woven fabric, particularly a synthetic fiber woven fabric, having a soft hand, a high vision through-preventing property and an excellent water and perspiration absorbing property.

SUMMARY OF THE INVENTION

15 [0014] An object of the present invention is to provide a flat multifilament yarn woven fabric exhibiting a hand with a high softness, a high water and perspiration-absorbing property, abrasion resistance, appropriate air permeability, light transmission and a high see through-preventing property.

[0015] Another object of the present invention is to provide a flat multifilament yarn woven fabric useful for constituting textile materials having an appropriate air permeability, textile materials having a high vision through-preventing property, textile materials having a high water and perspiration-absorbing property and/or textile materials having a high abrasion resistance.

[0016] The above-mentioned objects can be attained by the flat multifilament yarn woven fabric of the present invention.

25 [0017] The flat multifilament yarn woven fabric of the present invention comprises a plurality of multifilament yarns comprising a plurality of artificial individual filaments comprising, as a principal component, an artificial fiber-forming polymer and having a flat cross-sectional profile,

wherein in both the side sections of a longitudinal center line of the flat cross sectional profile of each artificial individual filament, at least three projections per side section are projecting outward from the longitudinal center line and at least two constrictions per side section formed between the projections are formed approximately in symmetry with respect to the longitudinal center line, and a degree of flatness of the cross-sectional profile represented by a ratio (B/C1) of a largest length (B) of the cross-sectional profile in the direction of the longitudinal center line to a largest width (C1) of the cross-sectional profile in the direction at right angles to the longitudinal center line is 2 to 6, and the woven fabric has a cover factor of 800 to 3500.

35 [0018] In the flat multifilament yarn woven fabric of the present invention, the artificial fiber-forming polymer is preferably selected from polyesters, polyamides, polyvinylidene chloride, polypropylene, regenerated cellulose and cellulose acetates.

[0019] In the flat multifilament yarn woven fabric of the present invention, in the cross-sectional profile of the artificial individual filaments, a ratio (C1/C2) of the largest width (C1) to a smallest width (C2) is preferably in the range of from 1.05 to 4.00.

40 [0020] In the flat multifilament yarn woven fabric of the present invention, the total thickness of the multifilament yarns is preferably in the range of from 30 to 170 dtex and the thickness of the individual filaments is preferably in the range of from 0.5 to 5 dtex.

[0021] The flat multifilament yarn woven fabric of the present invention preferably has a weave structure selected from plain weave, twill weave and satin weave structures.

45 [0022] In the flat multifilament yarn woven fabric of the present invention, the multifilament yarns comprising the artificial individual filaments having the flat cross-sectional profile is preferably contained in an amount of 10 to 100% by mass based on the mass of the woven fabric.

[0023] In an embodiment (1) of the flat multifilament yarn woven fabric of the present invention, the cover factor of the woven fabric is in the range of from 1500 to 3500.

50 [0024] In the embodiment (1) of the flat multifilament yarn woven fabric of the present invention, the multifilament yarn preferably has a number of twists of 0 to 2500 turns/m.

[0025] In the embodiment (1) of the present invention, the flat multifilament yarn woven fabric preferably has an air permeability of 5 ml/cm²-sec or less, determined in accordance with JIS L 1096-¹⁹⁹⁸, 6.27.1, Method A (using a Frazier type tester).

55 [0026] In the embodiment (1) of the flat multifilament yarn woven fabric of the present invention, the air-permeability is preferably in the range of from 0.1 to 4.0 ml/cm²-sec.

[0027] In the embodiment (1) of the present invention, the flat multifilament yarn woven fabric preferably has a water absorption velocity of 40 mm or more, determined in accordance with JIS L 1096-¹⁹⁹⁸, 6.26.1, (2) Method B (Byreck

method).

[0028] In the embodiment (1) of the present invention, the flat multifilament yarn woven fabric preferably has an abrasion resistance of 50 abrasions, determined in accordance with JIS L 1096-1998, 6.171., (1) Method A-1 (flat surface method).

5 **[0029]** A low air permeability textile material of the present invention comprises a flat multifilament yarn woven fabric of the embodiment (1) of the present invention.

[0030] In an embodiment (2) of the flat multifilament yarn woven fabric of the present invention, the artificial individual filaments of the multifilament yarn contains 0.2% by mass of a delustering agent, and the cover factor of the woven fabric is in the range of from 1300 to 3000.

10 **[0031]** In the embodiment (2) of the flat multifilament yarn woven fabric of the present invention, the multifilament yarn preferably has a number of twists of 0 to 1500 turns/m.

[0032] In the embodiment (2) of the present invention, the flat multifilament yarn woven fabric preferably has a degree of vision through-prevention of the woven fabric represented, in a $L^*a^*b^*$ color system, by a difference $\Delta L (= L^*_w - L^*_b)$ between an L^* value of the woven fabric placed on a white plate, represented by L^*_w , and an L^* value of the woven fabric placed on a black plate, represented by L^*_b , is 15 or less.

15 **[0033]** In the embodiment (2) of the present invention, the flat multifilament yarn woven fabric preferably has a water absorption velocity of 40 mm or more, determined in accordance with JIS L 1096-1998, 6.26.1, (2) Method B (Byreck method).

20 **[0034]** A vision through-preventing, perspiration-absorbent textile material of the present invention comprises a flat multifilament yarn woven fabric of the embodiment (2) of the present invention.

[0035] In an embodiment (3) of the flat multifilament yarn woven fabric of the present invention, the artificial individual filaments of the multifilament yarn contains 0 to 0.2% by mass and the cover factor of the woven fabric is in the range of from 800 to 2000.

25 **[0036]** In the embodiment (3) of the flat multifilament yarn woven fabric of the present invention, the multifilament yarn preferably has a number of twists of 0 to 1000 turns/m.

[0037] In the embodiment (3) of the present invention, the flat multifilament yarn woven fabric preferably has a degree of light transmittance of 10 to 70%, determined in accordance with JIS L 1055-1987, 6.1. Method A, at a degree of illumination of 100000 lx.

30 **[0038]** A vision through-preventive textile material of the present invention comprises a flat multifilament yarn woven fabric of the embodiment (3) of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039]

35 Fig. 1 is an explanatory cross-sectional profile of an example of flat multifilaments usable for the flat multifilament yarn woven fabric of the present invention,

Fig. 2 is an explanatory cross-sectional profile of another example of flat multifilaments usable for the flat multifilament yarn woven fabric of the present invention, and

40 Fig. 3 is an explanatory cross-sectional profile of still another example of flat multifilaments usable for the flat multifilament yarn woven fabric of the present invention.

BEST MODE OF CARRYING OUT THE INVENTION

45 **[0040]** The inventors of the present invention have found that, in a woven fabric comprising, as warp and/or weft yarns, multifilament yarns each comprising a plurality of individual filaments comprising an artificial fiber-forming polymeric material and having a flat cross-sectional profile, in the case where the cross-sectional profile of each of the individual filaments has projections projecting outward from a longitudinal center line of the flat profile in the number of 3 or more, preferably 4 or more, still more preferably 4 to 6, per one side section of the flat profile with respect to the longitudinal center line of the flat profile, and constrictions formed between the projections, in the number of 2 or more, preferably 3 or more, still more preferably 3 to 5, per one side section of the flat profile with respect to the longitudinal center line of the flat profile, the projections and constrictions being respectively formed approximately in symmetry with respect to the longitudinal center line of the flat profile, and a flatness of the cross-sectional profile of the individual filament represented by a ratio (B/C1) of the largest length, in the longitudinal direction, of the flat profile to a largest width (C1); in the cross direction at right angles to the longitudinal direction, of the flat profile is controlled within the range of from 2 to 6, (1) the flat individual filaments in the flat multifilament yarns of the resultant woven fabric are closely contacted at flat peripheries thereof with each other, and at warp-weft yarn-intersecting portions of the woven fabric, the closely contacting flat individual filaments are easily slip-spread by the compressing pressure of

the intersecting warp and weft yarns to each other, to form, in the woven fabric, broad, dense intersecting portions in which the gaps between the flat individual filaments become decreased, and (2) the flat peripheries of the flat individual filaments closely contacting each other have a plurality of projections and a plurality of constrictions and thus are roughened, and therefore, the frictional resistance between the flat individual filaments become decreased so that the warp-weft yarn-intersecting portions of the resultant flat multifilament yarn woven fabric exhibit a high softness (flexibility) and a low air permeability.

[0041] Further, the inventors of the present invention have found that the plurality constrictions formed on the peripheries of the flat individual filament causes a capillarity to liquids to be generated and thus the woven fabric of the present invention to exhibit excellent water and perspiration-absorption property.

[0042] Furthermore, the inventors of the present invention have found that the plurality of productions and constrictions formed in the peripheries of the flat individual filaments cause the frictional resistance of the peripheries of the flat individual filaments and thus the resultant woven fabric of the present invention to exhibit an excellent abrasion resistance. Still furthermore, the inventor of the present invention have found that the plurality of projections and constrictions formed in the peripheries of the flat individual filaments in the woven fabric of the present invention cause the peripheries to be roughened surfaces which scatter light transmitting through the surface by irregular reflections and reflections of the light and thus contribute to decreasing the vision through property of the woven fabric and to preventing seeing an article through the woven fabric, without significantly decrease the quantity of light transmitted through the woven fabric (amount of light lighted through the woven fabric).

[0043] Moreover, the inventors of the present invention have found that by appropriately establishing the cover factor of the flat multifilament yarn woven fabric of the present invention in the range of from 800 to 3500, the air permeability, water and perspiration-absorbing property, abrasion resistance and vision through-preventing property of the flat multifilament yarn woven fabric of the present invention can be appropriately controlled and, thereby, various types of textile materials having the above-mentioned properties can be provided.

[0044] The present invention is one completed on the basis of the above-mentioned findings.

[0045] The flat multifilament yarn woven fabric of the present invention comprises, as warp and/or weft yarns, a plurality of multifilament yarns each comprising a plurality of artificial individual filaments comprising, as a principal component, a fiber-forming artificial polymer and having a flat cross-sectional profile.

[0046] In the above-mentioned flat multi-filament yarn woven fabric, for example, referring to Fig. 1, the profile of a cross-section 1 of an individual filament is in a flat form in which the width in the direction at right angles to the longitudinal center line of the profile is relatively small in comparison with the longitudinal length of the profile.

[0047] In the cross sectional profile 1 shown in Fig. 1, in both side sections of the profile with respect to the longitudinal center line 2, 3 or more projections 3 (4 projections in Fig. 1) projecting outward from the longitudinal center line and two or more constrictions 4 (3 constrictions in Fig. 1) formed between the projections are respectively formed per one side section of the profile, approximately in symmetry with respect to the longitudinal center line 2. In the cross-sectional profile of Fig. 1, a flatness of the cross-sectional profile represented by a ratio (B/C1) of a largest length (B) of the profile in the direction of the longitudinal center line to a largest width (C1) of the profile in a direction at right angles to the longitudinal center line direction is in the range of from 2 to 6.

[0048] In the cross-sectional profile of each flat individual filament, the 3 or more projections and 2 or more constrictions formed in one side section of the flat profile are approximately in symmetry, in shape and location with respect to the longitudinal center line of the flat profile, with the 3 or more projections and 2 or more constrictions formed in the opposite side section of the flat profile, to the above-mentioned one side section.

[0049] In the above-mentioned cross-sectional profile of the flat individual filaments of the multifilament yarn, the number of the projections is 3 or more, preferably 4 or more, still more preferably 4 to 6 per one side of the flat profile. Also, the number of constrictions is 2 or more, preferably 3 or more, still more preferably 3 to 5, per one side of the flat profile. Also, the flatness of the cross-sectional profile is 2 to 6, preferably 3 to 5.

[0050] If the number of the projections is 2 or less, and the number of the constrictions is 1 or less, the peripheries of the resultant individual filaments exhibit an increased frictional resistance, and thus the slip-spreading of the individual filaments in the warp-weft intersecting portions of the woven fabric in which portions a compressive presence of the warp and weft yarns is applied to each other, becomes insufficient, the air permeability of the resultant woven fabric becomes to be difficult to control, and the abrasion resistance of the resultant woven fabric becomes insufficient, and the decrease in the number of the constrictions causes the water and perspiration-absorbing property of the resultant woven fabric to be insufficient, and the light-scattering effect on the individual filament peripheries to be insufficient and thus the resultant wove fabric exhibits an unsatisfactory vision through-preventing property.

[0051] In the flat multifilament yarn woven fabric of the present invention, the cross-sectional flatness (B/C1) of the individual filaments of the flat multifilament yarn is 2 to 6, preferably 3 to 5. If the cross-sectional flatness is less than 2, the bending resistance (rigidity) of the individual filaments is too high, the resultant woven fabric exhibits an insufficient softness, and thus the target soft hand of the woven fabric cannot be obtained.

[0052] Also, when the cross-sectional flatness is less than 2, in the warp-weft intersecting portions of the woven

fabric, the slip-spreading of the individual filaments in the multifilament yarn due to the compressive pressure of the warp and weft yarns to each other becomes insufficient, the gaps between the warp and weft yarns cannot be sufficiently small, the size of the spaces between the filaments cannot be sufficiently small, and thus the air permeability of the resultant woven fabric becomes difficult to control to a desired level.

[0053] Also, individual filaments having a cross-sectional flatness (B/C1) of more than 6 are difficult to produce.

[0054] In the cross-sectional profile of the flat individual filaments of the flat multifilament yarn usable for the woven fabric of the present invention, the ratio (C1/C2) of the largest width (C1) to the smallest width (C2) in the direction at right angles to the longitudinal center line of the flat profile is preferably in the range of from 1.05 to 4.00, more preferably 1.10 to 2.50. The ratio (C1/C2) as mentioned above is a parameter relating to a depth of the constrictions of the flat individual filaments. If the ratio (C1/C2) is less than 1.05, namely, the depth of the constriction is too small, the peripheral surfaces of the resultant flat individual filaments may exhibit too high a frictional resistance and the resultant woven fabric may exhibit too high an air permeability and insufficient abrasion resistance, vision through-preventing property, and water and perspiration-absorbing properties. Also, if the ratio (C1/C2) is more than 4.0, the depth of the constrictions of the flat individual filaments is too large, the effects of the constrictions is saturated, and the resultant woven fabric may be disadvantageous in that the filament-forming procedures may be unstable, the resultant individual filaments may be slit along the constrictions, and the uniformity in the cross-sectional profile of the individual filaments may be degraded.

[0055] In each of Figs. 2 and 3, another embodiment of the cross-sectional profile of the flat individual filaments usable for the flat multifilament yarn woven fabric of the present invention is shown.

[0056] The cross-sections of filament 1 shown in Fig. 2 has a profile having similar projections and constrictions formed in both side sections with respect to the longitudinal center line 2, to those is Fig. 1, except that the profile of the projections in Fig. 2 is in the form of an arc of an ellipse extending along the major axis of the ellipse and thus the form of the ellipse arc is more gentle than that of the circle arc form of the projections of Fig. 1, and thus the depth of the constrictions in Fig. 2 is smaller than that in Fig. 2.

[0057] The cross-sectional profile of a filament 1 shown in Fig. 3 has projections and constrictions formed in both side sections of the flat profile with respect to the longitudinal center line and in the numbers of 4 and 3 per one side section of the flat profile, respectively. In Fig. 3, a projection 3a is smaller in width and height than the other 3 projections 3, and thus the depth of the constrictions 4a formed in both sides of the projection 3a namely from the top of the projection 3a to the bottoms of constrictions 4a is smaller than that of the other constrictions 4.

[0058] The cover factor of the flat multifilament yarn woven fabric is in the range of from 800 to 3500, as mentioned above, can be appropriately established in response to the properties and performances necessary to the woven fabric.

[0059] The cover factor (CF) of a woven fabric is defined by the following equation.

$$CF = (DWp/1.1)^{1/2} \times NWp + (DWf/1.1)^{1/2} \times MWf$$

[0060] In the above-mentioned equation,

DWp represents a total thickness (dtex) of the warp yarns,

MWp represents a weave density (yarns/2.54 cm) of the warp yarns,

DWf represents a total thickness (dtex) of the weft yarns,

MWp represents a weave density (yarns/2.54 cm) of the weft yarns.

[0061] In the flat multifilament yarn woven fabric of the present invention, if the cover factor (CF) of the fabric is less than 800, the gaps between the warp and weft yarns is large and the air permeability of the woven fabric is difficult to control to a desired value and also a woven fabric having a vision through-preventing property at a desired high level is difficult to produce.

[0062] Also, if the cover factor (CF) is more than 3500, the resultant woven fabric exhibits an insufficient softness and an unsatisfactory light transmission (lighting property).

[0063] The fiber-forming artificial polymer usable for forming the flat multifilament yarns for the flat multifilament yarn woven fabric of the present invention may be selected from fiber-forming synthetic polymers, for example, polyester, polyamide polyvinylidene chloride and polypropylene resins; fiber-forming semisynthetic polymers, for example, cellulose acetates and regenerated polymers, for example, regenerated celluloses, etc. In consideration of the ease or the difficulty in the production of the flat multifilament yarns, fiber-forming thermoplastic polymers capable of being formed into fibers by a melt-spinning method, for example, polyesters, for example, polyethylene terephthalate, trimethylene terephthalate, etc.; polyamides, for example, nylon 6, nylon 66, etc., polyvinylidene chloride and polypropylene, are preferably used.

[0064] In the fiber-forming artificial polymer, an additive comprising at least one member selected from, for example, delustering agents (for example, titanium dioxide, etc.), fine pore-forming agents (for example, organic sulfonate metal salts, etc.), cationic dye-dyeability-imparting agent (for example, a sulfonium isophthalate salt, etc.), antioxidants (for

example, hindered phenol compounds, etc.), thermostabilizers, flame-retardants (for example, diantimony trioxide, etc.), fluorescent brightening agents, coloring materials, antistatic agents, (for example, organic sulfonate metal salt, etc.), moisture-conditioning agents (for example, polyoxyalkyleneglycols, etc.), and antibacterial agents fine particles, etc.), may be mixed.

5 **[0065]** There is no limitation to the total thickness of the multifilament yarn and to the thickness of the flat individual filaments usable for the woven fabric of the present invention, as long as the target woven fabric of the present invention can be obtained. Usually, the total thickness of the yarn is preferably 30 to 170 dtex, more preferably 50 to 100 dtex and the thickness of the individual filaments is preferably 0.5 to 5 dtex, more preferably 1 to 4 dtex.

10 **[0066]** Also, there is no limitation to the number of twists of the flat multifilament yarn usable for the flat multifilament yarn woven fabric of the present invention, as long as the target woven fabric of the present invention can be obtained.

[0067] Namely, the number of twists may be appropriately established in response to the use and the necessary properties of the target woven fabric. Usually, the number of twist is preferably 0 to 2500 turns/m, more preferably 0 to 600 turns/m.

15 **[0068]** The multifilament yarns usable for the woven fabric of the present invention may be textured yarns by false-twisting method, TASLAN method or air texturing method, for example, an air-interlacing method, as long as the target woven fabric of the present invention can be obtained.

[0069] In the woven fabric of the present invention, the warp and/or weft yarns from which the woven fabric is constituted must be constituted from the multifilament yarns comprising a plurality of individual filaments having the flat cross-sectional profile as mentioned above.

20 **[0070]** Namely, the flat multifilament yarns may be used as both the warp and weft yarns, or as either one of the warp and weft yarns, and the other either one of the warp and weft yarns may be constituted by yarns different from the flat multifilament yarns.

25 **[0071]** The different yarns may be selected from monofilament yarns, multifilament yarns and spun yarns. These different yarns may have a specific property, for example, an anti-static property, a sheening property etc. Also, in the warp and/or weft yarns usable for the woven fabric of the present invention, a small amount of filaments or fibers different from the flat individual filaments may be used together with the flat multifilament yarns, as long as the target woven fabric of the present invention can be obtained.

30 **[0072]** In the flat multifilament yarn woven fabric of the present invention, the content of the flat multifilament yarns is preferably 10 to 100% by mass, more preferably 20 to 100% by mass, still more preferably 40 to 100% by mass, based on the total mass of the woven fabric.

[0073] The flat multifilament yarns for the woven fabric of the present invention can be produced by using a spinneret for flat filaments, for example, a spinneret provided with a plurality of spinning orifices having a cross-sectional profile as shown in Fig. 2-C appearing on page 5 of Japanese Unexamined Patent Publication No. 56-107,044.

35 **[0074]** The flat multifilament yarn woven fabric of the present invention can be produced a conventional weaving procedure in which the flat multifilament yarns produced as mentioned above are used as warp and/or weft yarns, and can be dyed and finished by a conventional dyeing and finishing procedures. In the case where the flat multifilament yarns are flat polyester multifilament yarns, the resultant woven fabric may be subjected to a mass-reduction treatment with an alkali. Also, in the finishing procedures, the woven fabric may be subjected to one or more of water absorption-enhancing treatments (by coating or impregnating with a water-absorbing agent, for example, an anionic hydrophilic polymeric compound), water-repellent treatments (by coating or impregnating with a water-repellent agent, for example, a water-repellent fluorine compound), ultraviolet ray-blocking treatments (by applying a dispersion of ultrafine particles of a metal oxide), antistatic treatments, deodorant-applying treatments, mothproofing agent-applying treatments and a light storage agent-applying treatments, successively or simultaneously.

40 **[0075]** In an embodiment of the flat multifilament yarn woven fabric of the present invention, the thickness of the warp and weft yarns and the weave density of the warp and weft yarns are controlled to an extent that the resultant woven fabric exhibits a cover factor (CF) in the range of from 1500 to 3500.

45 **[0076]** In the embodiment (1) of the present invention, the cover factor of the woven fabric is preferably 1500 to 3000 and preferably 1500 to 2500.

[0077] Also, in the embodiment (1) of the present invention, the flat multifilament yarn preferably has a number of twists of 0 to 2500 turns/m, more preferably 0 to 600 turns/m, still more preferably 0 turn/m, namely non-twisted.

50 **[0078]** In the embodiment (1) of the present invention, the flat multifilament yarn woven fabric preferably has an air permeability of 5 ml/cm²·sec or less, more preferably 4 ml/cm²·sec or less, still more preferably 0.1 to 3 ml/cm²·sec. The air permeability is determined in accordance with JIS L 1096-1998, 6.27.1, Method A (using a Frazier type tester).

55 **[0079]** In the embodiment (1) of the present invention, the flat multifilament yarn woven fabric preferably has a water absorption velocity of 40 mm or more, more preferably 50 to 70 mm, determined in accordance with JIS L 1096-1998, 6.26.1 (2) Method (B) (Byreck method) and an abrasion resistance of 50 abrasions or more, more preferably 80 abrasions or more, still more preferably 100 abrasions or more.

[0080] On the embodiment (1) of the present invention, if the cover factor (CF) of the woven fabric is less than 1500,

the areas of gaps formed between the warp yarns and the weft yarns may be too large, the resultant woven fabric may exhibit too high an air permeability (of, for example, more than 5 ml/cm²-sec) and insufficient water and perspiration-absorbing property and an insufficient abrasion resistance. Also, if the cover factor (CF) of the woven fabric is more than 3500, the warp and weft yarns in the resultant woven fabric may closely contact with each other, the resultant woven fabric may have an insufficient softness and too high a flexing resistance and thus the hand of the woven fabric may become unsatisfactory and the abrasion resistance of the woven fabric may be insufficient.

[0081] In the flat multifilament yarn woven fabric of the embodiment (1) of the present invention having a cover factor of 1500 to 3500, the flat multifilament yarns from which the warp and/or weft yarns of the woven fabric are constituted, are flattened and laterally spread due to the compressive pressure generated at the warp-weft intersecting portions of the fabric, under which compressive pressure, the flat individual filaments contacting each other, at the flat periphery thereof, slip laterally on each other to make the yarn flat. In this flattening of the yarn, the areas of the gaps between the warp and weft yarns decrease and thus the resultant woven fabric exhibits a decreased air permeability. Therefore, the flat multifilament yarn woven fabric of the embodiment (1) of the present invention preferably exhibits a low air permeability of 5 ml/cm²-sec or less.

[0082] In the embodiment (1) of the present invention the flattening of the flat multifilament yarn causes the resultant woven fabric to exhibit a decreased flexing resistance an increased softness and a good soft hand. Also, in the woven fabric of the embodiment (1) of the present invention, each of the flat individual filaments in the multifilament yarns has 3 or more projections extending along the longitudinal direction of the periphery and 2 or more constrictions formed between the projections, per one side section of the flat profile, and thus the periphery of the flat individual filament is roughened. Thus, when the individual filaments in the yarns are brought into contact with each other, particularly under a compressive pressure generated at the intersecting portions of the warp and weft yarns, the contact area of the individual filaments brought into contact with each other is relatively small, and thus the frictional resistance between the individual filaments is small. Therefore, the roughened peripheries of the individual filaments contributes to enhancing the softness of the resultant woven fabric. Further, in the periphery of each individual filament, the constrictions extending along the longitudinal direction of the periphery are not, or are substantially not, closed even when the peripheries of the individual filaments are brought into contact with each other. Therefore, water or perspiration can easily diffuse along the constrictions due to the capillary phenomenon, and thus the resultant woven fabric exhibits excellent water and perspiration-absorbing property.

[0083] The flat multifilament yarn woven fabric of the embodiment (1) of the present invention exhibits an excellent soft hand, a high water and perspiration-absorbing property and a high abrasion resistance and thus is useful as low air permeability textile materials for various clothes, for example, sport clothes and uniform clothes for men and women, and folk costumes (native dresses), for example, tabes, undergarments, lining clothes, hats caps and fabrics for umbrellas and parasols.

[0084] In an embodiment (2) of the flat multi-filament yarn woven fabric of the present invention, the multifilament yarns contain a delustering agent in a content of 0.2% by mass or more, preferably 0.4 to 3.5% by mass, more preferably 1.0 to 2.5% by mass, and the woven fabric has a cover factor (CF) of 1300 to 3000, preferably 1400 to 2500.

[0085] There is no limitation to the composition and type of the delustering agent contained in the multifilament yarn of the flat multifilament yarn woven fabric of the embodiment (2) of the present invention, as long as the target woven fabric of the present invention can be obtained. Usually, the delustering agent may comprise at least one type of fine inorganic particles, for example, titanium dioxide and barium sulfate. If the content of the delustering agent is less than 0.2% by mass, on the basis of the total mass of the multifilaments, the resultant multifilament yarn may exhibit an insufficient reflectance and thus the resultant woven fabric may be not able to exhibit a satisfactory vision through-preventing property. It should be noted that if the content of the delustering agent exceeds 7% by mass, the fiber-forming property of the resultant polymer composition may become unstable.

[0086] If the cover factor (CF) of the woven fabric of the embodiment (2) of the present invention is less than 1300, the gaps between the warp and weft yarns may be too large, and the resultant woven fabric may exhibit an unsatisfactory vision through-preventing property. Also, if the cover factor (CF) if more than 3000, the resultant woven fabric may exhibit an insufficient softness and an unsatisfactory hand.

[0087] In the case where the woven fabric of the embodiment (2) of the present invention has a plain weave structure, the cover factor of the plain weave fabric preferably in the range of from 1400 to 1800, more preferably from 1500 to 1700.

[0088] In the case where the woven fabric of the embodiment (2) of the present invention has a twill weave structure, the resultant twill weave fabric preferably has a cover factor (CF) of 1900 to 2400, more preferably 2000 to 2300.

[0089] There is no specific limitation to the number of twists of the multifilament yarns usable for the woven fabric of the embodiment (2) of the present invention, as long as the target woven fabric of the present invention can be obtained. However, in order to fully ensure the freedom of movement of the individual filaments in the yarn, relative to each other, the number of twists of the flat multifilament yarn is preferably 0 to 1500 turns/m, more preferably 0 to 600 turns/m. Still more preferably, the number of twists is 0 turn/m, namely, non-twisted.

[0090] In the embodiment (2) of the present invention, the flat multifilament yarn woven fabric preferably has a degree of vision through-prevention, represented, in a $L^*a^*b^*$ color system, by a difference $\Delta L (= L^*_w - L^*_b)$ between an L^* value of the woven fabric placed on a white plate, represented by L^*_w , and an L^* value of the woven fabric placed on a black plate, represented by L^*_b , is 15 or less, more preferably 10 to 13. If the degree ΔL of the vision through prevention is more than 15, the vision through preventing property of the resultant woven fabric may be insufficient, in practice.

[0091] The flat multifilament yarn woven fabric of the embodiment (2) of the present invention, preferably has a water absorption velocity of 40 mm or more, more preferably 45 mm or more, still more preferably 50 to 70 mm, determined in accordance with JIS L 1096-1998, 6.26.1, (2) Method B (Byreck method). If the water absorption velocity is less than 40 mm, the resultant woven fabric may exhibit insufficient water and perspiration-absorbing property in practice.

[0092] In the flat multifilament yarn woven fabric of the embodiment (2) of the present invention, the cross-sectional profile of individual filaments from which the flat multifilament yarn is constituted is flat. In this flat cross-sectional profile, three or more projections and two or more constrictions between the projections per one side section of the flat profile are formed. Thus the peripheries of the individual filaments brought into contact with each other exhibit a low frictional resistance to each other and can easily slip on each other. When a compressive pressure is applied to the multifilament yarns, the individual filaments can easily move relative to each other along the contacting peripheries, so that the multifilament yarn is flattened and laterally spread. Also, the individual filaments closely contact at the flat peripheries with each other, to cause the gaps between the yarns arranged in the woven fabric to be reduced, and the quantity of light transmitted through the woven fabric to decrease. Also, the delustering agent contained in a content of 0.2% by mass in the individual filaments causes the light transmittance through the resultant woven fabric to reduce and the light irradiated toward the woven fabric to irregularly reflect on the woven fabric. Further, the plurality of the projections and constrictions formed on the peripheries of the individual filaments cause the peripheries of the individual filaments to be roughened to scatter the incident light and to prevent vision through the woven fabric. At the intersecting portions of the warp and weft yarns of the woven fabric, the flattening and spreading of the multifilament yarns can cause the intersecting portions to be softened and the hand of the resultant woven fabric to be soft.

[0093] Further, the constrictions extending along the longitudinal axis of the individual filament can cause a capillary phenomenon to water and perspiration to be generated and the resultant woven fabric to exhibit a high water and perspiration absorption velocity.

[0094] Thus, the flat multifilament yarn woven fabric of the embodiment (2) of the present invention are useful as a textile material for a use in which high vision through-preventing property and water and perspiration-absorbing property are necessary, for example, lining clothes, sport clothes and uniform clothes.

[0095] In an embodiment (3) of the flat multifilament yarn woven fabric of the present invention, the artificial individual filaments of the multifilament yarn contains a delustering agent in a small content of 0 to 0.2% by mass and the woven fabric has a cover factor (CF) in the range of from 800 to 2000.

[0096] In the flat multifilament yarn woven fabric of the embodiment (3) of the present invention, the content of the delustering agent in the artificial individual filaments are 0 to 0.2% by mass, preferably 0 to 0.1% by mass. More preferably, no delustering agent is contained in the individual filaments. The delustering agent for the present invention may be selected from conventional delustering agents, for example, titanium dioxide and barium sulfate. If the content of the delustering agent is more than 0.2% by mass, in the preferable use of the woven fabric of the embodiment (3) of the present invention, for example, curtains, the resultant woven fabric may exhibit an insufficient light transmittance and thus an unsatisfactory lightening property.

[0097] In the flat multifilament yarn woven fabric of the embodiment (3) of the present invention, the multifilament yarn preferably has a number of twists of 0 to 1000 turns/m, more preferably 0 to 200 turns/m, still more preferably no twist.

[0098] The cover factor (CF) of the flat multifilament yarn woven fabric of the embodiment (3) of the present invention is in the range of from 800 to 2000, preferably from 900 to 1800, more preferably from 1000 to 1800.

[0099] If the cover factor (CF) is less than 800, in the preferable use of the flat multifilament yarn woven fabric of the embodiment (3) of the present invention, for example, curtains, the gaps between the warp and weft yarns in the woven fabric may be too large, and the resultant woven fabric may exhibit an insufficient vision through-preventing property. Also, if the cover factor is more than 2000, the resultant woven fabric may exhibit an insufficient lighting property.

[0100] The flat multifilament yarn woven fabric of the embodiment (3) of the present invention, preferably exhibits a degree of light transmittance of 10 to 70%, more preferably 20 to 50%, determined in accordance with JIS L 1055-1987, 6.1. Method A, at a degree of illumination of 100000 lx. The light transmittance in % is calculated by subtracting a light-blocking rate in % of the woven fabric from 100%. If the light transmittance is less than 10%, in the preferable use of the woven fabric, for example, curtains, the lighting property of the resultant woven fabric may be insufficient. Also, if the light transmittance is more than 70%, the resultant woven fabric may exhibit an insufficient vision through-preventing property.

[0101] The flat multifilament yarn woven fabric of the embodiment (3) of the present invention preferably is non-colored or dyed into a light or moderate color. The type and amount of the dye used for dyeing may be established in

view of the use and necessary properties of the resultant dyed woven fabric.

[0102] In the flat multifilament yarn woven fabric of the embodiment (3) of the present invention, the flat multifilaments are laterally spread and flattened at the warp-weft-intersecting portions of the woven fabric due to a compressive pressure generated in the intersecting portions, the individual filaments are, at flat peripheries thereof, closely contacted with each other, to form a dense structure. In this dense structure, the gaps between the warp and weft yarns are small, and the quantity of the light passing through the gaps is reduced. A small amount of the light passing through the gaps is diffracted in the small gaps and transmitting light rays through the small gaps adjacent to each other interfere with each other, to enhance the vision through-preventing effect of the woven fabric. Also, the specific cross-sectional profile of the flat individual filaments in the multifilament yarn causes the irregular reflection of the incident light on the peripheries of the individual filaments and the refraction of the light transmitted through the filaments are increased in comparison with filaments having a flat cross-sectional profile and provided with smooth peripheries, filaments having a circular cross-sectional profile, and filaments having a triangular cross-sectional profile. Thus, the resultant woven fabric exhibits an excellent vision through-preventing effect without reducing the lighting property thereof.

[0103] The flat multifilament yarn woven fabric of the embodiment (3) of the present invention exhibits good soft hand, a low flexing resistance, a low air permeability and a high abrasion resistance, similar to those of the embodiments (1) and (2).

[0104] For the reasons as mentioned above, the flat multifilament yarn woven fabric of the embodiment (3) of the present invention is useful for vision through-preventing textile materials for interior, for example, curtains, roll blinds (shades) and partitions.

EXAMPLES

[0105] The present invention will be further illustrated by the following examples which are not intended to limit the scope of the present invention in any way.

Example 1

[0106] A polyethylene terephthalate resin was melt-extruded at a temperature of 300°C through 30 melt-spinning orifices formed in a melt-spinneret and having a hole shape corresponding to the cross-sectional profile of a filament shown in Fig. 1, which profile has 4 circular arc-shaped projections and 3 constrictions formed between the projections, per one side section of the profile, formed on both the sides of a longitudinal center line of the profile. The extruded filamentary melt streams were taken up at a taking up speed of 4000 m/minute, while cool-solidifying the melt streams. The resultant undrawn multifilaments were, without winding up, directly drawn at a temperature of 97°C at a draw ratio of 1.3, to prepare a drawn multifilament yarn having a yarn count of 84 dt/30 filaments. The individual filaments of the multifilament yarn had a cross-sectional profile as shown in Fig. 1, a flatness of the cross-sectional profile of 3.2, and a filament width ratio C1/C2 was 1.2.

[0107] The flat multifilament yarns, which were kept non-twisted, were used as warp and weft yarns to produce a plain weave having the following warp and weft densities.

Warp density: 101 warps/2.54 cm
Weft density: 90 wefts/2.54 cm

[0108] In the resultant plain weave, a content of the flat multifilament yarn was 100%. The plain weave was finished by scouring and dyeing. The finished plain weave had a cover factor (CF) of 1782.

[0109] The finished plain weave was subjected to the following tests.

(1) Air permeability

[0110] The air permeability of the woven fabric was determined in accordance with JIS L 1096-1998, 6.27.1, Method A (using a Frazier type tester).

(2) Abrasion resistance

[0111] The abrasion resistance of the woven fabric was determined in accordance with JIS L 1096-1998, 6.17.1, (1) Method A-1 (flat surface method).

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(3) Water-absorbing property

[0112] A water-absorption velocity of the woven fabric was determined in accordance with JIS L 1096-1998, 6.26.1, (2) Method B (Byreck method).

(4) Hand

[0113] The hand of the woven fabric was evaluated, by touching with a hand, into the following five classes.

Class	Hand
5	Very high softness, Excellent good hand
4	High softness, Good hand
3	Sufficient softness, Satisfactory hand
2	Slightly insufficient softness, Slightly unsatisfactory hand
1	Insufficient softness, Unsatisfactory hand

(5) General evaluation.

[0114] The general evaluation results of the tested woven fabric were shown in the following four classes.

Class	General evaluation
4	Excellent
3	Good
2	Slightly unsatisfactory
1	Bad

[0115] The test results are shown in Table 1.

Example 2

[0116] A plain weave of flat multifilament yarns was produced and tested by the same procedures as in Example 1, with exceptions as shown below.

[0117] In the cross-sectional profile of the flat individual filaments, the number of the circular arc-shaped projections was changed from 4 to 3, and the number of the constrictions was changed from 3 to 2, per one side of the longitudinal center line of the flat profile.

[0118] The flatness (B/C1) of the flat cross-sectional profile was 3.2, the ratio (C1/C2) was 1.2, and the cover factor of the plain weave was 1782.

[0119] The test results are shown in Table 1.

Comparative

Example 1

[0120] A plain weave of flat multifilament yarns was produced and tested by the same procedures as in Example 1, with exceptions as shown below.

[0121] In the flat cross-sectional profile of the individual filaments, no constrictions were formed.

[0122] The flatness (B/C1) of the flat cross-sectional profile was 3.2, the ratio (C1/C2) was 1.0, and the cover factor of the plain weave was 1782.

[0123] The test results are shown in Table 1. Comparative

Example 2

[0124] A plain weave of multifilament yarns was produced and tested by the same procedures as in Example 1, with exceptions as shown below.

[0125] The flat cross-sectional profile of the individual filaments was changed to a circular cross-sectional profile.

[0126] The cover factor of the resultant plain weave was 1782.

[0127] The test results are shown in Table 1.

Table 1

Item	Cross-sectional profile			Cover factor (CF)	Air permeability (ml/cm ² ·s)	Abrasion resistance (Abrasion number)	Water-absorption velocity (mm)	Hand	General evaluation	
	Constriction number (per one side)	Ratio (B/C1)	Ratio (C1/C2)							
Example No.	1	3	3.2	1.2	1782	0.74	110	55	5	4
Example	2	2	3.2	1.2	1782	0.92	82	50	5	4
Comparative Example	1	0	3.2	1.0	1782	2.75	56	20	4	2
Example	2	Circular			1782	5.55	45	22	2	1

Example 3

[0128] A polyethylene terephthalate resin containing 2.5% by mass of a delustering agent consisting of titanium dioxide was melt-extruded at a temperature of 300°C through 30 melt-spinning orifices formed in a melt-spinneret and having a hole shape corresponding to the cross-sectional profile of a filament shown in Fig. 1, which profile has 4 circular arc-shaped projections and 3 constrictions formed between the projections, per one side section of the profile, formed on both the sides of a longitudinal center line of the profile. The extruded filamentary melt streams were taken up at a taking up speed of 4000 m/minute, while cool-solidifying the melt streams. The resultant undrawn multifilaments were, without winding up, directly drawn at a temperature of 97°C at a draw ratio of 1.3, to prepare a drawn multifilament yarn having a yarn count of 84 dt/30 filaments. The individual filaments of the multifilament yarn had a cross-sectional profile as shown in Fig. 1, a flatness of the cross-sectional profile of 3.2, and a filament width ratio C1/C2 was 1.2.

[0129] The flat multifilament yarns, which were kept non-twisted, were used as warp and weft yarns to produce a plain weave having the following warp and weft densities.

Warp density: 101 warps/2.54 cm

Weft density: 84 wefts/2.54 cm

[0130] In the resultant plain weave, a content of the flat multifilament yarn was 100%. The plain weave was finished by scouring and dyeing. The finished plain weave had a cover factor (CF) of 1700.

[0131] The resultant woven fabric was subjected to the following tests.

(1) Degree of vision through-prevention

[0132] The degree of vision through prevention of the woven fabric subjected to the test was represented, in a L*a*b* color system, by a difference $\Delta L (= L^*_w - L^*_b)$ between an L* value of the woven fabric placed on a white plate, represented by L*_w, and an L* value of the woven fabric placed on a black plate, represented by L*_b.

(2) Water-absorbing property

[0133] The water absorption velocity of the woven fabric was determined in accordance with JIS L 1096-1998, 6.26.1, (2) Method B (Byreck method), as in Example 1.

(3) Hand

[0134] The hand of the woven fabric was evaluated, by touching with a hand, into the following five classes, as in Example 1.

Class	Hand
5	Very high softness, Excellent good hand

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(continued)

Class	Hand
4	High softness, Good hand
3	Sufficient softness, Satisfactory hand
2	Slightly insufficient softness, Slightly unsatisfactory hand
1	Insufficient softness, Unsatisfactory hand

(5) General evaluation.

[0135] The general evaluation results of the tested woven fabric were shown in the following four classes, as in Example 1.

Class	General evaluation
4	Excellent
3	Good
2	Slightly unsatisfactory
1	Bad

[0136] The test results are shown in Table 2.

Example 4

[0137] A plain weave of flat multifilament yarns was produced and tested by the same procedures as in Example 3, with exceptions as shown below.

[0138] In the cross-sectional profile of the flat individual filaments, the number of the circular arc-shaped projections was changed from 4 to 3, and the number of the constrictions was changed from 3 to 2, per one side of the longitudinal center line of the flat profile.

[0139] The flatness (B/C1) of the flat cross-sectional profile was 3.2, the ratio (C1/C2) was 1.2, and the cover factor of the plain weave was 1700.

[0140] The test results are shown in Table 2.

Comparative

Example 3

[0141] A plain weave of flat multifilament yarns was produced and tested by the same procedures as in Example 3, with exceptions as shown below.

[0142] In the flat cross-sectional profile of the individual filaments, no constrictions were formed.

[0143] The flatness (B/C1) of the flat cross-sectional profile was 3.2, the ratio (C1/C2) was 1.0, and the cover factor of the plain weave was 1700.

[0144] The test results are shown in Table 2. Comparative

Example 4

[0145] A plain weave of multifilament yarns was produced and tested by the same procedures as in Example 3, with exceptions as shown below.

[0146] The flat cross-sectional profile of the individual filaments was changed to a circular cross-sectional profile.

[0147] The cover factor of the resultant plain weave was 1700.

[0148] The test results are shown in Table 2.

Table 2

Example No.	Item	Cross-sectional profile			Cover factor (CF)	Degree of vision through-prevention (ΔL)	Water-absorption velocity (mm)	Hand	General evaluation
		Constriction number (per one side)	Ratio (B/C1)	Ratio (C1/C2)					
Example	3	3	3.2	1.2	1700	12.5	55	5	4
	4	2	3.2	1.2	1700	12.4	50	5	4
Comparative Example	3	0	3.2	1.0	1700	13.4	20	4	2
	4	Circular			1700	15.0	22	2	1

Example 5

[0149] A polyethylene terephthalate resin containing no delustering agent was melt-extruded at a temperature of 300°C through 30 melt-spinning orifices formed in a melt-spinnert and having a hole shape corresponding to the cross-sectional profile of a filament shown in Fig. 1, which profile has 4 circular arc-shaped projections and 3 constrictions formed between the projections, per one side section of the profile, formed on both the sides of a longitudinal center line of the profile. The extruded filamentary melt streams were taken up at a taking up speed of 4000 m/minute, while cool-solidifying the melt streams. The resultant undrawn multifilaments were, without winding up, directly drawn at a temperature of 97°C at a draw ratio of 1.3, to prepare a drawn multifilament yarn having a yarn count of 84 dt/30 filaments. The individual filaments of the multifilament yarn had a cross-sectional profile as shown in Fig. 1, a flatness of the cross-sectional profile of 3.2, and a filament width ratio C1/C2 was 1.2.

[0150] The flat multifilament yarns, which were kept non-twisted, were used as warp and weft yarns to produce a plain weave having the following warp and weft densities.

Warp density: 63 warps/2.54 cm

Weft density: 52 weft/2.54 cm

[0151] In the resultant plain weave, a content of the flat multifilament yarn was 100%. The plain weave was finished by scouring and dyeing. The finished plain weave had a cover factor (CF) of 1000.

[0152] The resultant woven fabric was subjected to the following tests.

(1) Light transmittance

[0153] The woven fabric was subjected to a measurement of a light blocking rate in accordance with JIS L 1055-1987, 6.1, Method A at a degree of illumination of 100,000 lx, and the light transmittance through the woven fabric was calculated in accordance with the following equation.

$$\text{Light transmittance (\%)} = 100 - \text{Light blocking rate (\%)}$$

(2) Vision through-preventing property

Vision through-preventing property in the daytime

[0154] In a room lighted at an illumination of 700 lx by using a 80W fluorescent lamp for a room, an article (color: red, form: rectangular parallelepiped, dimensions: 15 cm × 7 cm × 7 cm) to be seen through a woven fabric was placed at a location of 20 cm far from a surface of the woven fabric, and the naked eye of an observer was positioned outside of the room at a location of 30 cm away from the opposite surface of the woven fabric and at an illumination of 100,000 lx of sunlight, to allow the observer to see the article through the woven fabric.

[0155] The degree of the vision through-prevention of the woven fabric in the daytime was evaluated in the following four classes.

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Class	Degree of vision through prevention
4	Completely not able to recognize the article
3	Slightly able to recognize the article
2	Approximately able to recognize the contours of the article
1	Clearly able to recognize the article

Vision through-preventing property in the nighttime

[0156] The vision through-presenting property of the woven fabric in the nighttime was tested by the same method as that for the daytime, except that the observer for the article was positioned outside the room in the nighttime at an illumination of 0.2 lx.

[0157] The degree of the vision through-prevention of the woven fabric in the nighttime was evaluated in the same four classes as those in the daytime.

[0158] The test results are shown in Table 3.

Example 6

[0159] A plain weave of flat multifilament yarns was produced and tested by the same procedures as in Example 5, with exceptions as shown below.

[0160] The weave structure of the plain weave was changed to that having a warp density of 55 warps/2.54 cm and a weft density of 36 wefts/2.54 cm, and the cover factor (CF) of the resultant plain weave was 880.

[0161] The test results are shown in Table 3.

Example 7

[0162] A plain weave of flat multifilament yarns was produced and tested by the same procedures as in Example 5, with exceptions as shown below.

[0163] The weave structure of the plain weave was changed to that having a warp density of 112 warps/2.54 cm and a weft density of 74 wefts/2.54 cm, and the cover factor (CF) of the resultant plain weave was 1800.

[0164] The test results are shown in Table 3.

Example 8

[0165] A plain weave of flat multifilament yarns was produced by the same procedures as in Example 5, with exceptions as shown below.

[0166] The flat multifilament yarn was twisted at a number of twists of 200 turns/m, and the resultant plain weave exhibited a cover factor (CF) of 1000.

[0167] The test results are shown in Table 3.

Comparative

Example 5

[0168] A plain weave of flat multifilament yarns was produced and tested by the same procedures as in Example 5, with exceptions as shown below.

[0169] The flat cross-sectional profile of the individual filaments of the multifilament yarn had no constrictions. (Flatness of the flat profile: 3.2, Ratio (C1/C2): 1.0).

[0170] The resultant woven fabric had a cover factor (CF) of 1000.

[0171] The test results are shown in Table 3.

Comparative

Example 6

[0172] A plain weave of flat multifilament yarns was produced by the same procedures as in Example 5, with excep-

tions as shown below.

[0173] The flat cross-sectional profile of the individual filaments of the multifilament yarn was changed to a triangular cross-sectional profile.

[0174] The resultant woven fabric had a cover factor of 1000.

[0175] The test results are shown in Table 3.

Comparative

Example 7

[0176] A plain weave of flat multifilament yarns was produced by the same procedures as in Example 5, with exceptions as shown below.

[0177] The flat cross-sectional profile of the individual filaments of the multifilament yarn was changed to a circular cross-sectional profile.

[0178] The resultant woven fabric had a cover factor of 1000.

[0179] The test results are shown in Table 3.

Comparative

Example 8

[0180] A plain weave of flat multifilament yarns was produced by the same procedures as in Example 6, with exceptions as shown below.

[0181] The flat cross-sectional profile of the individual filaments of the multifilament yarn was changed a triangular cross-sectional profile.

[0182] The resultant woven fabric had a cover factor of 880.

[0183] The test results are shown in Table 3.

Comparative

Example 9

[0184] A plain weave of flat multifilament yarns was produced by the same procedures as in Example 7, with exceptions as shown below.

[0185] The flat cross-sectional profile of the individual filaments of the multifilament yarn was changed to a triangular cross-sectional profile.

[0186] The resultant woven fabric had a cover factor of 1800.

[0187] The test results are shown in Table 3.

Table 3

Item	Cross-sectional profile			Cover factor (CF)	Light transmittance (%)	Vision through-preventing property		
	Number of constrictions per one side	Ratio B/C1	Ratio C1/C2			Daytime	Nighttime	
Example No.								
Example	5	3	3.2	1.2	1000	35	4	3
	6	3	3.2	1.2	880	40	3	3
	7	3	3.2	1.2	1800	25	4	4
	8	3	3.2	1.2	1000	38	3	3
Comparative Example	5	0	3.2	1.0	1000	30	2	2
	6	Triangular cross section			1000	25	2	1
	7	Circular cross section			1000	30	2	2
	8	Triangular cross section			880	30	2	1
	9	Triangular cross section			1800	15	3	2

INDUSTRIAL APPLICABILITY OF THE INVENTION

[0188] In the flat multifilament yarn woven fabric of the present invention, the specific flat cross-sectional profile of the individual filaments in the multifilament yarn enables the individual filaments to easily slip on each other due to a compressive pressure generated at the intersecting portions of the warp and weft yarns to cause the multifilament yarn to be flattened and laterally spread, and the gaps between the yarns to become narrow. Therefore, the air permeability of the woven fabric can be appropriately controlled. The resultant woven fabric of the present invention exhibits a high abrasion resistance and an excellent water and perspiration absorbing property, and can scatter the incident light by diffraction and irregular reflection of the light, to reduce the vision through property of the woven fabric, without significantly decreasing the light transmittance of the woven fabric. Accordingly, the flat multifilament yarn woven fabric of the present invention is useful as a low air permeability textile material, a vision through-preventing textile material, a water and perspiration-absorbing textile material and lighting, vision through-preventing textile material.

Claims

1. A flat multifilament yarn woven fabric comprising a plurality of multifilament yarns comprising a plurality of artificial individual filaments comprising, as a principal component, an artificial fiber-forming polymer and having a flat cross-sectional profile,

wherein in both the side sections of a longitudinal center line of the flat cross sectional profile of each artificial individual filament, at least three projections per side section are projecting outward from the longitudinal center line and at least two constrictions per side section formed between the projections are formed approximately in symmetry with respect to the longitudinal center line, and a degree of flatness of the cross-sectional profile represented by a ratio (B/C1) of a largest length (B) of the cross-sectional profile in the direction of the longitudinal center line to a largest width (C1) of the cross-sectional profile in the direction at right angles to the longitudinal center line is 2 to 6, and woven fabric has a cover factor of 800 to 3500.
2. The flat multifilament yarn woven fabric as claimed in claim 1, wherein the artificial fiber-forming polymer is selected from polyesters, polyamides, polyvinylidene chloride, polypropylene, regenerated cellulose and cellulose acetates.
3. The flat multifilament yarn woven fabric as claimed in claim 1, wherein in the cross-sectional profile of the artificial individual filaments, a ratio (C1/C2) of the largest width (C1) to a smallest width (C2) is in the range of from 1.05 to 4.00.
4. The flat multifilament yarn woven fabric as claimed in claim 1, wherein the total thickness of the multifilament yarns is in the range of from 30 to 170 dtex and the thickness of the individual filaments is in the range of from 0.5 to 5 dtex.

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5. The flat multifilament yarn woven fabric as claimed in claim 1, having a weave structure selected from plain weave, twill weave and satin weave structures.
- 5 6. The flat multifilament yarn woven fabric as claimed in claim 1, wherein the multifilament yarns comprising the artificial individual filaments having the flat cross-sectional profile is contained in an amount of 10 to 100% by mass based on the mass of the fabric.
7. The flat multifilament yarn woven fabric as claimed in claim 1, wherein the cover factor of the woven fabric is in the range of from 1500 to 3500.
- 10 8. The flat multifilament yarn woven fabric as claimed in claim 7, wherein the multifilament yarn has a number of twists of 0 to 2500 turns/m.
- 15 9. The flat multifilament yarn woven fabric as claimed in claim 7, having an air permeability of 5 ml/cm²·sec or less, determined in accordance with JIS L 1096-1998, 6.27.1, Method A (using a Frazir type tester).
- 20 10. The flat multifilament yarn woven fabric as claimed in claim 9, wherein the air-permeability is in the range of from 0.1 to 4.0 ml/cm²·sec.
- 25 11. The flat multifilament yarn woven fabric as claimed in claim 7, having a water absorption velocity of 40 mm or more, determined in accordance with JIS L 1096-1998, 6.26.1, (2) Method B (Byreck method).
12. The flat multifilament yarn woven fabric as claimed in claim 7, having an abrasion resistance of 50 or more abrasions, determined in accordance with JIS L 1096-1998, 6.17.1, (1) Method A-1 (flat surface method).
- 25 13. A low air permeability textile material comprising a flat multifilament yarn woven fabric as claimed in any of claims 7 to 12.
- 30 14. The flat multifilament yarn woven fabric as claimed in claim 1, wherein the artificial individual filaments of the multifilament yarn contains 0.2% or more by mass of a delustering agent and the cover factor of the woven fabric is in the range of from 1300 to 3000.
- 35 15. The flat multifilament yarn woven fabric as claimed in claim 14, wherein the multifilament yarn has a number of twists of 0 to 1500 turns/m.
- 40 16. The flat multifilament yarn woven fabric as claimed in claim 14, having a degree of vision through-prevention of the woven fabric represented, in a L^{*}a^{*}b^{*} color system, by a difference $\Delta L(L = L^*_w - L^*_b)$ between an L^{*} value of the woven fabric placed on a white plate, represented by L^{*}_w, and an L^{*} value of the woven fabric placed on a black plate, represented by L^{*}_b, is 15 or less.
- 45 17. The flat multifilament yarn woven fabric as claimed in claim 14, having a water absorption velocity of 40 mm or more, determined in accordance with JIS L 1096-1998, 6.26.1, (2) Method B (Byreck method).
18. A vision through-preventive, perspiration-absorbent textile material comprising a flat multifilament yarn woven fabric as claimed in any of claims 14 to 17.
- 50 19. The flat multifilament yarn woven fabric as claimed in claim 1, wherein the artificial individual filaments of the multifilament yarn contains 0 to 0.2% by mass and the cover factor of the woven fabric is in the range of from 800 to 2000.
20. The flat multifilament yarn woven fabric as claimed in claim 19, wherein the multifilament yarn has a number of twists of 0 to 1000 turns/m.
- 55 21. The flat multifilament yarn woven fabric as claimed in claim 19, having a degree of light transmittance of 10 to 70%, determined in accordance with JIS L 1055-1987, 6.1. Method A, at a degree of illumination of 100000 lx.
22. A vision through-preventive textile material comprising a flat multifilament yarn woven fabric as claimed in any of claims 19 to 21.

Fig.1

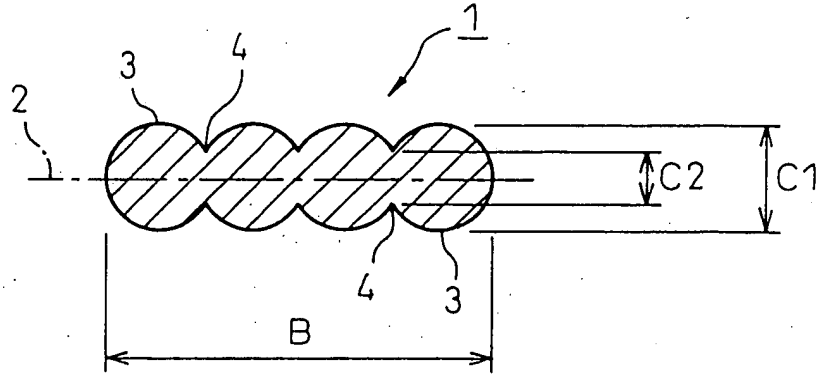


Fig.2

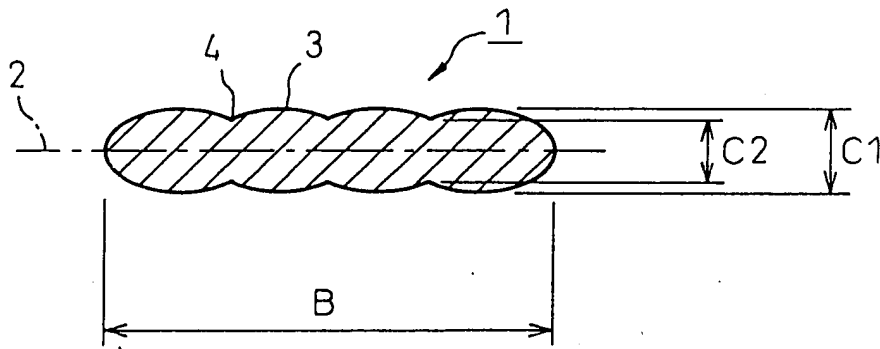
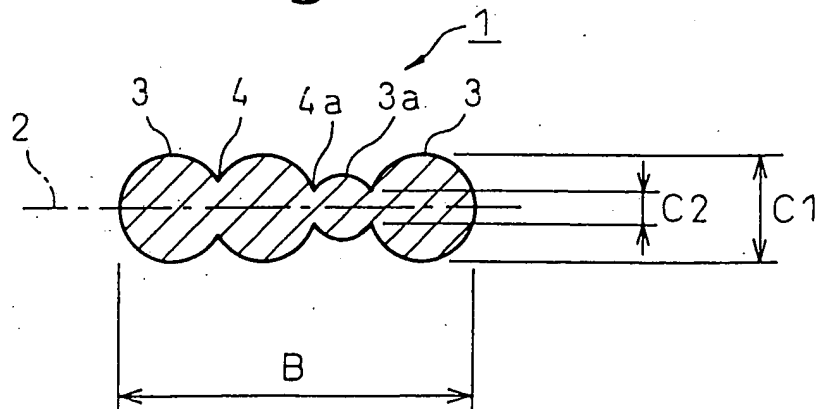


Fig.3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/09277

<p>A. CLASSIFICATION OF SUBJECT MATTER Int.Cl⁷ D03D15/00, D01D5/253</p> <p>According to International Patent Classification (IPC) or to both national classification and IPC</p>												
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) Int.Cl⁷ D03D15/00, D01D5/253, D01F6/00-6/96</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Jitsuyo Shinan Toroku Koho 1996-2003</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)</p>												
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>WO 02/14590 A1 (Toray Industries, Inc.), 21 February, 2002 (21.02.02), Claims & EP 1316633 A1 Claims & JP 2002-293209 A Claims</td> <td>1-22</td> </tr> <tr> <td>Y</td> <td>JP 8-60425 A (Unitika Ltd.), 05 March, 1996 (05.03.96), Claim 1; Par. No. [0013] (Family: none)</td> <td>1-22</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	WO 02/14590 A1 (Toray Industries, Inc.), 21 February, 2002 (21.02.02), Claims & EP 1316633 A1 Claims & JP 2002-293209 A Claims	1-22	Y	JP 8-60425 A (Unitika Ltd.), 05 March, 1996 (05.03.96), Claim 1; Par. No. [0013] (Family: none)	1-22	
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Y	JP 8-60425 A (Unitika Ltd.), 05 March, 1996 (05.03.96), Claim 1; Par. No. [0013] (Family: none)	1-22										
<p><input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.</p>												
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E" earlier document but published on or after the international filing date</td> <td>"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</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E" earlier document but published on or after the international filing date	"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	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed	
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"P" document published prior to the international filing date but later than the priority date claimed												
<p>Date of the actual completion of the international search 15 October, 2003 (15.10.03)</p>		<p>Date of mailing of the international search report 28 October, 2003 (28.10.03)</p>										
<p>Name and mailing address of the ISA/ Japanese Patent Office</p>		<p>Authorized officer</p>										
<p>Facsimile No.</p>		<p>Telephone No.</p>										

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/09277

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 4-24214 A (Toray Industries, Inc.), 28 January, 1992 (28.01.92), Claims; Fig. 1; page 5, upper left column, lines 7 to 10 (Family: none)	1-22
Y	JP 5-195367 A (Teijin Ltd.), 03 August, 1993 (03.08.93), Claim 1 (Family: none)	1-22
Y	JP 11-286848 A (Asahi Chemical Industry Co., Ltd.), 19 October, 1999 (19.10.99), Claim 1 (Family: none)	1-22
Y	JP 11-222721 A (Asahi Chemical Industry Co., Ltd.), 17 August, 1999 (17.08.99), Claim 5; examples (Family: none)	1-22
Y	JP 62-6983 A (Unitika Ltd.), 13 January, 1987 (13.01.87), Page 2, lower right column, line 16 to page 3, upper left column, line 2 (Family: none)	11,17,18
Y	JP 2-234915 A (Kuraray Co., Ltd.), 18 September, 1990 (18.09.90), Claims; Fig. 1 (Ro) (Family: none)	11,17,18
Y	JP 2-221411 A (Toray Industries, Inc.), 04 September, 1990 (04.09.90), Claims; page 2, upper left column, lines 8 to 11 (Family: none)	14-18
Y	JP 7-145575 A (Toray Industries, Inc.), 06 June, 1995 (06.06.95), Par. Nos. [0019], [0020] (Family: none)	16,18,21,22

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