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(54) **SWIM SUIT**

SCHWIMMANZUG

MAILLOT DE BAIN

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Description

Technical Field

[0001] The present invention relates to a swimsuit including elastic polyurethane yarns, which has high water repellency and keeps a low water retention rate for an extended time to resist being wetted when immersed in water.

Background Art

[0002] Water and oil repellent agents containing fluorine-based compounds have been widely used to impart water repellency and oil repellency to clothing materials and industrial materials made from textiles.

[0003] However, such fluorine-based water and oil repellent agents are found to contain compounds that may affect the living environment and living organisms, such as perfluorooctanoate (hereinafter PFOA) and perfluorooctane sulfonate (hereinafter PFOS). Therefore, fluorine-based water and oil repellent agents free of these compounds are demanded for textiles.

[0004] It is considered that a small amount of PFOA as an impurity is mixed in the fluorine-based water repellent agents during the manufacturing process, but the mechanism is not clarified. Since fluorine-based water repellent agents containing a polyfluoroalkyl group with 8 or more carbon atoms are likely to generate PFOA when decomposed by some influence, they are being replaced with those containing a polyfluoroalkyl group with 6 or less carbon atoms that generate no PFOA by decomposition. Patent Document 1 proposes a water and oil repellent fabric obtained by applying a fluorine-based water repellent agent free of PFOA and a crosslinker to a fabric and subjecting it to heat treatment. Patent Document 2 proposes a fiber structure in which a fluorine-based water repellent compound having a PFOA and/or PFOS concentration of less than 5 ng/g is fixed to monofilament surfaces, on which a layer of the fluorine-based compound is further fixed to form a two-layer structure. Both of the above, however, have lower water repellent performance than the fluorine-based water repellent agents containing PFOA with 8 or more carbon atoms.

[0005] To improve water repellent performance, Patent Document 3 proposes a method of fixing a polymer containing a specific fluoroalkyl alcohol (meth)acrylic acid derivative in a part, a melamine resin, and a water-dispersible polyfunctional isocyanate crosslinker to fiber surfaces, through at least one of a sulfone group-containing compound or a polyphenol compound fixed to the fiber surfaces. This method achieves a low water retention rate, but the water repellent performance is lower than the fluorine-based water repellent agents containing PFOA with 8 or more carbon atoms when immersed in water for an extended time.

Prior Art Documents

Patent Documents

[0006]

Patent Document 1: JP 2007-270374A
Patent Document 2: JP 2010-150693 A
Patent Document 3: JP 2014-194098 A
Patent Document 4: WO 2009-084815 A relates to an easily dyeable polyurethane urea spandex yarn containing polyimine or polyamine.
Patent Document 5: JP 2006-342448 A relates to a polyurethane-based elastic fiber having excellent elastic recovery characteristics.

Disclosure of Invention

Problem to be Solved by the Invention

[0007] As described above, the water repellency of conventional swimsuits is not satisfactory, and there have been demands for swimsuits with higher water repellency, lower water retention rate, and higher buoyancy.

[0008] To solve the above conventional problem, it is an object of the present invention to provide a swimsuit having improved water repellency, water retention rate, and buoyancy.

Means for Solving Problem

[0009] A swimsuit of the present invention is a swimsuit including an elastic polyurethane yarn. The elastic polyurethane yarn contains: 0.5 to 10% by mass (mass%) of a cationic high-molecular-weight compound A having a number-average molecular weight of 2000 to 10000; and an inorganic chlorine deterioration inhibitor B. The mass ratio of the cationic high-molecular-weight compound A to the inorganic chlorine deterioration inhibitor B ranges from 0.3 to 3, and a silicone oil is applied to the elastic polyurethane yarn. A fabric for the swimsuit is treated with water repellent finishing. The ratio of fluorine (F) to carbon (C) on the elastic polyurethane yarn of the swimsuit is 0.030 or more in an elemental mass concentration as measured according to scanning electron microscope - energy dispersive X-ray spectroscopy (SEM-EDX).

Effect of the Invention

[0010] The present invention provides a swimsuit with high water repellency, a low water retention rate, and high buoyancy by improving the water repellency of the elastic polyurethane yarn itself. Such a swimsuit is advantageous for competitive swimmers to swim at high speed and for general swimmers to swim comfortably.

Brief Description of Drawings

[0011]

[FIG. 1] FIG. 1 is a schematic plan view of a stretch woven fabric for a swimsuit according to one embodiment of the present invention in which a plain weave part and a weft double weave part are repeated alternately.
[FIG. 2] FIG. 2 is a schematic plan view of a stretch woven fabric for a swimsuit according to another embodiment of the present invention in which a plain weave part and a warp double weave part are repeated alternately.
[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 for the stretch woven fabric, and FIG. 4B is a schematic plan view of a covered yarn according to another embodiment.
[FIG. 5] FIG. 5 is a schematic front view of a swimsuit using the stretch woven fabric.
[FIG. 6] FIG. 6 is a schematic back view of the swimsuit using the stretch woven fabric.
[FIG. 7] FIG. 7A is a schematic front view of a men's swimsuit using the stretch woven fabric, and FIG. 7B is a back view thereof.
[FIG. 8] FIG. 8 is a schematic explanatory view illustrating a method for measuring the buoyancy of a swimsuit using the stretch woven fabric.

Description of the Invention

[0012] To make fabrics such as swimwear fabrics water repellent, the present inventors have focused on elastic polyurethane yarns, which have not received much attention, and conducted various studies to improve the water repellency of the elastic polyurethane yarns themselves. As a result of the studies, specific elastic polyurethane yarns are found to be highly compatible with water repellent agents.

[0013] The elastic polyurethane yarn of the present invention contains: 0.5 to 10 mass% of a cationic high-molecular-weight compound A having a number-average molecular weight of 2000 to 10000; and an inorganic chlorine deterioration inhibitor B. The mass ratio of the cationic high-molecular-weight compound A to the inorganic chlorine deterioration inhibitor B ranges from 0.3 to 3, and a silicone oil is applied to the elastic polyurethane yarn. By treating a swimsuit including the elastic polyurethane yarn with water repellent finishing, it is possible to obtain a highly water and oil repellent swimsuit having high water repellency and a low water retention rate to resist being wetted when immersed in water for an extended time.

[0014] The water repellent treatment finishing agent used in the present invention makes the ratio of fluorine (F) / carbon (C) (hereinafter, referred to as a F/C ratio) on the elastic polyurethane yarn satisfy 0.030 or more in the elemental mass concentration according to SEM-EDX. In the elemental mass concentration according to SEM-EDX, the F/C ratio of 0.030 or more on the elastic polyurethane fiber indicates that the adhesion amount of the fluorine-based water repellent agent is large, whereas the F/C ratio of less than 0.03 indicates that the adhesion amount of the fluorine-based water repellent agent is small, and wettability is not lowered sufficiently. The F/C ratio is preferably 0.045 or more.

[0015] The water repellent finishing of the present invention preferably contains a water repellent agent and a crosslinker. As the crosslinker, melamine resin, a water-dispersible polyfunctional isocyanate crosslinker or the like is suitably used, and these may be mixed together. Examples of the melamine resin include trimethylolmelamine and hexamethylolmelamine. The water-dispersible polyfunctional isocyanate crosslinker is not particularly limited as long as it is an organic compound containing two or more isocyanate functional groups in the molecule. Examples of the same includes tolylene diisocyanate, hexamethylene diisocyanate, diphenylmethane diisocyanate, hydrogenated diphenylmethane diisocyanate, triphenyl triisocyanate, xylene diisocyanate, and diclohexylmethane diisocyanate. More preferably, the water-dispersible polyfunctional isocyanate crosslinker is a polyfunctional blocked isocyanate crosslinker obtained by reacting a trimethylolpropane tolylene diisocyanate adduct, a glycerin tolylene diisocyanate adduct or the like, with a blocking compound (a compound that regenerates an isocyanate group when heated to 70 to 200°C together with an isocyanate adduct), phenol, diethyl malonate, methyl ethyl ketoxime, sodium bisulfite, ε-caprolactam, etc.

[0016] It is preferred that the melamine resin is mixed in a proportion of 1 to 40 mass% based on the solid content of the water repellent agent, and the polyfunctional isocyanate crosslinker is mixed in a proportion of 1 to 10 mass% based on the solid content of the water repellent agent.

[0017] The swimsuit of the present invention includes the elastic polyurethane yarn in an amount of preferably 5 to 70 mass%, more preferably 5 to 60 mass%, further preferably 5 to 50 mass%, and particularly preferably 5 to 40 mass%, when the swimsuit is assumed to be 100 mass%. With this configuration, the swimsuit including the elastic polyurethane yarn can keep high water repellency and a low water retention rate as a whole. As other fiber yarns, synthetic fiber yarns such as polyester yarns, nylon yarns, and polypropylene yarns can be appropriately used.

[0018] The water repellency of the swimsuit of the present invention is preferably grade 4 or higher, and more preferably grade 5 in the spray test according to JIS L 1092. The fabric having a water repellency of grade 4 or higher is suitable for, e.g., a swimsuit. The water retention rate of the swimsuit after 60 minutes is preferably 50 mass% or less, more preferably 40 mass% or less, and further preferably 30 mass% or less of the mass of the swimsuit.

[0019] The elastic polyurethane yarn may be either a bare yarn or a yarn covered with another synthetic fiber yarn. The covered yarn may be either a single covered yarn or a double covered yarn. The swimsuit is preferably constituted by a woven fabric or knitted fabric using an elastic polyurethane fiber yarn covered with another synthetic fiber yarn. Examples of the synthetic fiber yarn include, but are not particularly limited to, polyester synthetic fiber yarns typified by polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, and copolymerized polyester fiber yarns containing any of these as a main component; polyamide synthetic fiber yarns typified by nylon 6 and nylon 6,6; and polypropylene synthetic fiber yarns. Among them, polyamide synthetic fiber yarns and polyester synthetic fiber yarns are preferred. The polyamide fibers are preferable from the viewpoint of strength and processability with the elastic polyurethane yarn. The synthetic fibers may have any fiber form and any cross-sectional shape, but it is preferable to subject them to false twisting by a known method to impart crimps, in order to produce a highly stretchable woven fabric. To lower the water retention rate, it is preferable to use straight yarns to minimize spaces between yarns. It is more preferable to subject yarns to surface smoothing by a known method to reduce spaces therebetween.

[0020] The tearing strength of the swimsuit is preferably 8 N or more, more preferably 10 N or more, and further preferably 12 N or more according to JIS L 1096. With this configuration, it is possible to maintain a high tearing strength as a swimsuit. Moreover, the bursting strength of the swimsuit is preferably 200 kPa or more, more preferably 300 kPa or more, and further preferably 400 kPa or more according to JIS L 1096. With this configuration, it is possible to maintain a high bursting strength as a swimsuit.

[0021] The swimsuit is preferably at least one of a woven fabric or a knitted fabric. In many cases, swimsuits for top swimmers are made from woven fabrics, and swimsuits for general swimmers are made from knitted fabrics. When the above-described fabric is used for a swimsuit, wettability in water is reduced during swimming. Particularly when it is used for a competition swimsuit, wettability of the swimsuit during a race is reduced and water resistance is also reduced. The fabric for a swimsuit has a buoyancy of preferably 1.70 g or more, more preferably 1.85 g or more, and further preferably 2.00 g or more per 1 g of the fabric. The swimsuit has a buoyancy of preferably 1.45 g or more, and more preferably 1.50 g or more per 1 g of the swimsuit. This is advantageous for the competitive swimmers to swim at high speed and for the general swimmers to swim comfortably. The buoyancy of the swimsuit is lower than that of the fabric because the swimsuit includes areas such as sewn areas that get wet with water.

[0022] The elastic polyurethane yarn of the present invention is mainly composed of polyurethane. First, the polyurethane will be described.

[0023] The polyurethane used in the present invention is not particularly limited as long as a polymer diol and a diisocyanate are used as starting materials. The synthesis method is also not particularly limited. For example, the polyurethane may be a polyurethane urea composed of a polymer diol, a diisocyanate and a low-molecular-weight diamine, or a polyurethane urethane composed of a polymer diol, a diisocyanate and a low-molecular-weight diol. Further, the polyurethane may be a polyurethane urea prepared using a compound having a hydroxyl group and an amino group in the molecule as a chain extender. It is also preferred that a polyfunctional glycol having trifunctionality or higher functionality, isocyanate and the like are used within a range that does not impair the effect of the present invention.

[0024] Preferable examples of the polymer diol include polyether diol, polyester diol, and polycarbonate diol. Among these, a polyether diol is preferred particularly from the viewpoint of imparting flexibility and elongation to the yarn.

[0025] Preferable examples of the polyether diol include polyethylene oxide, polyethylene glycol, derivatives of polyethylene glycol, polypropylene glycol, polytetramethylene ether glycol (hereinafter, abbreviated as PTMG), copolymers of tetrahydrofuran (THF) and 3-methyltetrahydrofuran (modified PTMG), copolymers of THF and 2,3-dimethyl THF (modified PTMG), polyols having side chains on both sides as disclosed in, e.g., Japanese Patent No. 2615131, and random copolymers in which THF and ethylene oxide and/or propylene oxide are irregularly arranged. Such polyether diols may be used individually, or two or more kinds of these may be mixed or copolymerized.

[0026] From the viewpoint of imparting wear resistance and light stability to the elastic polyurethane yarn, polyester diols such as butylene adipate, polycaprolactone diol and polyester polyol having a side chain as disclosed in, e.g., JP S61-26612 A, and polycarbonate diols as disclosed in, e.g., JP H2-289616 A are favorably used.

[0027] Such polymer diols may be used individually, or two or more kinds of these may be mixed or copolymerized.

[0028] As the molecular weight of the polymer diol, the number-average molecular weight is preferably 1000 or more and 8000 or less, and more preferably 1500 or more and 6000 or less, from the viewpoint of imparting elongation, strength, heat resistance and the like to the yarn. The use of a polyol having a molecular weight of this range makes it possible to easily obtain an elastic yarn excellent in elongation, strength, elastic recovery, and heat resistance.

[0029] Next, as the diisocyanate, aromatic diisocyanates are particularly suitable for synthesizing a polyurethane with high heat resistance and high strength, examples of which include diphenylmethane diisocyanate (hereafter, abbreviated as MDI), tolylene diisocyanate, benzene 1,4-diisocyanate, xylylene diisocyanate, and 2,6-naphthalene diisocyanate. Further, preferable examples of alicyclic diisocyanates include methylenebis(cyclohexyl isocyanate), isophorone diisocyanate, methylcyclohexane 2,4-diisocyanate, methylcyclohexane 2,6-diisocyanate, cyclohexane 1,4-diisocyanate, hexahydroxylylene diisocyanate, hexahydrotolylene diisocyanate, and octahydro-1,5-naphthalene diisocyanate. Aliphatic diisocyanates are particularly effective to prevent yellowing of the elastic polyurethane yarn. Such diisocyanates may be used individually or in combinations of two or more kinds.

[0030] Next, the chain extender used in the synthesis of the polyurethane preferably contains at least one of a low-molecular-weight diamine or a low-molecular-weight diol. The chain extender also may be a compound having a hydroxyl group and an amino group in the molecule such as ethanolamine.

[0031] Preferred examples of the low-molecular-weight diamine include ethylenediamine, 1,2-propanediamine, 1,3-propanediamine, hexamethylenediamine, p-phenylenediamine, p-xylylenediamine, m-xylylenediamine, p,p'-methylenedianiline, 1,3-cyclohexyldiamine, hexahydro metaphenylenediamine, 2-methylpentamethylenediamine, and bis(4-aminophenyl)phosphine oxide. It is preferable to use one or two or more of the above. Ethylenediamine is particularly preferred. The use of ethylenediamine makes it possible to easily obtain a yarn excellent in elongation, elastic recovery, and heat resistance. A triamine compound capable of forming a crosslinking structure with these chain extenders, such as diethylenetriamine, may be added within a range that does not impair the effect.

[0032] Typical examples of the low-molecular-weight diol include ethylene glycol, 1,3-propanediol, 1,4-butanediol, bishydroxyethoxybenzene, bishydroxyethylene terephthalate, and 1-methyl-1,2-ethanediol. It is preferable to use one or two or more of the above. Ethylene glycol, 1,3-propanediol, and 1,4-butanediol are particularly preferred. The use of the above makes it possible to obtain a yarn with further improved heat resistance as for polyurethane having diol extension and further improved strength.

[0033] As the molecular weight of the polyurethane in the present invention, the number-average molecular weight preferably ranges from 30000 to 150000, from the viewpoint of imparting high durability and strength to the fibers. The molecular weight is measured by GPC and converted by polystyrene.

[0034] One or a mixture of two or more kinds of end-capping agents are preferably used for the polyurethane. Preferable examples of the end-capping agent include monoamines such as dimethylamine, diisopropylamine, ethyl methylamine, diethylamine, methyl propylamine, isopropyl methylamine, diisopropylamine, butyl methylamine, isobutyl methylamine, isopentyl methylamine, dibutylamine and diamylamine, monools such as ethanol, propanol, butanol, isopropanol, allyl alcohol and cyclopentanol, and monoisocyanates such as phenylisocyanate.

[0035] In the present invention, when an elastic polyurethane yarn made from the polyurethane having the above basic composition contains 0.5 to 10 mass% of a cationic high-molecular-weight compound A having a number-average molecular weight of 2000 to 10000 and an inorganic chlorine deterioration inhibitor B, and the A/B mass ratio ranges from 0.3 to 3, a large synergistic effect is produced, and an excellent effect of resisting chlorine deterioration and excellent water repellent property are exhibited.

[0036] The cationic high-molecular-weight compound used in the present invention is not particularly limited as long as it is a compound having an amino group in the structure. From the viewpoint of preventing chlorine deterioration and yellowing of the elastic polyurethane yarn, it is particularly preferable to use a compound having only a tertiary amino group in the molecule among primary to tertiary amino groups. If the number-average molecular weight of the cationic high-molecular-weight compound is less than 2000, the water repellent property degrades due to falling off by rubbing with a guide or a knitting needle during formation of the elastic polyurethane yarn, or due to bleeding during processing such as dyeing in a bath. Therefore, the number-average molecular weight needs to be 2000 or more. In terms of solubility in the polyurethane spinning solution, the number-average molecular weight ranges from 2000 to 10000. More preferably, it ranges from 2000 to 4000.

[0037] Containing the cationic high-molecular-weight compound can improve the water repellent property of the elastic polyurethane yarn. The content of the cationic high-molecular-weight compound is preferably more than 0.5 mass% and 10 mass% or less, and more preferably more than 0.5 mass% and 4 mass% or less with respect to the fiber mass, from the viewpoint of sufficiently producing this effect and not adversely affecting the physical properties of the fibers.

[0038] Moreover, the polyurethane yarn of the present invention is to contain the inorganic chlorine deterioration inhibitor, together with the cationic high-molecular-weight compound.

[0039] The inorganic chlorine deterioration inhibitor used in the present invention is preferably at least one of an oxide, a carbon oxide, a complex oxide or a solid solution of one or more elements selected from the group consisting of Zn, Mg, Ca and Al. From the viewpoint of durability against pool water and environment, carbon oxides CaCOs, MgCOs and hydrotalcites composed of Mg and Al are particularly preferred.

[0040] The content of the inorganic chlorine deterioration inhibitor in the elastic polyurethane yarn in the present invention preferably ranges from 0.5 mass% to 10 mass%, from the viewpoint of durability against pool water and stability during production. The content thereof more preferably ranges from 1 mass% to 5 mass%.

[0041] From the viewpoint of achieving both of durability against pool water and water repellent property, the mass ratio (A)/(B) of the cationic high-molecular-weight compound (A) to the inorganic chlorine deterioration inhibitor (B) in the elastic polyurethane yarn ranges from 0.3 to 3, and more preferably 0.5 to 2.

[0042] The inorganic chlorine deterioration inhibitor, which is blended in the spinning solution and spun, is preferably fine powder with an average particle diameter of 2 μm or less, and more preferably fine powder with an average particle diameter of 1 μm or less, from the viewpoint of spinning stability. Further, if the average primary particle diameter is smaller than 0.01 μm, the cohesive force increases, which makes the particles difficult to be uniformly mixed in the spinning solution. Therefore, the average primary particle diameter is preferably 0.01 um or more from the viewpoint of dispersibility. As the average particle diameter, a 50% particle diameter is measured by the laser diffracted light scattering method. The measuring device is, e.g., a laser diffraction/scattering particle size distribution analyzer LA-950S2 manufactured by HORIBA, Ltd.

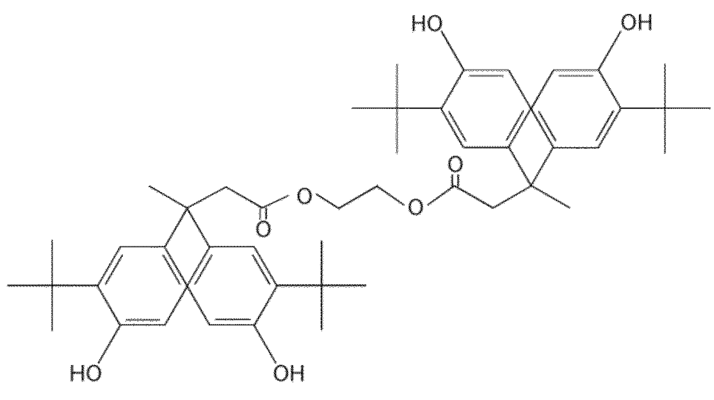
[0043] To finely pulverize the inorganic chlorine deterioration inhibitor, it is preferable to employ a method that includes: mixing the inorganic chlorine deterioration inhibitor with a solvent such as N,N-dimethylacetamide (hereafter, abbreviated as DMAc), dimethylformamide (hereafter, abbreviated as DMF), dimethylsulfoxide (hereafter, abbreviated as DMSO), N-methylpyrrolidone (hereafter, abbreviated as NMP) or a solvent containing any of these as a main component, and other additives such as a thickener to prepare a slurry; and crushing the slurry by, e.g., a vertical or horizontal mill.

[0044] Further, for the purpose of improving the dispersibility of the inorganic chlorine deterioration inhibitor into the yarn and stabilizing the spinning, it is also preferable to use an inorganic chlorine deterioration inhibitor that has been surface-treated with, e.g., an organic substance such as a fatty acid, a fatty acid ester, a phosphoric acid ester or a polyol organic substance, a silane coupling agent, a titanate coupling agent, water glass, a fatty acid metal salt, or a mixture of these.

[0045] Moreover, it is preferred that the elastic polyurethane yarn of the present invention contains a partially hindered phenol compound, from the viewpoint of improving durability against pool water. The partially hindered phenol compound preferably contains at least two partially hindered hydroxyphenyl groups and has a skeleton selected from bisester and alkylidene. It is more desirable that the alkyl group present in the ring position adjacent to the hydroxyl group in the hydroxyphenyl group is a tertiary butyl group, and it is further desirable that the equivalent of the hydroxyl group is 600 or less.

[0046] A preferable example of such a partially hindered phenol compound is ethylene-1,2-bis(3,3-bis[3-t-butyl-4-hydroxyphenyl]butyrate) having a structure in which a partially hindered hydroxyphenyl group is covalently bonded to a bisester skeleton (Chemical Formula 1 below).

[Chemical Formula 1]



[0047] Containing the partially hindered phenol compound can increase the effect of resisting chlorine deterioration. The content of the partially hindered phenol compound is preferably 0.15 to 4 mass%, and more preferably 0.5 to 3.5

mass% with respect to the elastic polyurethane yarn, from the viewpoint of sufficiently producing this effect and not adversely affecting the physical properties of the fibers.

[0048] As a treatment agent for the elastic polyurethane yarn in the present invention, a specific amount of silicone, ranging from 0.5 mass% to 20 mass%, is applied to the elastic fibers in the form of, e.g., an oil. The silicone is typically used to reduce the tension fluctuation during unwinding of the elastic polyurethane yarn in the manufacture of fabrics so that fine elastic fibers can be prevented from breaking due to the tension fluctuation during unwinding. In the present case, the silicone greatly contributes to an improvement in the water repellent property. The content of the silicone in the treatment agent is 0.5 to 10 mass%, preferably 1 to 6 mass% in dry mass. Thus, the affinity with the water repellent treatment agent can be improved. For example, an oil containing silicone can reduce the surface energy of a fabric and remarkably improve spreadability of a water repellent finishing agent when it is applied to the fabric surface.

[0049] As the silicone, polydimethylsiloxane having dimethylsiloxane units and/or a modified polysiloxane are preferred. Examples of the modified polysiloxane include polydialkylsiloxanes having dimethylsiloxane units and dialkylsiloxane units containing an alkyl group with 2 to 4 carbon atoms, and polysiloxanes having dimethylsiloxane units and methylphenylsiloxane units, and these silicone oils are preferably used. Further, it is preferred that the silicone has a viscosity at 25°C of 5×10^{-6} to 50×10^{-6} m^2 /s, from the viewpoint of handleability and reduction of running friction with guides or the like. The viscosity can be measured by the method specified in JIS-K2283: "Crude petroleum and petroleum products - Determination of kinematic viscosity and calculation of viscosity index from kinematic viscosity".

[0050] The silicone oil is preferably mixed with a paraffinic hydrocarbon such as a mineral oil, an antistatic agent, a dispersant, a metal soap, etc. The paraffinic hydrocarbon such as a mineral oil preferably has a viscosity at 25°C of 5×10^{-6} to 50×10^{-6} m^2/s, from the viewpoint of handleability and reduction of running friction with guides or the like. Preferable examples of the antistatic agent include anionic surfactants such as alkyl sulfate, fatty acid soap, alkyl sulfonate, and alkyl phosphate. Preferable examples of the dispersant include silicone resin, polyether-modified silicone, carbinol-modified silicone, carboxyl-modified silicone, amino-modified silicone, amide-modified silicone, carboxyamide-modified silicone, mercapto-modified silicone, and organic carboxylic acid, and these may be used individually or as a mixture. Preferable examples of the metal soap include magnesium stearate (hereafter, abbreviated as St-Mg) and calcium stearate, and the average particle diameter is preferably 0.1 to 1.0 μm from the viewpoint of improving handleability and dispersibility.

[0051] The silicone oil used in the present invention preferably contains components that are typically used in treatment agents for synthetic fibers, including a binder, an ultraviolet absorber, an antioxidant, a preservative, and a wettability modifier, as needed. The contents of the paraffinic hydrocarbon such as a mineral oil, metal soap, antistatic agent, dispersant, etc., are appropriately determined depending on the intended purpose.

[0052] Further, the silicone oil is preferably blended with a stabilizer, a thermal conductivity improver, and a pigment, within a range that does not impair the effect of the present invention.

[0053] The elastic polyurethane yarn of the present invention may contain various stabilizers, a pigment and the like, as needed. For example, as a light resistance agent, an antioxidant and the like, the elastic polyurethane yarn may contain the following: a sterically hindered phenol-based chemical agent typified by BHT or "SUMILIZER" (registered trademark) GA-80 manufactured by Sumitomo Chemical Co., Ltd., a benzotriazole- or benzophenone-based chemical agent such as "Tinuvin" (registered trademark) manufactured by Ciba-Geigy Corporation, a phosphorus-based chemical agent such as "SUMILIZER" P-16 manufactured by Sumitomo Chemical Co., Ltd., various hindered amine-based chemical agents, an inorganic pigment such as titanium oxide or carbon black, a fluorine- or silicone-based resin powder based on vinylidene polyfluoride or the like, a metal soap such as magnesium stearate, a germicide containing silver, zinc or any of these compounds, a deodorant, a lubricant such as silicone or mineral oil, barium sulfate, cerium oxide, an antistatic agent such as betaine, a phosphoric acid compound or phosphoric acid ester compound. These may be reacted with polymer to remain present. To further increase durability, especially against light and nitrogen oxides, it is preferred that the elastic polyurethane yarn also contains a nitrogen oxide scavenger such as HN-150 manufactured by Nippon Hydrazine Co., Ltd., or "Hostanox" (registered trademark) SE 10 manufactured by Clariant Corporation, a thermo-oxidation stabilizer such as "SUMILIZER" GA-80 manufactured by Sumitomo Chemical Co., Ltd., and a light stabilizer such as "SUMISORB" (registered trademark) 300#622 manufactured by Sumitomo Chemical Co., Ltd.

[0054] Next, the method for producing the elastic polyurethane yarn of the present invention will be described in detail.

[0055] The production method of the polyurethane may be either melt polymerization or solution polymerization, or another method. However, solution polymerization is more preferred. In the solution polymerization, foreign substances such as gel are less generated in the polyurethane, spinning is easy, and an elastic polyurethane yarn of low fineness is easily obtained. Obviously, solution polymerization is advantageous in that the operation of preparing a solution can be omitted.

[0056] A polyurethane particularly suitable for the present invention is synthesized using PTMG having a molecular weight of 1500 to 6000 as a polymer diol, MDI as a diisocyanate, and at least one of ethylenediamine, 1,2-propanediamine, 1,3-propanediamine or hexamethylenediamine as a chain extender.

[0057] The polyurethane is obtained, for example, by synthesizing the above raw materials in a solvent such as DMAc, DMF, DMSO, NMP, or a solvent containing any of these as a main component. For example, particularly suitable methods which may be employed are: a one-shot method of throwing the raw materials into such a solvent to dissolve, and heating and reacting them to form a polyurethane; and a method of first melting and reacting a polymer diol and a diisocyanate, then dissolving the reaction product in a solvent and reacting it with the chain extender to form a polyurethane.

[0058] In the case of using a diol as a chain extender, it is preferable to adjust the melting point of the polyurethane on the high temperature side to a range from 200°C to 260°C, from the viewpoint of obtaining a polyurethane having excellent heat resistance. A typical method of achieving this adjustment is to control the type and ratio of the polymer diol, MDI, and diol. In the case that the polymer diol has a low molecular weight, increasing the relative proportion of MDI can yield a polyurethane having a high melting point on the high temperature side. Similarly, in the case that the diol has a low molecular weight, reducing the relative proportion of the polymer diol can yield a polyurethane having a high melting point on the high temperature side.

[0059] In the case that the polymer diol has a molecular weight of 1800 or more, the polymerization preferably takes place with a ratio of (the number of moles of MDI) / (the number of moles of polymer diol) = 1.5 or more in order to make the melting point on the high temperature side 200°C or higher.

[0060] One or a mixture of two or more kinds of catalysts such as an amine catalyst and an organometallic catalyst are preferably used for the synthesis of the polyurethane.

[0061] Examples of the amine catalyst include N,N-dimethyl cyclohexylamine, N,N-dimethyl benzylamine, triethylamine, N-methylmorpholine, N-ethylmorpholine, N,N,N',N'-tetramethyl ethylenediamine, N,N,N',N'-tetramethyl-1,3-propanediamine, N,N,N',N'-tetramethyl hexanediamine, bis-2-dimethylaminoethyl ether, N,N,N',N',N'-pentamethyl diethylenetriamine, tetramethylguanidine, triethylenediamine, N,N'-dimethylpiperazine, N-methyl-N'-dimethylaminoethyl-piperazine, N-(2-dimethylaminoethyl)morpholine, 1-methylimidazole, 1,2-dimethylimidazole, N,N-dimethylaminoethanol, N,N,N'-trimethylaminoethyl ethanolamine, N-methyl-N'-(2-hydroxyethyl)piperazine, 2,4,6-tris(dimethylaminomethyl)phenol, N,N-dimethylaminohexanol, and triethanolamine.

[0062] Examples of the organometallic catalyst include tin octanoate, dibutyltin dilaurate, and lead dibutyl octanoate.

[0063] Typically, the concentration of the polyurethane in the polyurethane solution thus obtained preferably ranges from 30 mass% to 80 mass%.

[0064] In the present invention, the polyurethane solution contains the cationic high-molecular-weight compound having a number-average molecular weight of 2000 to 10000 and the inorganic chlorine deterioration inhibitor to improve durability against chlorine in pool water and the water repellent property. As a method for incorporating the cationic high-molecular-weight compound into the spinning solution, it may be solely mixed with the spinning solution, or it may be mixed with the inorganic chlorine deterioration inhibitor beforehand. As a method for evenly dispersing the cationic high-molecular-weight compound and the inorganic chlorine deterioration inhibitor in the polyurethane spinning solution before spinning, it is preferred that they are added to a polyurethane spinning solution containing N,N-dimethylformamide or N,N-dimethylacetamide as a solvent, and then stirred and mixed evenly. Specifically, it is preferred that the cationic high-molecular-weight compound and the inorganic chlorine deterioration inhibitor are dissolved or dispersed in a solvent such as N,N-dimethylformamide or N,N-dimethylacetamide beforehand, and the solution or dispersion is mixed with the polyurethane spinning solution. Here, the solvent for the cationic high-molecular-weight compound and the inorganic chlorine deterioration inhibitor to be added is preferably the same as the solvent for the polyurethane solution, from the viewpoint of adding them evenly in the polyurethane solution. The chemical agents such as a light resistance agent and an antioxidant and the pigment described above may be added simultaneously with the cationic high-molecular-weight compound and the inorganic chlorine deterioration inhibitor. Any method can be adopted to add the cationic high-molecular-weight compound and the inorganic chlorine deterioration inhibitor into the polyurethane solution. Various typical methods may be adopted, including a method using a static mixer, a method using stirring, a method using a homomixer, and a method using a biaxial extruder.

[0065] To improve durability against chlorine in pool water, the elastic polyurethane yarn preferably contains a partially hindered phenol compound having at least one partially hindered hydroxyphenyl group and having a molecular weight of 300 or more, in an amount of, e.g., 0.15 mass% or more and 4.0 mass% or less. Any method can be adopted to incorporate the partially hindered phenol compound into the spinning solution, and it may be solely mixed with the spinning solution, or it may be mixed with the above solution or dispersion beforehand.

[0066] The polyurethane yarn of the present invention can be obtained by subjecting the spinning solution prepared as described above to dry spinning, wet spinning or melt spinning, followed by winding, for example. Among them, dry spinning is preferred because it enables stable spinning in any fineness from thin to thick.

[0067] The elastic polyurethane yarn of the present invention may have any fineness and any cross-sectional shape. For example, the cross-sectional shape of the yarn may be circular or elliptical.

[0068] The dry spinning method is also not specifically limited, and suitable spinning conditions are to be selected depending on the desired characteristics, spinning equipment, etc.

[0069] The spinning speed is preferably 250 m/min or greater from the viewpoint of improving the strength of the elastic polyurethane yarn to be obtained.

[0070] The knitted fabric including the elastic polyurethane yarn may be any of a circular knitted fabric, a weft knitted fabric, or a warp knitted fabric (e.g., a tricot knitted fabric, a raschel knitted fabric). The knitted structure may be pile stitch, flat stitch, plain stitch, rib stitch, smooth stitch (interlock stitch), rib stitch, pearl stitch, denbigh stitch, double denbigh stitch, cord stitch, half stitch, back half stitch, atlas stitch, double atlas stitch, chain stitch, inlay stitch, or any combination of the above.

[0071] The woven fabric including the elastic polyurethane yarn and other fibers is woven by a general method. Examples of the woven fabric structure include plain weave, twill weave, sateen weave, variegated plain weave, variegated twill weave, variegated sateen weave, fancy weave, brocade, single texture, double texture, multiple texture, warp pile weave, weft pile weave, interweave, and any combination of the above. The woven fabric may be either a one-way stretch fabric in which the polyurethane yarn is used for warp or weft, or a two-way stretch fabric in which the polyurethane yarn is used for both warp and weft.

[0072] The fabric including the elastic polyurethane yarn and other fibers is scoured, relaxed, and set under normal conditions. The fabric is usually dyed with a dye and conditions that are suitable for other fibers mixed at a high ratio in the fabric. The dye may be a disperse dye, an acid dye, a metal complexed dye, or a conventional dye. The fabric may be subjected to a fixing treatment for dye fixing, an antibiotic treatment, a softening treatment, etc., as needed.

[0073] The following describes the water repellent finishing method of the present invention. The water repellent finishing of the present invention is preferably imparted by dry heat treatment. The dry heat treatment may be performed by applying a treatment liquid containing a water repellent agent to a swimsuit with a device such as a mangle, followed by drying and heat treatment. As a device for applying the treatment liquid containing a water repellent agent to a swimsuit, a device that can uniformly apply the liquid to the swimsuit is preferred, and a normal mangle is suitable as a liquid applying device. The treatment liquid also can be applied by a foam processing machine, or a method such as printing, inkjet, spraying or coating method. The drying temperature is preferably 80°C to 150°C. The treatment time is preferably 15 seconds to 5 minutes, more preferably 30 seconds to 3 minutes at 100°C to 140°C. The heat treatment temperature after drying is preferably 80 to 200°C. The treatment time is preferably 15 seconds to 8 minutes, more preferably 30 seconds to 5 minutes at 130°C to 190°C. When the treatment temperature is low, the reaction will not occur sufficiently, which lowers water repellency.

[0074] 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 a plain weave part 2 and a weft double weave part 3 are repeated alternately. In the plain weave part 2, a warp yarn 4 and a weft yarn 5 cross each other to constitute the woven fabric. In the weft double weave part 3, the warp yarn 4 and weft yarns 6a, 6b cross each other to constitute the woven fabric. The weft yarn 6a is located on the front side, and the weft yarn 6b is located on the back side, which makes the weft double weave part 3 thicker than the plain weave part 2. Further, for reinforcement, the weft double weave part 3 includes more elastic yarns than the plain weave part 2, thereby increasing stretchability and ease of wear of the fabric. The plain weave part 2 is a depression, and the weft double weave part 3 is a projection. A stripe pattern as a whole is constituted by the depressions and projections arranged in one direction. Therefore, for example, by using the stripe pattern along the stature direction of a body, it is possible to form a swimsuit that can reduce the surface friction resistance against water flow.

[0075] FIG. 2 is a schematic plan view of a stretch woven fabric 7 according to another embodiment of the present invention in which a plain weave part 8 and a warp double weave part 9 are repeated alternately. In the plain weave part 8, a warp yarn 10 and a weft yarn 11 cross each other to constitute the woven fabric. In the warp double weave part 9, warp yarns 12a, 12b and the weft yarn 11 cross each other to constitute the woven fabric. The warp yarn 12a is located on the front side, and the warp yarn 12b is located on the back side, which makes the warp double weave part 9 thicker than the plain weave part 8.

[0076] 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. In a plan view, a stripe pattern is constituted by the depressions and projections arranged in one direction.

[0077] FIG. 4 is a schematic plan view of a single covered yarn 13 to be used in the stretch woven fabric, wherein a core yarn 14 is an elastic yarn made from, e.g., polyurethane, and a covering yarn 15 is a textured yarn made from, e.g., nylon. FIG. 4B is a schematic plan view of a double covered yarn 16 according to another embodiment, wherein a core yarn 17 is an elastic yarn made from, e.g., polyurethane, and a covering yarn (upper yarn) 19 and a covering yarn 18 (lower yarn) are textured yarns made from, e.g., nylon.

[0078] FIG. 5 is a schematic front view of a competition swimsuit 20 using 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 a woven fabric in which the plain weave part and the double weave part shown in FIGS. 1 and 3 are repeated alternately. 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 a plain part 22 in a belt portion from the shoulder to the back are 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 the stripe part 21 (a woven fabric in which the plain weave part and the double weave part are repeated alternately). The stripe part 21 is preferably arranged along a stature direction of a human body.

[0079] FIG. 7 is a schematic front view of a men's competition swimsuit 23 using the stretch woven fabric. A stripe part 24 is a woven fabric in which the plain weave part and the double weave part are repeated alternately. A plain part 25 is a woven fabric of the plain weave structure. The stripe part 24 is preferably arranged along a stature direction of a human body.

[0080] It is preferred that a competition swimsuit is formed using a pattern that is about 20% to 40% smaller than a human body. The swimsuit formed thereby fits a human body tightly.

Examples

[0081] Hereinafter, the present invention will be described further specifically by way of examples. However, the present invention is not limited to the following examples. Further, in the following examples, the weight ratio simply expressed by % indicates mass%.

[0082] Various characteristics of woven fabrics were measured in the following manner.

<Elemental Mass Concentration>

[0083] The elemental mass concentration was measured according to SEM-EDX under the conditions below, using elastic polyurethane yarns that appeared on the surface of a dismantled swimsuit or elastic polyurethane fibers taken out from unraveled yarns. The F/C ratio was calculated from the obtained elemental mass concentration. A SEM (S-3400N manufactured by Hitachi, Ltd.) and an EDX detector (EMAX x-act manufactured by HORIBA, Ltd.) were used as the measuring devices.

(Measurement Conditions)

[0084]

Acceleration voltage: 5 kV
Resolution: 1024 × 768
Probe current: 50 mA
Live time: 120 sec
Vacuum: 30 Pa
Process time: mode: 4
WD: 10 mm
Spectral range: 0 to 20 keV
Magnification: 2000 times
Number of channels: 2K

<Water Repellency>

[0085] The water repellency was evaluated and classified according to the spray method specified in JIS L 1092: "Testing methods for water resistance of textiles" (1998).

<Water Retention Rate>

[0086] A circle of diameter 11.2 cm was drawn in the middle of each swimsuit that was cut in 20 cm long and 20 cm wide, and the swimsuit was stretched to extend the circled area by 80%, to which a specimen holding frame for a water repellency test (JIS L 1092) was attached. After the spray test (JIS L 1092), the swimsuit was removed from the holding frame and air-dried in an environment of 20°C × 53% RH. Ten pieces of the same swimsuit were prepared, and each was weighed as a "weight before treatment".

[0087] 30 L of water (water temperature: 25 to 29°C) was filled in a washing machine (JIS C 9606), into which the 10 pieces of the swimsuit were immersed. They were rotated for a predetermined period of time (10 minutes, 60 minutes, 120 minutes) under "strong conditions" and taken out from water one by one. They were inclined about 15 degrees in a spread state for 10 seconds to remove water droplets from the swimsuit, and each was weighed as a "weight after treatment" to measure the water retention rate by Formula below.

$$\text{Water retention rate (\%)} = ((\text{Weight after treatment} - \text{Weight before treatment}) / \text{Weight before treatment}) \times 100$$

<Buoyancy Test>

[0088] First, a weight (W1) of the sample was measured in air. Then, a weight (W2) of the sample was measured in water using the buoyancy measuring method illustrated in FIG 8. In a buoyancy test device 30, water 32 was filled in a container 31, a sample 38 was placed therein, and a test device 33 was fixed above the sample 38. The test device includes a support 34, a plate 36, a scale held between the support 34 and the plate 36, support rods 35, and a wire mesh 37. The wire mesh 37 was immersed under water as illustrated in FIG. 8 to measure the weight (W2) of the sample 38 in water. The buoyancy is calculated by W1-W2. As for fabric samples, five samples 3 cm long and 4 cm wide were measured and averaged. The weights of dry fabric samples were measured.

<Tearing Strength>

[0089] The tearing strength was evaluated according to the pendulum method specified in JIS L 1096: "Testing methods for woven and knitted fabrics" (1999).

<Bursting Strength>

[0090] The bursting strength was evaluated according to the Mullen method specified in JIS L 1096: "Testing methods for woven and knitted fabrics" (1999).

<Elongation Rate>

[0091] The elongation rate was measured according to the cut strip method specified in JIS L 1096 A: "Testing methods for woven and knitted fabrics" (1999). A test piece was 5 cm wide, and a clamp interval was 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.

<Stress at 30% Elongation>

[0092] The stress (N) at 30% elongation during measurement of the elongation rate in warp and weft directions was measured, and the value obtained was converted into per centimeter and expressed by N/cm. The stress at 30% elongation can be a criterion for evaluating the compression (wearing pressure) function of the sample.

(Preparation of Elastic Polyurethane Yarn A)

[0093] PTMG having a number-average molecular weight of 1800 and MDI were placed in a container at a molar ratio of MDI/PTMG = 1.58/1 and reacted at 90°C, and the resulting reaction product was dissolved in N,N-dimethylacetamide (DMAc). Next, a DMAc solution containing ethylenediamine and diethylamine was added to the solution in which the reaction product was dissolved to prepare a polyurethane urea solution having a solid content of 35 mass% in polymer.

[0094] A condensation polymer of p-cresol and divinylbenzene ("Methacrol" (registered trademark) 2390 manufactured by DuPont), as an antioxidant, and 2-[4,6-bis(2,4-dimethylphenyl)-1,3,5-triazin-2-yl]-5-(octyloxy)phenyl ("Cyasorb" (registered trademark) 1164 manufactured by Cytech Inc.), as an ultraviolet absorber, were mixed at a ratio (mass ratio) of 3/2 to prepare a DMAc solution (concentration: 35 mass%) as an additive solution (35 mass%).

[0095] The polyurethane urea solution and the additive solution were mixed at a ratio of 98 mass% and 2 mass% to prepare a polymer solution (X1).

[0096] As a cationic high-molecular-weight compound, a cationic high-molecular-weight compound having a number-average molecular weight of 2600 was prepared by reacting t-butyldiethanolamine with methylene-bis- (4-cyclohexyl isocyanate). The cationic high-molecular-weight compound thus obtained was dissolved in DMAc to prepare a solution (A1) with a concentration of 35 mass%.

[0097] Calcium carbonate Hakuenka A ($CaCO_3$, average primary particle diameter: 1.0 pm) manufactured by Shiraishi Kogyo Kaisha, Ltd., was used as a chlorine deterioration inhibitor to prepare a 35 mass% DMAc dispersion. For this preparation, a horizontal mill DYNO-MIL KDL manufactured by Willy A. Bachofen AG was used, and 85% zirconia beads were filled therein to finely and evenly disperse them at a flow rate of 80 g/min to prepare a DMAc dispersion B 1 of synthetic carbonate (35 mass%).

[0098] As a partially hindered phenol compound, ethylene-1,2-bis(3,3-bis[3-t-butyl-4-hydroxyphenyl]butyrate ("Hostanox" (registered trademark) O3 manufactured by Clariant Corporation) was dissolved in DMAc to prepare a solution (C 1) with a concentration of 35 mass%.

[0099] The polymer solutions X1, A1, B 1 and C 1 were mixed at a ratio of 97 mass%, 1 mass%, 3 mass% and 1 mass%, respectively, to prepare a spinning solution Y1. The spinning solution Y1 was dry-spun at a winding speed of 580 m/min to produce an elastic polyurethane yarn (78 decitex) (Z1). A silicone oil as a treatment agent was applied thereto while winding. As the silicone oil, a treatment agent (oil) containing 96% of silicone (polydimethylsiloxane), 3% of St-Mg and 1% of dispersant was applied in an amount of 6% in dry weight.

[0100] The elastic polyurethane yarn obtained in the above-described manner was covered with a nylon 66 yarn. The nylon 66 yarn used was 33 decitex, 10 filaments. Thus, a yarn A (single covered yarn) was obtained.

(Preparation of Elastic Polyurethane Yarn B)

[0101] A yarn B was produced in the same manner as the yarn A except that an elastic polyurethane yarn was produced in 55 decitex.

(Preparation of Elastic Polyurethane Yarn C)

[0102] A yarn C was produced in the same manner as the yarn A except that an elastic polyurethane yarn was produced in 44 decitex and covered with a nylon 66 yarn of 33 decitex, 10 filaments.

(Preparation of Elastic Polyurethane Yarn D)

[0103] A yarn D was produced in the same manner as the yarn A except that an elastic polyurethane yarn was produced in 44 decitex and covered with a nylon 66 yarn of 22 decitex, 24 filaments.

(Preparation of Elastic Polyurethane Yarn E)

[0104] A yarn E was produced in the same manner as the yarn A except that an elastic polyurethane yarn was produced in 33 decitex and covered with a nylon 66 yarn of 22 decitex, 24 filaments.

(Preparation of Elastic Polyurethane Yarn F)

[0105] An elastic polyurethane yarn of 78 decitex (Type 176E, manufactured by TORAY OPELONTEX CO., LTD.) was covered with a nylon 66 yarn of 33 decitex, 10 filaments, to produce a yarn F.

(Preparation of Elastic Polyurethane Yarn G)

[0106] An elastic polyurethane yarn of 55 decitex (Type 254E, manufactured by TORAY OPELONTEX CO., LTD.) was covered with a nylon 66 yarn of 33 decitex, 10 filaments, to produce a yarn G.

(Preparation of Elastic Polyurethane Yarn H)

[0107] An elastic polyurethane yarn of 44 decitex (Type 254T, manufactured by TORAY OPELONTEX CO., LTD.) was covered with a nylon 66 yarn of 33 decitex, 10 filaments, to produce a yarn H.

(Preparation of Elastic Polyurethane Yarn I)

[0108] An elastic polyurethane yarn of 44 decitex (Type 254T, manufactured by TORAY OPELONTEX CO., LTD.) was covered with a nylon 66 yarn of 22 decitex, 24 filaments, to produce a yarn I.

(Preparation of Elastic Polyurethane Yarn J)

[0109] An elastic polyurethane yarn of 33 decitex (Type 254E, manufactured by TORAY OPELONTEX CO., LTD.) was covered with a nylon 66 yarn of 22 decitex, 24 filaments, to produce a yarn J.

(Example 1)

[0110] The yarn A, yarn B, and yarn C were used as a warp yarn, a weft front yarn, and a weft back yarn, respectively, to produce a stretch woven fabric 1 in which the plain weave part 2 and the weft double weave part 3 were repeated alternately as illustrated in FIG. 1. The obtained woven fabric was 66 mass% of nylon and 34 mass% of polyurethane. The woven fabric was subjected to scouring, intermediate setting, dyeing, and drying according to ordinary methods. The obtained woven fabric was immersed in a water repellent preparation below, squeezed with a pickup of 50%, and then dried in a pin tenter set at a temperature of 130°C. Then, the woven fabric was subjected to dry heat treatment for 1 minute in the pin tenter at 170°C to obtain a processed woven fabric of Example 1. The obtained processed fabric was a highly water repellent woven fabric having a high water repellent degree and a low water retention rate.

- FX-ML (fluorine-based water repellent agent manufactured by Kyokenkasei): 100 g/L
- BECKAMINE M-3 (melamine resin manufactured by DIC Corporation): 3 g/L
- BECKAMINE ACX (catalyst manufactured by DIC Corporation): 2 g/L
- Super Fresh JB7200 (water-dispersible polyfunctional isocyanate crosslinker manufactured by Kyokenkasei): 5 g/L

[0111] The surface of the woven fabric was subjected to smoothing. The smoothing is a process of heating and pressurizing a fabric between a pair of rollers. The roller temperature was 220°C, the linear load was 5500 kgf, and the roller speed was about 6-10 m/min.
[0112] The warp density of the obtained woven fabric was 186 yarns/2.54 cm, the weft density of the plain weave part was 179 yarns/2.54 cm, the weft density of the weft double weave part was 209 yarns/2.54 cm, the mass per unit area was 142 g/m^2, the width of the plain weave part 2 was 1.70 mm, and the width of the weft double weave part 3 was 1.70 mm.
[0113] The woven fabric thus obtained had an elongation rate of 52.9% in the warp direction and 35.2% in the weft direction, and had a stress at 30% elongation of 1.72 N/cm in the warp direction and 2.96 N/cm in the weft direction. The obtained woven fabric had high stretchability, excellent close fitting to the skin of a human body, a low water retention rate, and excellent water repellency.

(Example 2)

[0114] The yarn D and the yarn E were used as a warp yarn and a weft yarn, respectively, to produce a plain woven fabric. The woven fabric was 70% of nylon and 30% of polyurethane. The fabric was then subjected to dyeing and water repellent finishing similarly to Example 1 to produce a woven fabric with a warp density of 205 yarns/2.54 cm, a weft density of 200 yarns/2.54 cm, and a mass per unit area of 95 g/m^2. The obtained processed fabric was a highly water repellent fabric for a swimsuit having high stretchability, excellent close fitting to the skin of a human body, a high water repellent degree, and a low water retention rate. Table 1 summarizes the results.

(Comparative Example 1)

[0115] A processed woven fabric of Comparative Example 1 was obtained through dyeing, water repellent finishing and surface smoothing in the same manner as in Example 1, except that the yarn F, yarn G, and yarn H were used as a warp yarn, a weft front yarn, and a weft back yarn, respectively, and the woven fabric was 66% of nylon and 34% of polyurethane.
[0116] The warp density of the obtained woven fabric was 184 yarns/2.54 cm, the weft density of the plain weave part was 178 yarns/2.54 cm, the weft density of the weft double weave part was 208/2.54 cm, the mass per unit area was 139 g/m^2, the width of the plain weave part 2 was 1.70 mm, and the width of the weft double weave part 3 was 1.70 mm.
[0117] The obtained processed fabric had a high water repellent degree but also a high water retention rate, which was unsatisfactory. Table 1 summarizes the results.

(Comparative Example 2)

[0118] A processed woven fabric of Comparative Example 2 was obtained through dyeing and water repellent finishing in the same manner as in Example 2, except that the yarn I and the yarn J were used as a warp yarn and a weft front yarn, respectively, and the woven fabric was 70% of nylon and 30% of polyurethane.
[0119] The warp density of the obtained woven fabric was 215 yarns/2.54 cm, the weft density thereof was 210 yarns/2.54 cm, and the mass per unit area was 116 g/m^2. The obtained processed fabric had a high water repellent degree but also a high water retention rate, which was unsatisfactory. Table 1 summarizes the results.

[Table 1]

			Example 1	Example 2	Comparative Example 1	Comparative Example 2
Mass (g/m^2)			142	95	139	116
Tearing strength (N)		Warp direction	18.4	19.0	19.8*	14.9*
		Weft direction	18.2	16.4	19.9*	13.0*
Bursting strength (kPa)			482	490	624	444
SEM-EDX analysis value (F/C ratio)			0.073	0.040	0.028	0.021
Elongation rate (%)		Warp direction	52.9	66.8	54.1	65.1
		Weft direction	35.2	42.0	36.8	50.1
Stress at 30% elongation (N/cm)		Warp direction	1.72	0.98	1.38	1.08
		Weft direction	2.96	1.96	2.70	1.71
Water repellency (grade)			5	5	5	5
Water retention rate (%)	After 10 minutes		4.5	6.2	8.5	9.3
	After 60 minutes		5.8	16.3	31.4	34.3
	After 120 minutes		10.0	27.8	53.3	51.2
Buoyancy test	Weight in air W1 (g) A		0.151	0.113	0.160	0.133
	Weight in water W2 (g)		-0.107	-0.134	-0.082	-0.076
	Buoyancy W1-W2 (g) B		0.258	0.247	0.242	0.209
	Buoyancy per 1 g of fabric sample (g) B/A		1.71	2.19	1.51	1.57
* Tearing strength: including untorn part						

[0120] Table 1 shows that the fabrics for swimsuit of Examples 1 and 2 were high in water repellency and low in water retention rate, and high in buoyancy.

(Example 3)

[0121] A men's competition swimsuit shown in FIG. 7 was produced using the woven fabric of Example 1 and the woven fabric of Example 2. A stripe part 24 of the woven fabric of Example 1 was a woven fabric in which the plain weave part and the weft double weave part were repeated alternately. The stripe part 24 was arranged along a stature direction of a human body. The woven fabric of the plain weave structure of Example 2 was a plain part 25.

(Comparative Example 3)

[0122] A men's competition swimsuit shown in FIG. 7 was produced using the woven fabric of Comparative Example 1 and the woven fabric of the plain weave structure of Comparative Example 2.

[0123] Table 2 summarizes the results.

[Table 2]

		Example 3	Comparative Example 3
Buoyancy test	Weight in air W1 (g) A	105.8	109.8
	Weight in water W2 (g)	-56.0	-46.5
	Buoyancy W1-W2 (g) B	161.8	156.3
	Buoyancy per 1 g of swimsuit (g) B/A	1.53	1.42

[0124] Table 2 shows that the swimsuit of Example 3 had high buoyancy.

Industrial Applicability

[0125] Swimsuits using the elastic polyurethane yarn of the present invention have high water repellency, a low water retention rate and high buoyancy, and therefore are suitable for competitive swimmers and general swimmers.

Description of Reference Numerals

[0126]

1, 7 Stretch woven fabric
2, 8 Plain weave part
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
14, 17 Core yarn
15, 18, 19 Covering yarn
16 Double covered yarn
20 Women's swimsuit
21, 24 Stripe part
22, 25 Plain part
23 Men's swimsuit
30 Buoyancy test device
31 Container
32 Water
33 Scale
34 Support
35 Support rod
36 Plate
37 Wire mesh
38 Sample

Claims

1. A swimsuit comprising an elastic polyurethane yarn,
wherein the elastic polyurethane yarn comprises:

0.5 to 10% by mass of a cationic high-molecular-weight compound A having a number-average molecular weight of 2000 to 10000; and
an inorganic chlorine deterioration inhibitor B,
a mass ratio of the cationic high-molecular-weight compound A to the inorganic chlorine deterioration inhibitor B ranges from 0.3 to 3,
a silicone oil is applied to the elastic polyurethane yarn, and
a fabric for the swimsuit is treated with water repellent finishing,

wherein the ratio of fluorine (F) to carbon (C) on the elastic polyurethane yarn of the swimsuit is 0.030 or more in an elemental mass concentration as measured according to scanning electron microscope - energy dispersive X-ray spectroscopy (SEM-EDX) under the conditions defined for determination of Elemental Mass Concentration in the Examples.

2. The swimsuit according to claim 1, wherein the content of silicone in the silicone oil is 0.5 to 10 mass% in dry mass.

3. The swimsuit according to claim 1 or 2, wherein the swimsuit comprises 5 to 70% by mass of the elastic polyurethane yarn.

4. The swimsuit according to any of claims 1 to 3, wherein the fabric for the swimsuit has a water repellency of grade 4 or higher in the spray test according to JIS L 1092.

5. The swimsuit according to any of claims 1 to 4, wherein the fabric for the swimsuit has a water retention rate after 60 minutes of 50% by mass or less of the mass of the swimsuit when measured according to the Water Retention Rate method defined in the Examples.

6. The swimsuit according to any of claims 1 to 5, wherein the elastic polyurethane yarn is covered with another synthetic fiber yarn.

7. The swimsuit according to any of claims 1 to 6, wherein the fabric for the swimsuit comprises a polyamide fiber yarn or a polyester fiber yarn.

8. The swimsuit according to any of claims 1 to 7, wherein the fabric for the swimsuit has a tearing strength of 8 N or more according to JIS L 1096.

9. The swimsuit according to any of claims 1 to 8, wherein the fabric for the swimsuit has a bursting strength of 200 kPa or more according to JIS L 1096.

10. The swimsuit according to any of claims 1 to 9, wherein the fabric for the swimsuit is at least one of a woven fabric or a knitted fabric.

Patentansprüche

1. Badeanzug, der ein elastische Polyurethangarn umfasst,
wobei das elastische Polyurethangarn umfasst:

0,5 bis 10 Masse-% einer kationischen hochmolekularen Verbindung A, die ein zahlenmittleres Molekulargewicht von 2000 bis 10000 aufweist; und
einen anorganischen Chlor-Schädigungshemmstoff B,
wobei ein Massenverhältnis der kationischen hochmolekularen Verbindung A zum anorganischen Chlor-Schädigungshemmstoff B im Bereich von 0,3 bis 3 liegt,
auf das elastische Polyurethangarn ein Silikonöl aufgetragen ist, und
ein Stoff für den Badeanzug wasserabweisend behandelt ist,
wobei das Verhältnis von Fluor (F) zu Kohlenstoff (C) auf dem elastischen Polyurethangarn des Badeanzugs 0,030 oder mehr in einer elementaren Massenkonzentration, wie gemäß Rasterelektronenmikroskop-energiedispersiver Röntgenspektroskopie (SEM-EDX) unter den Bedingungen gemessen, die zur Bestimmung der Elementmassenkonzentration in den Beispielen definiert sind, beträgt.

2. Badeanzug nach Anspruch 1, wobei der Silikongehalt in dem Silikonöl 0,5 bis 10 Masse-% in der Trockenmasse beträgt.

3. Badeanzug nach Anspruch 1 oder 2, wobei der Badeanzug 5 bis 70 Masse-% des elastischen Polyurethangarns umfasst.

4. Badeanzug nach einem der Ansprüche 1 bis 3, wobei der Stoff für den Badeanzug im Sprühtest gemäß JIS L 1092 eine wasserabweisende Wirkung von Grad 4 oder höher aufweist.

5. Badeanzug nach einem der Ansprüche 1 bis 4, wobei der Stoff für den Badeanzug nach 60 Minuten eine Wasserretentionsrate von 50 Masse-% oder weniger der Masse des Badeanzugs, bei einer Messung gemäß dem Verfahren für die Wasserretentionsrate, die in den Beispielen definiert ist, aufweist.

6. Badeanzug nach einem der Ansprüche 1 bis 5, wobei das elastische Polyurethangarn mit einem anderen synthetischen Fasergarn überzogen ist.

7. Badeanzug nach einem der Ansprüche 1 bis 6, wobei der Stoff für den Badeanzug ein Polyamidfasergarn oder ein Polyesterfasergarn umfasst.

8. Badeanzug nach einem der Ansprüche 1 bis 7, wobei der Stoff für den Badeanzug eine Reißfestigkeit von 8 N oder mehr gemäß JIS L 1096 aufweist.

9. Badeanzug nach einem der Ansprüche 1 bis 8, wobei der Stoff für den Badeanzug eine Berstfestigkeit von 200 kPa oder mehr gemäß JIS L 1096 aufweist.

10. Badeanzug nach einem der Ansprüche 1 bis 9, wobei der Stoff für den Badeanzug mindestens eines von einem Gewebe oder einem Gewirk ist.

Revendications

1. Maillot de bain, comprenant un fil de polyuréthane élastique,
dans lequel le fil de polyuréthane élastique comprend :

de 0,5 à 10 % en masse d'un composé cationique à haut poids moléculaire A présentant une masse moléculaire moyenne en nombre de 2 000 à 10 000 ; et
un inhibiteur inorganique de détérioration par le chlore B,
un rapport massique du composé cationique à haut poids moléculaire A à l'inhibiteur inorganique de détérioration par le chlore B est compris entre 0,3 et 3,
une huile de silicone est appliquée sur le fil de polyuréthane élastique, et
un tissu pour le maillot de bain est traité avec une finition hydrofuge,
dans lequel le rapport du fluor (F) au carbone (C) sur le fil de polyuréthane élastique du maillot de bain est supérieur ou égal à 0,030 en une concentration en masse élémentaire, telle que mesurée selon une spectroscopie de rayons X à dispersion d'énergie avec microscope électronique à balayage (SEM-EDX) dans les conditions définies pour la détermination de la concentration en masse élémentaire dans les exemples.

2. Maillot de bain selon la revendication 1, dans lequel la teneur en silicone dans l'huile de silicone est de 0,5 à 10 % en masse en masse sèche.

3. Maillot de bain selon la revendication 1 ou 2, dans lequel le maillot de bain comprend de 5 à 70 % en masse du fil de polyuréthane élastique.

4. Maillot de bain selon l'une quelconque des revendications 1 à 3, dans lequel le tissu pour le maillot de bain présente une hydrophobie de catégorie 4 ou plus dans l'essai par pulvérisation selon JIS L 1092.

5. Maillot de bain selon l'une quelconque des revendications 1 à 4, dans lequel le tissu pour le maillot de bain présente un taux de rétention d'eau après 60 minutes inférieur ou égal à 50 % en masse de la masse du maillot de bain, lorsqu'il est mesuré selon le procédé de taux de rétention d'eau définie dans les exemples.

6. Maillot de bain selon l'une quelconque des revendications 1 à 5, dans lequel le fil de polyuréthane élastique est recouvert d'un autre fil de fibres synthétiques.

7. Maillot de bain selon l'une quelconque des revendications 1 à 6, dans lequel le tissu pour le maillot de bain comprend un fil de fibres de polyamide ou un fil de fibres de polyester.

8. Maillot de bain selon l'une quelconque des revendications 1 à 7, dans lequel le tissu pour le maillot de bain présente une résistance à la déchirure supérieure ou égale à 8 N selon JIS L 1096.

9. Maillot de bain selon l'une quelconque des revendications 1 à 8, dans lequel le tissu pour le maillot de bain présente une résistance à l'éclatement supérieure ou égale à 200 kPa selon JIS L 1096.

10. Maillot de bain selon l'une quelconque des revendications 1 à 9, dans lequel le tissu pour le maillot de bain est au moins un tissu tissé ou un tissu tricoté.

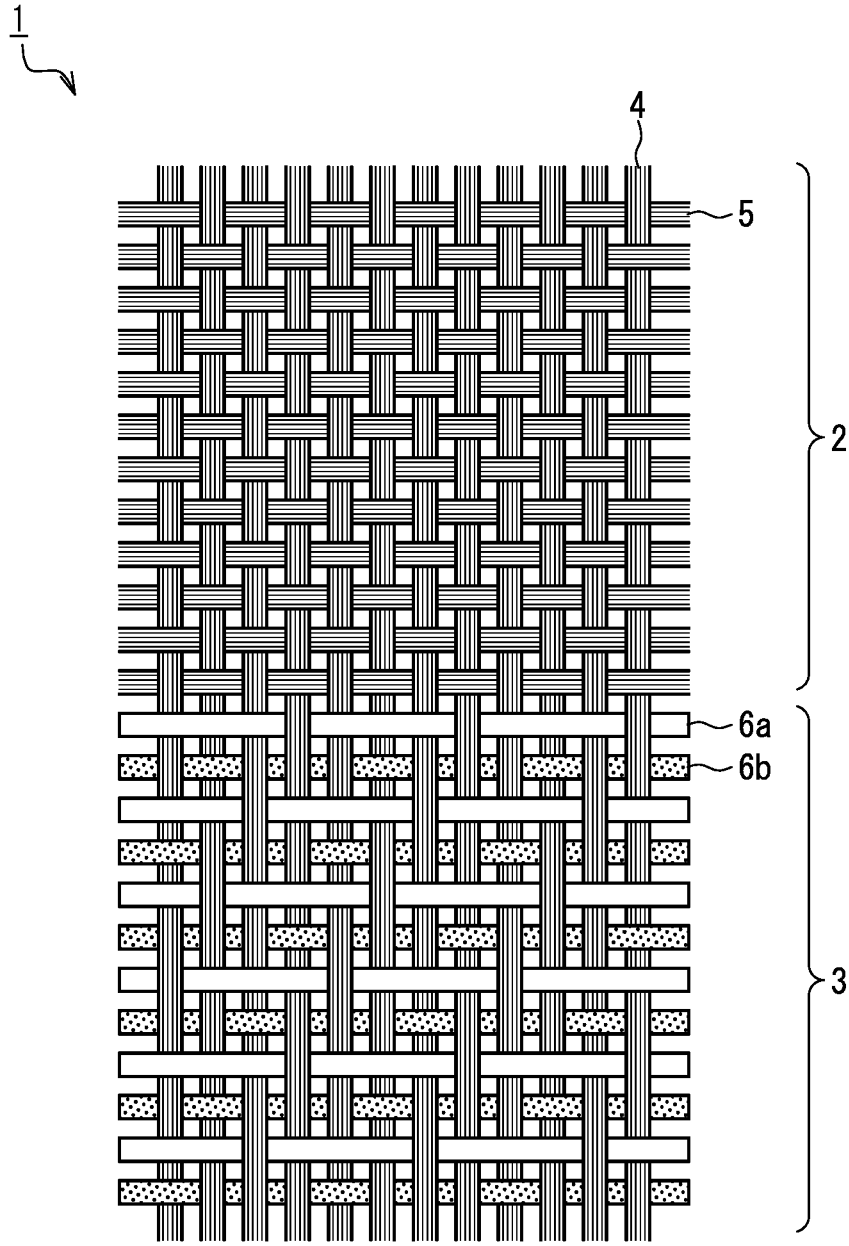


FIG. 1

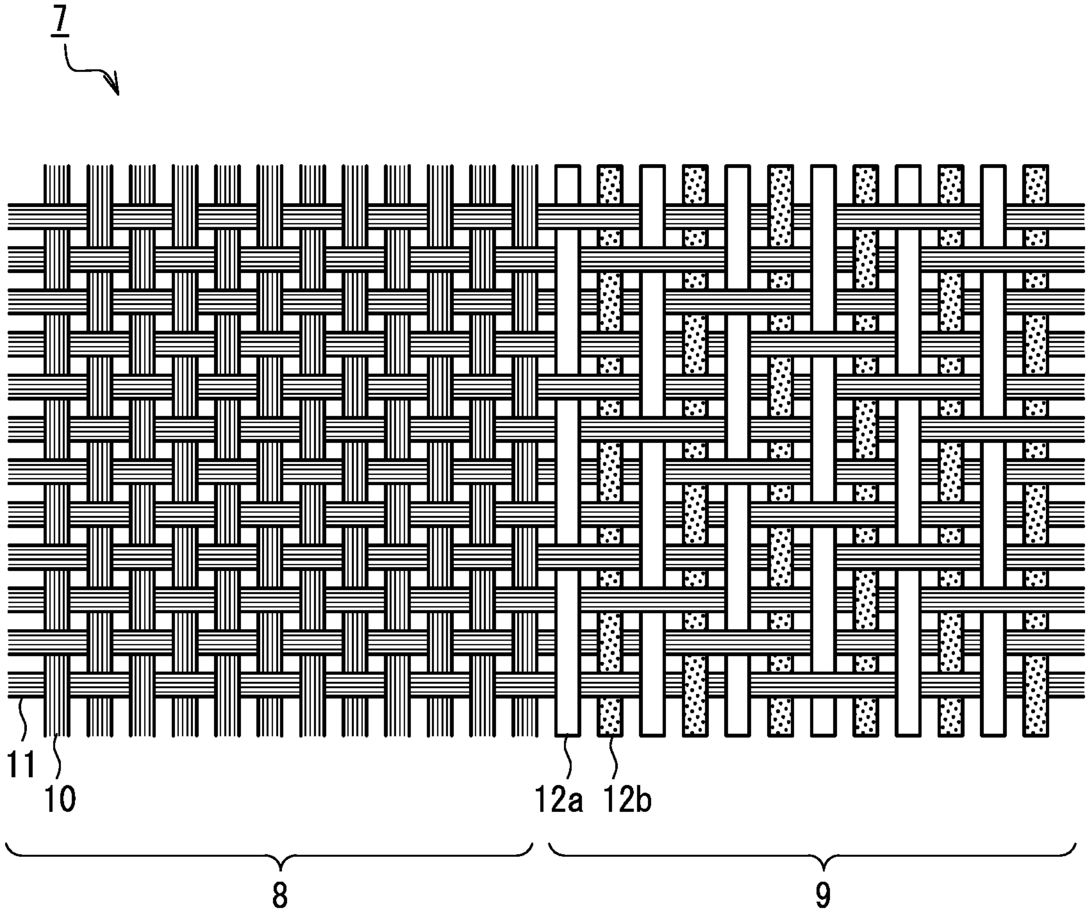


FIG. 2

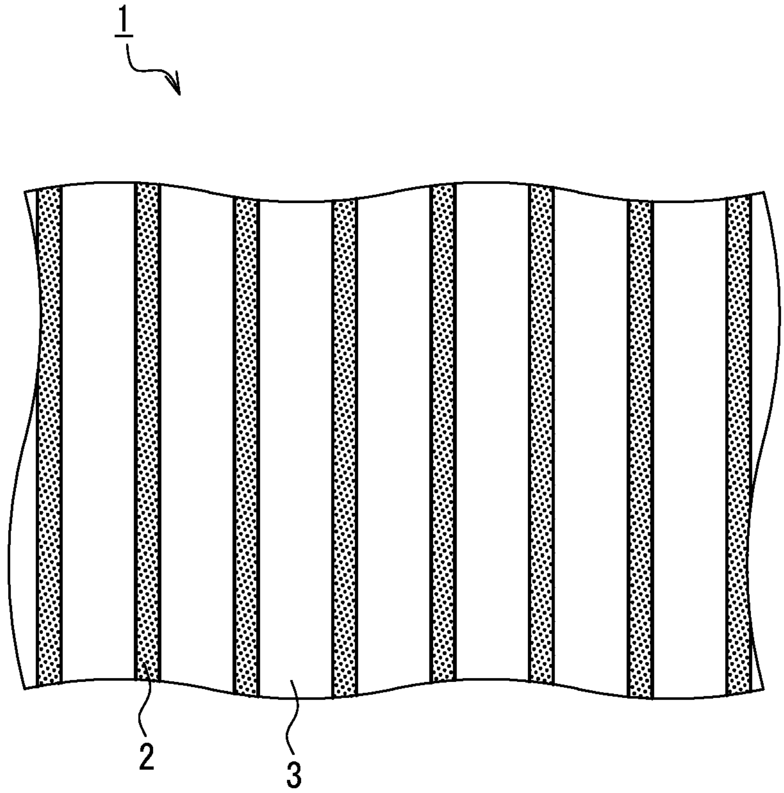


FIG. 3A

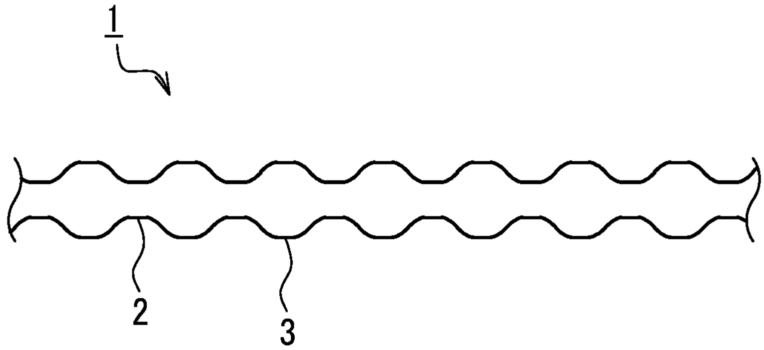


FIG. 3B

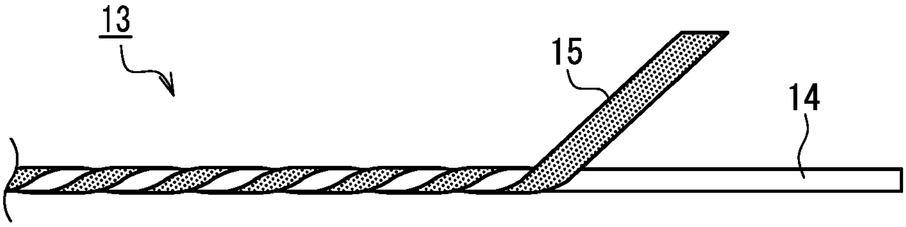


FIG. 4A

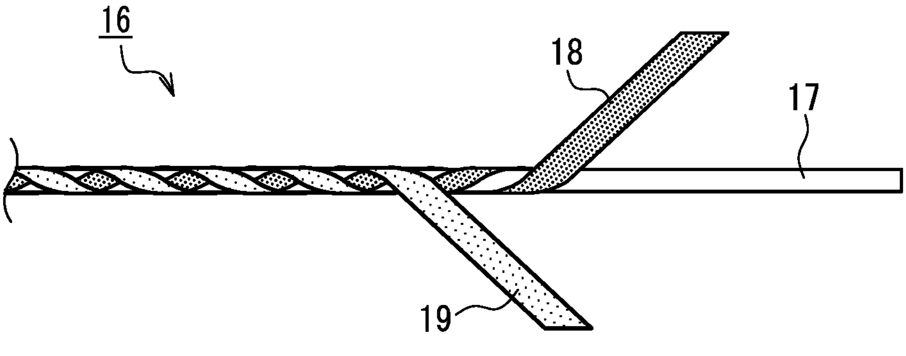


FIG. 4B

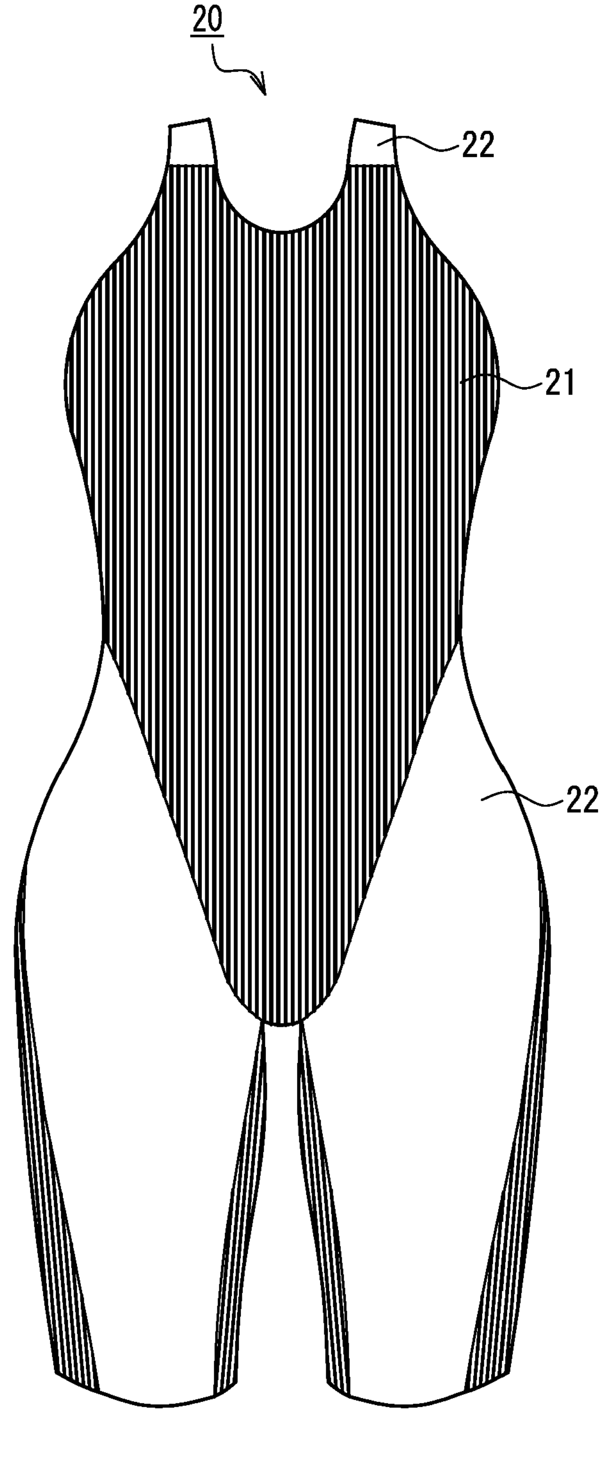


FIG. 5

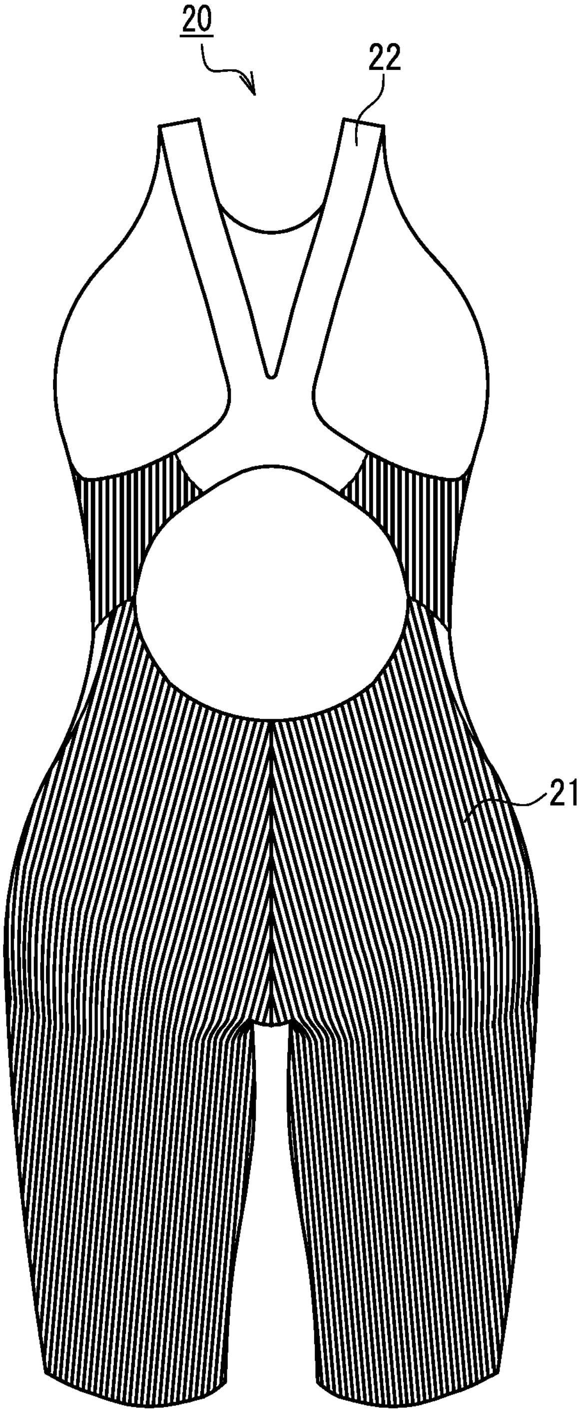


FIG. 6

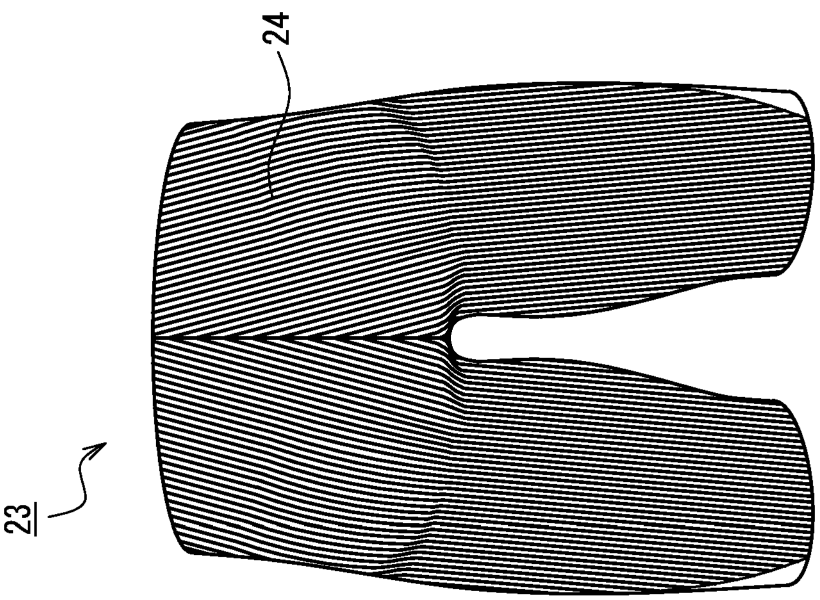


FIG. 7B

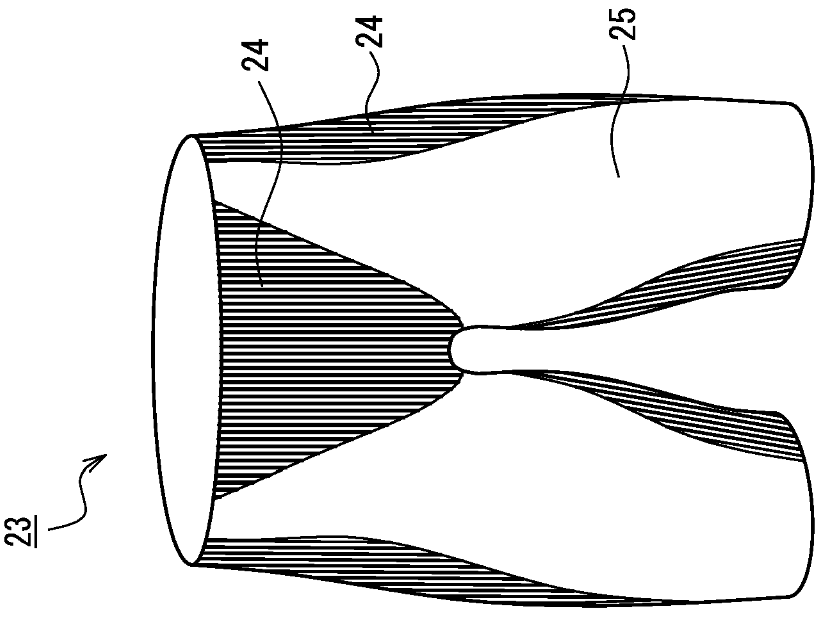


FIG. 7A

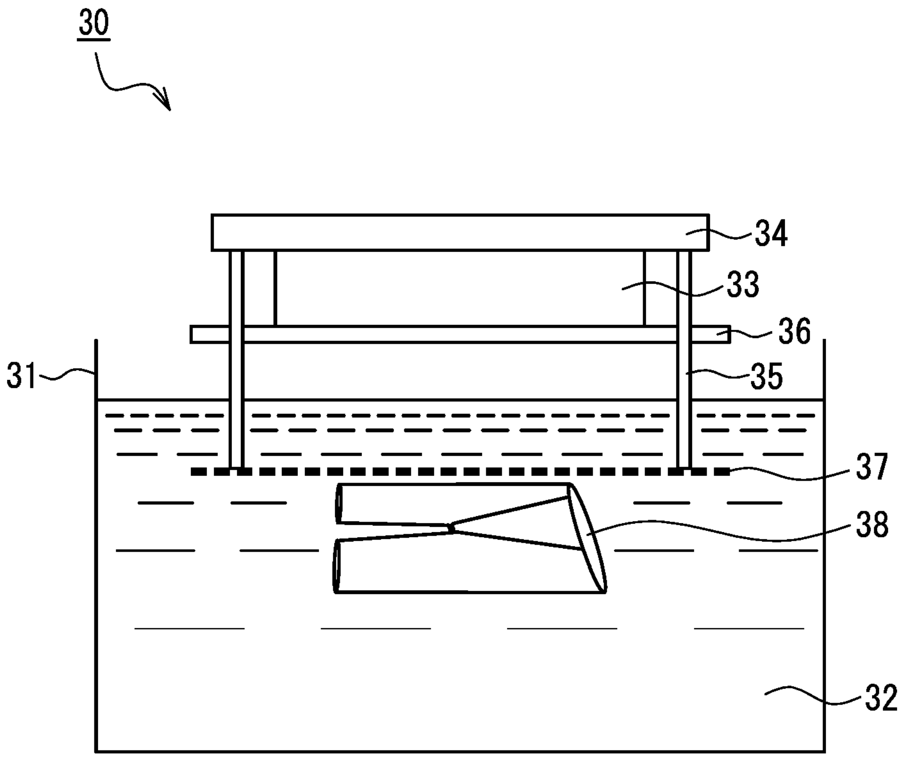


FIG. 8

REFERENCES CITED IN THE DESCRIPTION

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