

DESCRIPTION

STRETCH WOVEN FABRIC, AND
SPORTSWEAR AND SWIMWEAR EMPLOYING SAME

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Technical Field

[0001] The present invention relates to a stretch woven fabric with high stretchability, and sportswear and swimwear employing the same.

10 Background Art

[0002] Fabrics with excellent stretchability are suitable for sportswear and swimwear. One of the functions required for swimwear and swimcaps is to reduce the surface friction resistance in water in competitive swimming. Various kinds of stretch woven fabrics have been proposed conventionally. Patent Document 1 proposes a stretch
15 woven fabric in which regions having different stresses are formed using weft yarns of different stresses. Patent Documents 2 and 3 propose a stretch woven fabric having a specific elongation rate. The technique of reducing the surface friction resistance of swimwear is proposed by, for example, Patent Document 4, which discloses a swimsuit in which water-repellent parts and non-water-repellent parts are arranged in stripes
20 in the body length direction. Patent Document 5 proposes a swimsuit obtained by subjecting the entire surface of the swimsuit to water-repellent treatment and forming a plurality of fine channels on the surface in the body length direction. Patent Document 6 proposes a swimsuit obtained by arranging in stripes two or more kinds of synthetic fiber multifilaments having different cross-sectional shapes, forming
25 projections in a direction perpendicular to the stripes, and subjecting the entire surface to water repellent treatment.

Prior Art Documents

Patent Documents

- 30 [0003] Patent Document 1: JP 2013-096027 A
Patent Document 2: JP 2011-256483 A
Patent Document 3: JP 2010-138496 A

Patent Document 4: JP 3283404

Patent Document 5: JP 2000-314015 A

Patent Document 6: JP 2008-138345 A

5 Disclosure of Invention

Problem to be Solved by the Invention

[0004] However, the above conventional sportswear and swimwear are low in stretchability, and thus hard to wear. The conventional stretch woven fabrics also have high surface friction resistance in the form of swimwear.

- 10 [0005] In order to solve the above conventional problems, the present invention provides a highly stretchable woven fabric that can be worn easily (ease of wear) and that is low in surface friction resistance, and sportswear and swimwear employing the same.

15 Means for Solving Problem

[0006] A stretch woven fabric of the present invention is a stretch woven fabric including an elastic yarn. The elastic yarn is arranged in a warp yarn and a weft yarn, and the stretch woven fabric is stretchable in two-way directions. In the fabric, a plain weave part and a double weave part are formed alternately and repeatedly.

- 20 [0007] Sportswear and swimwear of the present invention include the above stretch woven fabric.

Effect of the Invention

- [0008] The stretch woven fabric of the present invention includes elastic yarns in
25 warp and weft yarns, and is stretchable in two-way directions. The plain weave part and the double weave part are formed alternately and repeatedly. Thus, it is possible to provide a stretch woven fabric with high stretchability and ease of wear, and low surface friction resistance, and sportswear and swimwear employing the same.

30 Brief Description of Drawings

[0009] [FIG. 1] FIG. 1 is a schematic plan view of a stretch woven fabric according to one embodiment of the present invention in which plain weave parts and weft double

weave parts are formed alternately and repeatedly.

[FIG. 2] FIG. 2 is a schematic plan view of a stretch woven fabric according to another embodiment of the present invention in which plain weave parts and warp double weave parts are formed alternately and repeatedly.

5 [FIG. 3] FIG. 3A is a schematic plan view of the stretch woven fabric, and FIG. 3B is a cross-sectional view thereof.

[FIG. 4] FIG. 4A is a schematic plan view of a covered yarn to be used in the stretch woven fabric, and FIG. 4B is a schematic plan view of a covered yarn according to another embodiment.

10 [FIG. 5] FIG. 5 is a schematic front view of a swimsuit employing the stretch woven fabric.

[FIG. 6] FIG. 6 is a schematic back view of the swimsuit employing the stretch woven fabric.

15 [FIG. 7] FIG. 7A is a side view of a cylindrical base to be used for measuring friction resistance in water in one example of the present invention, and FIG. 7B is a cross-sectional view taken along a line I-I in FIG. 7A.

[FIG. 8] FIG. 8 is an explanatory view showing a device for measuring a time taken for the cylindrical base to drop into water.

20 [FIG. 9] FIG. 9 is an explanatory view showing a method and a device for measuring a time taken for the cylindrical base to drop a predetermined distance in water.

[FIG. 10] FIG. 10 is an explanatory view showing a method and a device for measuring a time taken for the cylindrical base to enter into water from the air in another example of the present invention.

25 [FIG. 11] FIG. 11A is an exploded perspective view of the cylindrical base in one example of the present invention, and FIG. 11B is a plan view thereof.

[FIG. 12] FIG. 12 is a schematic front view of a swimsuit employing the stretch woven fabric in another example of the present invention.

[FIG. 13] FIG. 13 is a schematic back view of the swimsuit.

30 [FIG. 14] FIG. 14A is a schematic front view of a swimsuit employing the stretch woven fabric in still another example of the present invention, and FIG. 14B is a schematic back view of the swimsuit.

[FIG. 15] FIG. 15A is a schematic front view of a swimsuit employing the stretch woven fabric in still another example of the present invention, and FIG. 15B is a schematic back view of the swimsuit.

5 Description of the Invention

[0010] The present invention relates to a woven fabric in which elastic yarns are arranged in warp and weft yarns and that is stretchable in two-way directions. The term “two-way” as used herein refers to warp and weft directions. In the stretch woven fabric, plain weave parts and double weave parts are formed alternately and repeatedly in one piece. With this configuration, the woven fabric can have high stretchability and ease of wear, and low surface friction resistance. This is because the double weave part includes more elastic yarns than the plain weave part for reinforcement, thereby increasing stretchability and ease of wear of the fabric. Moreover, the plain weave part is a depression, and the double weave part is a projection. Depressions and projections arranged in one direction form a stripe pattern as a whole. Therefore, for example, in the case of forming the woven fabric into a swimsuit, the surface friction resistance with respect to water flow can be reduced by arranging the stripe pattern along the stature direction of a body.

[0011] The double weave part is preferably weft double weave or warp double weave, more preferably weft double weave from the viewpoint of the production cost. These woven fabric structures can reinforce a woven fabric with a minimum amount of elastic yarns, and thereby allowing the woven fabric to have a suitable thickness and strength as sportswear.

[0012] The plain weave part and the double weave part each have a width of preferably 0.125 to 10 mm, more preferably 0.25 to 5 mm. Within the above ranges, both of high stretchability and low surface friction resistance can be obtained.

[0013] The elastic yarn is preferably a covered yarn that is covered and twisted with a synthetic fiber filament yarn. Examples of the covered yarn include yarns (FTY) that are obtained by winding a filament processed yarn (wooly processed yarn) made of, e.g., nylon around an elastic yarn as a core yarn, such as a single covered yarn (SCY) and a double covered yarn (DCY). Among these, it is preferred to use FTY-SCY obtained by winding a nylon wooly processed yarn, from the viewpoint of reducing a

weight per unit area.

[0014] A spandex as the core yarn preferably has a thickness of 22 decitex or more and 156 decitex or less. The weight per unit area of the woven fabric is preferably 100 g/m² or more and 250 g/m² or less from the viewpoint of weight reduction. Further, any known spandex may be used, such as “ROICA (registered trademark)” manufactured by Asahi Kasei Corporation and “LYCRA (registered trademark)” manufactured by Toray Opelontex Co., Ltd. It is preferred that the type of spandex be selected properly depending on a use area because they have different stresses. In the case of swimwear, since swimwear is basically used in a pool, it is preferred to use spandex with excellent chlorine resistance such as “ROICA SP”, “LYCRA 176B”, “LYCRA 254B”, and “LYCRA 909B”.

[0015] As the sheath yarn, synthetic fibers such as polyamide-based fibers and polyester-based fibers are preferred from the viewpoint of strength and processability. Among a variety of the polyamide-based fibers, nylon 6, nylon 66, and nylon 610 are preferred from the viewpoint of strength and processability of a woven fabric blended with spandex. The synthetic fiber as the sheath yarn may have any fiber form and cross-sectional shape. In order to impart high stretchability to a woven fabric, the sheath yarn is preferably subjected to a false twist process by a known method so as to crimp the yarn. In order to impart surface smoothness to a woven fabric, the sheath yarn is preferably a straight grey yarn.

[0016] The elongation rates in the warp and weft directions of the stretch woven fabric determined by the cut strip method of JIS L1096 A (load: 17.7 N (1.8 kg), width: 5 cm) are preferably 10 to 90%, more preferably 30 to 70%. When the stretchability is within the above ranges, the woven fabric can have proper elasticity and ease of wear, and thus is suitable for sportswear including swimwear.

[0017] The stretch woven fabric may be used in a part or an entirety of sportswear, swimwear, and the like.

[0018] Hereinafter, the present disclosure will be described with reference to the drawings. In the drawings, the same reference numeral denotes the same element. FIG. 1 is a schematic plan view of a stretch woven fabric 1 according to one embodiment of the present invention in which plain weave parts 2 and weft double weave parts 3 are formed alternately and repeatedly. In the plain weave part 2, warp

yarns 4 and weft yarns 5 cross each other to constitute the woven fabric. In the weft double weave part 3, the warp yarns 4 and weft yarns 6a, 6b cross each other to constitute the woven fabric. The weft yarns 6a are arranged on the front side, and the weft yarns 6b are arranged on the back side, which makes the weft double weave part 3 thicker than the plain weave part 2. Further, the weft double weave part 3 includes more elastic yarns than the plain weave part 2 for reinforcement, thereby increasing stretchability and ease of wear of the fabric. Moreover, the plain weave part 2 is a depression, and the weft double weave part 3 is a projection. Depressions and projections arranged in one direction form a stripe pattern as a whole. Therefore, for example, in the case of forming the woven fabric into a swimsuit, the surface friction resistance with respect to water flow can be reduced by arranging the stripe pattern along the stature direction of a body.

[0019] FIG. 2 is a schematic plan view of a stretch woven fabric 7 according to another embodiment of the present invention in which plain weave parts 8 and warp double weave parts 9 are formed alternately and repeatedly. In the plain weave part 8, warp yarns 10 and weft yarns 11 cross each other to constitute the woven fabric. In the warp double weave part 9, warp yarns 12a, 12b and the weft yarns 11 cross each other to constitute the woven fabric. The warp yarns 12a are arranged on the front side, and the warp yarns 12b are arranged on the back side, which makes the warp double weave part 9 thicker than the plain weave part 8.

[0020] FIG. 3A is a schematic plan view of the stretch woven fabric 1 in one embodiment of the present invention, and FIG. 3B is a cross-sectional view thereof. The plain weave part 2 is a depression, and the weft double weave part 3 is a projection. Depressions and projections arranged in one direction form a stripe pattern in a plan view.

[0021] FIG. 4 is a schematic plan view of a single covered yarn 13 to be used in the stretch woven fabric, in which a core yarn 14 is an elastic yarn made of, e.g., polyurethane, and a covering yarn 15 is a processed yarn made of, e.g., nylon. FIG. 4B is a schematic plan view of a double covered yarn 16 according to another embodiment, in which a core yarn 17 is an elastic yarn made of, e.g., polyurethane, and a covering yarn (upper yarn) 19 and a covering yarn 18 (lower yarn) are processed yarns made of, e.g., nylon.

[0022] FIG. 5 is a schematic front view of a competition swimsuit 20 employing the stretch woven fabric, and FIG. 6 is a back view thereof. A stripe part 21 extending from the abdominal portion to the upper portion on the front side of the competition swimsuit 20 is the woven fabric shown in FIGS. 1 and 3, in which the plain weave parts and the double weave parts are formed alternately and repeatedly. A plain part 22 extending from the thigh portion to the side of the waist on the front side of the competition swimsuit 20 and in a belt portion from the shoulder to the back is a plain woven fabric. The stripe part 21 and the plain part 22 are sewn together. The back side of the competition swimsuit 20 is entirely composed of the stripe part 21 (woven fabric in which the plain weave parts and the double weave parts are formed alternately and repeatedly).

[0023] It is preferred that a competition swimsuit be produced using a pattern smaller than a human body by about 20% to 40%. The swimsuit thus produced can fit a human body perfectly.

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Examples

[0024] Hereinafter, the present invention will be described specifically by way of examples. However, the present invention is not limited to the examples.

[0025] <Elongation rate>

20 An elongation rate was measured according to the cut strip method of JIS L 1096 A. A test piece was 5 cm in width, and a clamp interval was set at 20 cm. An initial load was set at a load corresponding to a gravity applied to 1 m (length) of the test piece. A tensile speed was set at 20 cm/min. An elongation rate (%) under a load of 17.7 N (1.8 kg) was measured. The elongation rate represents stretchability.

25 [0026] <Stress at 30% elongation>

Stresses (N) at 30% elongation at the time of measuring the elongation rate in the warp and weft directions were measured, and the values obtained were each converted into per centimeter and expressed by N/cm. The stress at 30% elongation can be a criterion for evaluating a compression (wearing pressure) function of the sample piece.

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[0027] <Friction resistance in water>

Friction resistance was measured using a method and a device shown in FIGS.

7-9. FIG. 7A is a side view of a cylindrical base (model) to be used in this measurement, and FIG. 7B is a cross-sectional view taken along a line I-I in FIG. 7A. A front end portion 33 of the cylindrical base (model) 31 is spherical, and a rear end portion 34 thereof is tapered. A fabric sample 39 of the swimsuit is attached to a body 32 by wrapping the fabric sample 39 around the body 32, fixing the fabric sample 39 with cylindrical jigs 38a and 38b, and inserting the front end portion 33 and the rear end portion 34 into the body 32. The fabric sample 39 to be attached to the body 32 has an area of about 0.016 mm². A weight 35 is inserted in the lower part of the body 32. A hollow member (pipe) 36 is positioned along the axis of the cylindrical base (model) 31 and receives a wire 37 as shown in FIGS. 8 and 9. The weight of the cylindrical base (model) 31 in water with the swimsuit fabric sample being attached thereto is 0.3 N, and the volume thereof is 1.2×10^{-3} m³. The cylindrical base (model) 31 is entirely made of resin. The hollow member 36 has a diameter of 2.3 mm. The model 31 has a diameter of 30 mm, a length of 300 mm, and a length of a fabric attachment portion of 200 mm. The mass including the fabric sample is adjusted at 88 g. The buoyancy of the fabric and the model is taken into account, and a weight is placed in the cylindrical base (model) 31 so that the weight of the base in water will be 0.3 N.

[0028] FIG. 8 is an explanatory view showing a device 40 for measuring a time taken for the cylindrical base to drop into water. Water 42 is filled in a transparent water tank 41 made of, e.g., acrylic resin. A shielding sheet 43 is attached to the back side of the water tank 41, and a lamp 44 is arranged behind it. A high speed camera 45 is arranged on the front side. The water tank 41 is made of transparent acrylic resin, and is 1.7 m in height (H), and 0.22 m in width (L) and depth. The high speed camera 45 is arranged at a position 4.25 m away from the water tank and 0.85 m above the floor. The photographing speed of the high speed camera 45 is 1900 fps. In this state, the cylindrical base (model) 31 is quietly dropped from above the water tank. The cylindrical base (model) 31 drops along the wire 37.

[0029] FIG. 9 is an explanatory view showing a method and a device for measuring a time taken for the cylindrical base to drop a predetermined distance in water. First, the cylindrical base (model) 31 is positioned so that the rear end is located at the surface of the water. A point 200 mm below a front end 46 of the cylindrical base

(model) 31 is set as a laser point 47, a point 100 mm below the laser point 47 is set as a first measuring point 48, and a point 100 mm below the first measuring point 48 is set as a second measuring point 49. At the laser point 47, a hole is formed in the shielding sheet 43 shown in FIG. 8. In this state, the cylindrical base (model) 31 is quietly dropped, and the high speed camera is switched on for high speed photographing when the front end 46 passes the laser point 47. A dropping time of the cylindrical base (model) 31 from the first measuring point 48 to the second measuring point 49 is measured. This is performed ten times per test sample, and an average value thereof is used. The acceleration is determined from Formula (1) below.

[0030] [Formula 1]

$$\frac{du}{dt} = \frac{u_2 - u_1}{\Delta t}$$

[0031] $u_1 = k_1/t_1$

$$u_2 = k_2/t_2$$

15 $\Delta t = t_2$

(where k_1 represents a dropping distance (mm) from the laser point 47 to the first measuring point 48 in FIG. 9, t_1 represents a passage time (second) from the laser point 47 to the first measuring point 48 in FIG. 9, k_2 represents a dropping distance (mm) from the first measuring point 48 to the second measuring point 49, and t_2 represents a passage time (second) from the first measuring point 48 to the second measuring point 49. In this example, k_1 is 100 mm, and k_2 is 200 mm.)

[0032] A coefficient of friction resistance C_f of the swimsuit fabric in water is calculated by Formulae (2) and (3) below. The measuring accuracy of the coefficient of friction resistance C_f is 0.001.

25 [0033] [Formula 2]

$$m \frac{du}{dt} = W - B - D$$

[0034] [Formula 3]

$$C_f = \frac{2}{\rho u^2 A} \left(mg - B - m \frac{du}{dt} \right)$$

where W represents gravity: $W = mg$ (m represent the mass (kg) of the

cylindrical base, and g represents the acceleration of gravity (m/s^2), B represents buoyancy: $B = \rho_w g V$ (ρ_w represents the density of water (kg/m^3), and V represents the volume (m^3) of the cylindrical base), D represents resistance: $D = C_f \times (1/2) \times \rho u^2 A$ (ρ represents the density of water, u represents the dropping speed, and A represents the surface area of the swimsuit fabric)

[0035] FIG. 10 is an explanatory view showing a method and a device for measuring a time taken for the cylindrical base (model) to enter into water from the air in another example of the present invention. The cylindrical base (model) 31 is dropped from the air into water 42 of the water tank. The swimsuit fabric may be immersed in water in advance for about one minute before being dropped into water. The following describes the steps illustrated in FIG. 10.

- (a) A state in which the cylindrical base (model) 31 is in the air
- (b) A state (t'_0) in which the front end of the cylindrical base (model) 31 lands on water
- (c)–(d) A state in which the cylindrical base (model) 31 is entering into water
- (e) A state (t'_1) in which the cylindrical base (model) 31 is submerged in water.

[0036] A time between the t_0 and the t_1 is measured using a high speed camera. A water entry time T is determined using Formula (4) below. A material sheet with a shorter water entry time can be judged as a material with less friction resistance at the time of diving, for example.

[Formula 4]

Water entry time $T = t'_1 - t'_0$

[0037] FIG. 11A is an exploded perspective view of the cylindrical base in one example of the present invention, and FIG. 11B is a plan view thereof. A fabric sample is attached to the cylindrical base by wrapping a fabric around the body 32, fixing the fabric with cylindrical jigs 38a and 38b, and inserting the front end portion 33 and the rear end portion 34 into the body 32.

[0038] (Example 1)

1. Use of yarns

(1) Warp yarn

Core: polyurethane (fineness: 78 decitex, “LYCRA (registered trademark)”

176B manufactured by Toray Opelontex Co., Ltd.)

Covering yarn: nylon filament grey yarn (fineness: 33 decitex, the number of filaments: 10)

Single covered yarn (SCY)

(2) Weft yarn

5 Core: polyurethane (fineness: 44 decitex, "LYCRA (registered trademark)"
254B manufactured by Toray Opelontex Co., Ltd.)

Covering yarn: nylon filament grey yarn (fineness: 33 decitex, the number of filaments: 10)

Single covered yarn (SCY)

10 (3) Under weft yarn

Core: polyurethane (fineness: 55 decitex, "LYCRA (registered trademark)"
254B manufactured by Toray Opelontex Co., Ltd.)

Covering yarn: nylon filament grey yarn (fineness: 33 decitex, the number of filaments: 10)

15 Single covered yarn (SCY)

2. Woven fabric

A stretch woven fabric 1 shown in FIG. 1, in which plain weave parts 2 and weft double weave parts 3 are formed alternately and repeatedly, was woven using a rapier loom (the warp density of the plain weave part 2: 195 yarns/2.54 cm, the weft density thereof: 156 yarns/2.54 cm, the warp density of the weft double weave part 3: 195 yarns/2.54 cm, the weft density thereof: 230 yarns/2.54 cm, the weight per unit area: 157 g/m², the width of the plain weave part 2: 1.0 mm, the thickness thereof: 0.27 mm, the width of the weft double weave part 3: 1.0 mm, and the thickness thereof: 0.44 mm). The finish width of the woven fabric as a whole was 115 cm.

25 [0039] The woven fabric thus obtained had an elongation rate of 57.1% in the warp direction and 41.6% in the weft direction, and a stress at 30% elongation of 1.56 N/cm in the warp direction and 1.40 N/cm in the weft direction. The coefficient of friction resistance and the water entry time are as shown in Table 1.

[0040] A woman's competition swimsuit shown in FIGS. 5-6 was sewn using the
30 woven fabric of Example 1, and subjected to a wear test. It was confirmed that the swimsuit had high stretchability, ease of wear, and excellent close fitting to the skin of a human body, thereby being suitable for competitive swimming.

[0041] (Example 2)

A stretch woven fabric of Example 2 was produced in the same manner as in Example 1 using the yarns of Example 1 described above, except that the width of the plain weave part 2 was 0.5 mm, and the width of the weft double weave part 3 was 0.5 mm. The woven fabric thus obtained had an elongation rate of 57.1% in the warp direction and 41.6% in the weft direction, and a stress at 30% elongation of 1.56 N/cm in the warp direction and 1.40 N/cm in the weft direction. The coefficient of friction resistance and the water entry time of this woven fabric are as shown in Table 1.

[0042] (Example 3)

A stretch woven fabric of Example 3 was produced in the same manner as in Example 1 using the yarns of Example 1 described above, except that the fabric surface was subjected to smoothing. The smoothing is a process of heating and pressurizing a fabric between a pair of rolls. The roll temperature was set at 220°C, the linear load was set at 5500 kgf, and the roll speed was set at about 6–10 m/min. The woven fabric thus obtained had an elongation rate of 54.2% in the warp direction and 43.0% in the weft direction, and a stress at 30% elongation of 1.68 N/cm in the warp direction and 1.35 N/cm in the weft direction. The coefficient of friction resistance and the water entry time of this woven fabric are as shown in Table 1.

[0043] (Example 4)

A stretch woven fabric of Example 4 was the same as that of Example 2, except that the fabric surface was subjected to smoothing. The smoothing is a process of heating and pressurizing a fabric between a pair of rolls. The roll temperature was set at 220°C, the linear load was set at 5500 kgf, and the roll speed was set at about 6–10 m/min. The woven fabric thus obtained had an elongation rate of 54.2% in the warp direction and 43.0% in the weft direction, and a stress at 30% elongation of 1.68 N/cm in the warp direction and 1.35 N/cm in the weft direction. The coefficient of friction resistance and the water entry time of this woven fabric are as shown in Table 1.

[0044] (Comparative Example 1)

1. Use of yarns

(1) Warp yarn

Core: polyurethane (fineness: 78 decitex, "LYCRA (registered trademark)")

176B manufactured by Toray Opelontex Co., Ltd.)

Covering yarn: nylon filament wooly processed yarn (fineness: 33 decitex, the number of filaments: 10)

Single covered yarn (SCY)

5 (2) Weft yarn

Core: polyurethane (fineness: 55 decitex, "LYCRA (registered trademark)")

254B manufactured by Toray Opelontex Co., Ltd.)

Covering yarn: nylon filament wooly processed yarn (fineness: 33 decitex, the number of filaments: 10)

10 Single covered yarn (SCY)

2. Woven fabric

A plain woven fabric having a warp density of 178 yarns/2.54 cm, a weft density of 180 yarns/2.54 cm, a weight per unit area of 132 g/m², and a thickness of 0.30 mm was produced using a rapier loom. The finish width of the woven fabric as a whole was 122 cm.

The woven fabric thus obtained had an elongation rate of 56.2% in the warp direction and 46.2% in the weft direction, and a stress at 30% elongation of 2.02 N/cm in the warp direction and 2.40 N/cm in the weft direction. The coefficient of friction resistance and the water entry time are as shown in Table 1.

20 [0045] (Comparative Example 2)

1. Use of yarns

(1) Warp yarn

Core: polyurethane (fineness: 78 decitex, "LYCRA (registered trademark)")

176B manufactured by Toray Opelontex Co., Ltd.)

25 Covering yarn: nylon filament grey yarn (fineness: 33 decitex, the number of filaments: 26)

Single covered yarn (SCY)

(2) Weft yarn

Core: polyurethane (fineness: 55 decitex, "LYCRA (registered trademark)")

30 254B manufactured by Toray Opelontex Co., Ltd.)

Covering yarn: nylon filament grey yarn (fineness: 33 decitex, the number of filaments: 26)

Single covered yarn (SCY)

2. Woven fabric

A plain woven fabric having a warp density of 180 yarns/2.54 cm, a weft density of 178 yarns/2.54 cm, a weight per unit area of 135 g/m², and a thickness of 0.28 mm was produced using a rapier loom. The finish width of the woven fabric as a whole was 117 cm.

The woven fabric thus obtained had an elongation rate of 56.2% in the warp direction and 51.9% in the weft direction, and a stress at 30% elongation of 2.08 N/cm in the warp direction and 3.02 N/cm in the weft direction. The coefficient of friction resistance and the water entry time are as shown in Table 1.

[0046] (Comparative Example 3)

1. Use of yarns

(1) Warp yarn

Core: polyurethane (fineness: 78 decitex, "LYCRA (registered trademark)" 176B manufactured by Toray Opelontex Co., Ltd.)

Covering yarn: nylon filament wooly processed yarn (fineness: 33 decitex, the number of filaments: 10)

Single covered yarn (SCY)

(2) Weft yarn

Core: polyurethane (fineness: 55 decitex, "LYCRA (registered trademark)" 254B manufactured by Toray Opelontex Co., Ltd.)

Covering yarn: nylon filament wooly processed yarn (fineness: 33 decitex, the number of filaments: 10)

Single covered yarn(SCY)

25 (3)Under weft yarn

Core: polyurethane (fineness: 55 decitex, "LYCRA (registered trademark)" 254B manufactured by Toray Opelontex Co., Ltd.)

Covering yarn: nylon filament wooly processed yarn (fineness: 33 decitex, the number of filaments: 10)

30 Single covered yarn (SCY)

2. Woven fabric

A weft double woven fabric having a warp density of 188 yarns/2.54 cm, a weft

density of 260 yarns/2.54 cm, a weight per unit area of 166 g/m², and a thickness of 0.42 mm was produced using a rapier loom. The finish width of the woven fabric as a whole was 115 cm. The woven fabric thus obtained had an elongation rate of 51.5% in the warp direction and 57.6% in the weft direction, and a stress at 30% elongation of 1.92 N/cm in the warp direction and 2.60 N/cm in the weft direction. The coefficient of friction resistance and the water entry time are as shown in Table 1.

[0047] (Comparative Example 4)

(1) Front

Cation-dyeable polyester (fineness: 56 decitex, the number of filaments: 24)

10 (2) Back

Polyurethane (fineness: 44 decitex, "LYCRA (registered trademark)" 254B manufactured by Toray Opelontex Co., Ltd.)

A half structure was knitted using a 32 gauge single tricot knitting machine.

Wale: 80 yarns/2.54 cm, course: 135 yarns/2.54 cm

15 The weight per unit area was 304 g/m², the thickness thereof was 0.55 mm, and the finish width of the knitted fabric as a whole was 150 cm. The knitted fabric thus obtained had an elongation rate of 122.9% in the warp direction and 106.1% in the weft direction, and a stress at 30% elongation of 1.06 N/cm in the warp direction and 0.44 N/cm in the weft direction. This knitted fabric is called a plain knitted fabric.

20 [0048] Next, the surface of the plain woven fabric was subjected to smoothing. The smoothing is a process of heating and pressurizing a fabric between a pair of rolls. The roll temperature was set at 220°C, the linear load was set at 5500 kgf, and the roll speed was set at about 6–10 m/min. The woven fabric after smoothing is called a smoothed product. The coefficient of friction resistance and the water entry time of this smoothed product are as shown in Table 1.

[0049] (Comparative Example 5)

(1) Front

Cation-dyeable polyester (fineness: 44 decitex, the number of filaments: 36)

30 (2) Back

Polyurethane (fineness: 44 decitex, "LYCRA (registered trademark)" 254B manufactured by Toray Opelontex Co., Ltd.)

A half structure was knitted using a 32 gauge single tricot knitting machine.

Wale: 80 yarns/2.54 cm, course: 120 yarns/2.54 cm

The weight per unit area was 220 g/m², the thickness thereof was 0.53 mm, and the finish width of the knitted fabric as a whole was 150 cm. The knitted fabric thus obtained had an elongation rate of 132.8% in the warp direction and 128.2% in the weft direction, and a stress at 30% elongation of 0.90 N/cm in the warp direction and 0.24 N/cm in the weft direction. This knitted fabric is called a plain knitted fabric.

[0050] Next, the surface of the plain woven fabric was subjected to smoothing. The smoothing is a process of heating and pressurizing a fabric between a pair of rolls. The roll temperature was set at 220°C, the linear load was set at 5500 kgf, and the roll speed was set at about 6–10 m/min. The woven fabric after smoothing is called a smoothed product. The coefficient of friction resistance and the water entry time of this smoothed product are as shown in Table 1.

15 [0051] [Table 1]

Experiment No.	Swimsuit fabric	Coefficient of friction resistance	Water entry time (second)
Ex. 1	Woven fabric of plain weave part + weft double weave part Width 1.0 mm	0.077	0.179
Ex. 2	Woven fabric of plain weave part + weft double weave part Width 0.5 mm	0.072	0.179
Ex. 3	Woven fabric of plain weave part + weft double weave part Width 1.0 mm + Smoothing	0.072	0.180
Ex. 4	Woven fabric of plain weave part + weft double weave part Width 0.5 mm + Smoothing	0.068	0.178
Comp. Ex. 1	Plain weave (1)	0.115	0.178
Comp. Ex. 2	Plain weave (2)	0.078	0.180
Comp. Ex. 3	Weft double weave	0.081	0.180
Comp. Ex. 4	Tricot (1) + Smoothing	0.078	0.175
Comp. Ex. 5	Tricot (2) + Smoothing	0.079	0.180

* Ex.: Example, Comp. Ex.: Comparative Example

[0052] The fabrics of Comparative Examples 1–5 are conventional swimsuit fabrics. As compared with these conventional products (Comparative Examples 1–5), the woven fabrics of Examples 1–4 had a low coefficient of friction resistance in water and short water entry time.

[0053] (Example 5)

FIG. 12 is a schematic front view of a competition swimsuit 50 employing the stretch woven fabric of Example 1, and FIG. 13 is a back view of the same. A stripe part 51 extending from the abdominal portion to the upper portion on the front side of the competition swimsuit 50 is a woven fabric in which plain weave parts and double weave parts are formed alternately and repeatedly. A plain part 52 extending from the thigh portion to the side of the waist on the front side of the competition swimsuit 50 and in a belt portion from the shoulder to the back is a plain woven fabric. The stripe part 51 and the plain part 52 are sewn together. This swimsuit was subjected to a wear test. It was confirmed that the swimsuit had high stretchability, ease of wear, and excellent close fitting to the skin of a human body, thereby being suitable for competitive swimming.

[0054] (Example 6)

FIG. 14A is a schematic front view of a competition swimsuit 53 employing the stretch woven fabric of Example 1, and FIG. 14B is a back view of the same. A stripe part 54 extending from the back side to the both sides of the thigh portion and in the lower abdominal portion of the competition swimsuit 53 is a woven fabric in which plain weave parts and double weave parts are formed alternately and repeatedly. A plain part 55 extending from the thigh portion to the abdominal portion on the front side is a plain woven fabric. The stripe part 54 and the plain part 55 are sewn together. This swimsuit was subjected to a wear test. It was confirmed that the swimsuit had high stretchability, ease of wear, and excellent close fitting to the skin of a human body, thereby being suitable for competitive swimming.

[0055] (Example 7)

FIG. 15A is a schematic front view of a competition swimsuit 56 employing the stretch woven fabric of Example 1, and FIG. 15B is a back view of the same. A stripe part 57 extending from the back side to the both sides of the thigh portion and in the lower abdominal portion of the competition swimsuit 56 is a woven fabric in which plain weave parts and double weave parts are formed alternately and repeatedly. A plain part 58 extending from the thigh portion to the abdominal portion on the front side is a plain woven fabric. The stripe part 57 and the plain part 58 are sewn together. This swimsuit was subjected to a wear test. It was confirmed that the swimsuit had high stretchability, ease of wear, and excellent close fitting to the skin of

a human body, thereby being suitable for competitive swimming.

Industrial Applicability

[0056] The stretch woven fabric of the present invention is used favorably as wear
 5 that closely fits to a human body and wear that requires compression (wearing
 pressure), and thus can be applied favorably to, for example, various sportswear
 including swimsuits, tights, spats and shirts for marathon and trail running,
 skatewear, skiwear, jumpsuits, leotards, soccerwear, baseball uniforms and
 mountainwear, and wear and supporters including sports innerwear and underwear
 10 having a support function.

Description of Reference Numerals

[0057] 1, 7 stretch woven fabric
 2, 8 plain weave part
 15 3 weft double weave part
 4, 10, 12a, 12b warp yarn
 5, 6a, 6b, 11 weft yarn
 9 warp double weave part
 13 single covered yarn
 20 14, 17 core yarn
 15, 18, 19 covering yarn
 16 double covered yarn
 20 swimsuit
 31 cylindrical base (model)
 25 32 swimsuit fabric
 33, 46 front end portion of model
 34 rear end portion of model
 40 friction resistance measuring device
 41 water tank
 30 42 water
 43 shielding sheet
 44 lamp

- 45 high speed camera
- 47 laser point
- 48 first measuring point
- 49 second measuring point

CLAIMS

1. A stretch woven fabric comprising an elastic yarn,
wherein the elastic yarn is arranged in a warp yarn and a weft yarn, and
the stretch woven fabric is stretchable in two-way directions, and
a plain weave part and a double weave part are formed alternately and
repeatedly.
2. The stretch woven fabric according to claim 1, wherein the double weave
part is weft double weave or warp double weave.
3. The stretch woven fabric according to claim 1 or 2,
wherein the plain weave part is a depression, and the double weave part
is a projection, and
a plurality of the depression and a plurality of the projection are
arranged in one direction as a whole.
4. The stretch woven fabric according to any one of claims 1 to 3, wherein the
plain weave part and the double weave part each have a width of 0.125 mm to 10
mm.
5. The stretch woven fabric according to any one of claims 1 to 4, wherein the
elastic yarn is a covered yarn that is covered and twisted with a synthetic fiber
filament yarn.

6. The stretch woven fabric according to any one of claims 1 to 5, wherein the stretch woven fabric has an elongation rate of 10% to 90% in both warp and weft directions in accordance with a cut strip method of JIS L1096 A (load: 17.7 N (1.8 kg), width: 5 cm).

7. Sportswear comprising the stretch woven fabric according to any one of claims 1 to 6.

8. A swimsuit comprising the stretch woven fabric according to any one of claims 1 to 6.

9. The swimsuit according to claim 8,
wherein, in the stretch woven fabric, the plain weave part is a depression, and the double weave part is a projection, and a plurality of the depression and a plurality of the projection arranged in one direction form a stripe pattern as a whole, and
the stripe pattern is arranged along a stature direction of a body.