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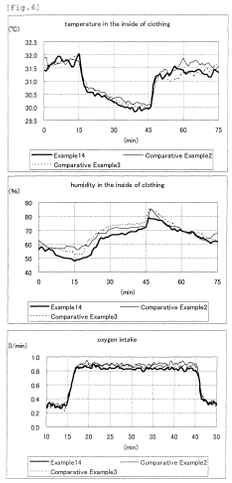
(54) FIBER HIGHLY COOL TO TOUCH

(57) It is the object of the invention to provide a fiber excellent in cool contact feeling which is excellent in hand and skin touch and capable of preventing unpleasant feeling in the wet state and a woven fabric, clothing, and underwear excellent in cool contact feeling and obtainable by using the fiber excellent in cool contact feeling.

The invention is a fiber excellent in cool contact feeling, which contains a thermoplastic elastomer and an inorganic filler.



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Description

TECHNICAL FIELD

[0001] The invention relates to a fiber excellent in cool contact feeling which is excellent in hand and skin touch and capable of preventing unpleasant feeling in the wet state and a woven fabric, clothing, and underwear excellent in cool contact feeling and obtainable by using the fiber excellent in cool contact feeling.

BACKGROUND ART

[0002] Recently, as underwear have been investigated those for summer using fibers excellent in cool contact feeling which can cause sensation of cool feeling at the time of wearing and give refreshing feeling.
Conventionally, methods of improving the water absorption property of fibers and methods of improving heat conductivity of fibers have been employed as a method of obtaining such fibers excellent in cool contact feeling.

[0003] The fibers comprising resins into which hydrophilic groups such as carboxyl and hydroxyl are introduced can be exemplified as the fibers having the improved water absorption property.
The fibers comprising resins in which fillers having high heat conductivity are kneaded and fibers subjected to surface coating treatment can be exemplified as the fibers having the improved heat conductivity.
However, in the case of using these fibers, although the cool touch feeling can theoretically be expected to be obtained, the fibers are scarcely distinguished from untreated ones in an actual sensory test by human being and cannot give them cool contact feeling.

[0004] Patent Document 1 discloses a fiber having cool contact feeling obtained by making the fiber retaining porous inorganic particles enclosing a water-absorbing polymer. The fiber has surely sensible cool contact feeling. However, it is required to add a large quantity of the porous inorganic particles to give sufficient cool contact feeling and accordingly, the hand and skin touch is adversely affected and thus the fiber cannot be used for underwear.
Patent Document 1: Japanese Kokai Publication 2002-235278

DISCLOSUER OF THE INVENTION

PROBLEMS WHICH THE INVENTION IS TO SOLVE

[0005] It is the object of the invention to provide a fiber excellent in cool contact feeling which can give sufficiently sensible cool contact feeling in a sensory test and is excellent in hand and skin touch and preferably usable for underwear and to provide a woven fabric, clothing, and underwear excellent in cool contact feeling and obtainable by using the fiber excellent in cool contact feeling.

MEANS FOR SOLVING THE OBJECT

[0006] The invention is a fiber which contains a thermoplastic elastomer and an inorganic filler.
Hereinafter, the invention will be descried more in detail.

[0007] The inventors have made various investigations and have found that a fiber obtained by spinning a thermoplastic elastomer is excellent in cool contact feeling in the case of using the fiber for clothing. However, in the case the fiber containing a thermoplastic elastomer is used for clothing, although the clothing are excellent in cool contact feeling, they become sticky or inferior in skin touch in the wet state owing to sweat and the like and therefore, in the case the fiber is used for clothing having direct contact with the skin such as underwear, it causes the new problem of unpleasant feeling. Therefore, the inventors have made further investigations and accordingly have found that addition of an inorganic filler to a fiber containing a thermoplastic elastomer makes it possible to prevent unpleasant feeling at the time of wetting in the case the fiber is used for clothing and to give excellent hand and skin touch and therefore the fiber is preferably usable for clothing particularly underwear, and accordingly have accomplished the invention.

[0008] The thermoplastic elastomer is not particularly limited, however a polyamide type elastomer and/or a polyester type elastomer is preferable.

[0009] The polyamide type elastomer is not particularly limited and examples are polyether block amide copolymers, polyether amide copolymers, and polyester amide copolymers. They may be used alone or two ore more of them may be used in combination.
Commercialized polyamide type elastomers among them are, for example, Pebax (manufactured by Arkema), UBE Nylon (manufactured by Ube Industries, Ltd.), Grilon ELX and Grilamid ELY (manufactured by Ems-Showa Denko KK), Daiamid and Vestamid (manufactured by Daicel-Degussa Ltd.).

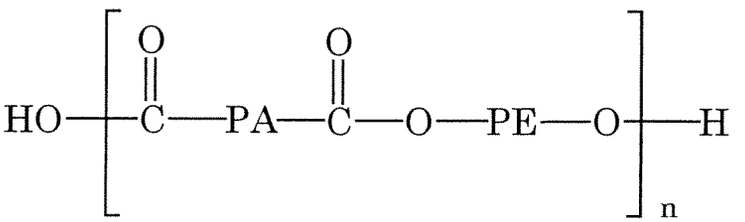
[0010] The polyester type elastomer is not particularly limited and examples are polyether ester copolymers and

polyester ester copolymers. They may be used alone or two ore more of them may be used in combination.
Commercialized polyester type elastomers among them are Grilux (manufactured by Dainippon Ink and Chemicals, Inc.), Nouvelan (manufactured by Teijin Chemicals Ltd.), Pelprene (manufactured by Toyobo Co., Ltd.), Hytrel (manufactured by Du porlt-Toray Co., Ltd.), and Primalloy (manufactured by Mitsubishi Chemical Corporation).

[0011] Among these thermoplastic elastomers, polyether block amide copolymers represented by the following formula (1) are particularly preferable since they are suitable for obtaining fibers remarkably excellent in cool contact feeling, excellent in spinning property, and suitable for producing a woven fabric, clothing and underwear which is light owing to having a light specific gravity. Commercialized products of such polyether block amide copolymers may be, for example, Pebax (manufactured by Arkema).

[0012]

[Chem. 1]



[0013] In the formula (1), PA represents polyamide and PE represents polyether.

[0014] As a resin component contained in the fiber excellent in cool contact feeling of the invention, the thermoplastic elastomers alone may be used, however, a fiber containing only a thermoplastic elastomer as the resin component generally has a sticky feeling and sometimes becomes difficult for spinning and therefore another resin may be used in combination with the thermoplastic elastomers.

[0015] The fiber excellent in cool contact feeling of the invention contains further an inorganic filler.
Addition of the inorganic filler forms very small roughness in the surface of the fiber and reforms the fiber surface, so that the sticky feeling, which is a characteristic of the thermoplastic elastomers in the wet state, can be prevented and in the case the fiber is used for clothing, the skin touch of the clothing in the case of putting on the skin and the releasing property at the time of taking off the clothing can remarkably improved. Further, since the sticky property of the fiber can be lowered, the spinning property at the time of producing raw yarns can be improved.
With respect to the fiber excellent in cool contact feeling of the invention, since the inorganic filler is added not for providing the cool contact feeling but for preventing the sticky feeling at the time of wetting, it need not add a large quantity of the inorganic filler and even if the fiber is used for clothing, the addition does not cause adverse effect on the hand and skin touch.

[0016] The inorganic filler is not particularly limited and examples may include mineral type pigments, such as calcium carbonate such as light calcium carbonate and heavy calcium carbonate, barium carbonate, magnesium carbonate such as basic magnesium carbonate, calcium sulfate, barium sulfate, titanium dioxide, iron oxide, tin oxide, titanium oxide, zinc oxide, magnesium oxide, ferrite powder, zinc sulfide, zinc carbonate, aluminum nitride, silicon nitride, Satin White, diatomaceous earth such as fired diatomaceous earth, calcium silicate, aluminum silicate, magnesium silicate, silica such as amorphous silica, amorphous synthesized silica, and colloidal silica, colloidal alumina, pseudo boehmite, aluminum hydroxide, magnesium hydroxide, alumina, hydrated alumina, litopon, zeolite, hydrated halloysite, clay, hydrotalcite, aluminosilicate, talc, pyrophyllite, smectite such as saponite, hectorite, sauconite, stevensite, montmorillonite, beidellite and nontromite, vermiculite, mica such as phologopite, biotie, zinnwaldite, muscovite, paragonite, celadonite and glauconite, clinochlore, chamosite, nimite, pennantite, sudoite, donbasite, clintonite, margarite, thulite, antigorite, lizardite, chrysotile, mesite, cronstedite, berthierine, greenalite, garnierite, kaorin such as kaolinite, dickite, nacrite and hallosite, delaminated kaolin, calcined kaolin, sepiolite, palygorskite, imogolite, allophane, hisingerite, penwithite, activated earth, bentonite, and sericite. They may be used alone or two or more kinds of them may be used in combination.
Preferable examples among them are titanium oxide, zinc oxide, barium oxide, and silica.
The form of the inorganic fillers is not particularly limited and examples are finite forms such as spherical, needle-like, plate type forms and the like, or nonfinite forms.

[0017] The preferable lower limit of an average particle diameter of the inorganic fillers is 0.20 μm, and the preferable upper limit of that is 3.00 μm. If the average particle diameter is less than 0.20 μm, the effect to improve the unpleasant feeling such as sticky feeling at the time of wetting sometimes becomes insufficient and if it is more than 3.00 μm, the hand and skin touch may possibly be deteriorated in the case the fiber is used for producing clothing or the strength of the fiber may be decreased in some cases.

[0018] The preferable lower limit of the content of the inorganic filler is 2% by weight, and the preferable upper limit of that is 30% by weight. And the more preferable upper limit is 7% by weight. If it is less than 2% by weight, the effect to improve the unpleasant feeling such as sticky feeling at the time of wetting sometimes becomes insufficient and if it is more than 30% by weight, the strength of the fiber may be decreased. And the spinning property may be decreased in some cases.

[0019] The fiber excellent in cool contact feeling of the invention may only comprise the fiber containing the thermoplastic elastomer and inorganic filler, however the fiber may be twisted with another fiber for improving the factors required for underwear such as skin touch within an extent that the aim of the invention is not inhibited.

Such another fiber is not particularly limited and examples are polyamide type resins such as nylon 6 and nylon 12; polyesters, cotton, and rayon.

[0020] The preferable lower limit of a q_{max} value of the fiber excellent in cool contact feeling of the invention is 0.20 J/sec/cm^2. If the q_{max} value is less than 0.20 J/sec/cm^2, most subjects do not feel cool contact feeling even if a sensory test is performed. The more preferable lower limit is 0.21 J/sec/cm^2 and the further preferable lower limit is 0.22 J/sec/cm^2.

In this description, the q_{max} value is defined as a peak value of the heat flow quantity of stored heat transferring to a sample at a lower temperature in the case a prescribed heat is stored in a heat plate with a specified surface area and a specified weight and immediately after the heat plate is brought into contact with the sample surface. It is supposed that the q_{max} value simulates the body heat removed from the body by the sample when clothing is put on and it is supposed that as the q_{max} value is higher, the body heat removed from the body is higher and the cool contact feeling is more excellent when the clothing is put on.

[0021] The preferable lower limit of the heat conductivity of the fiber excellent in cool contact feeling of the invention is 1×10^{-3}°C/W·m^2. The heat conductivity is also supposed to be one of important parameters to which the cool contact feeling is corresponding. If the heat conductivity is less than 1×10^{-3}°C/W·m^2, most subjects may not feel cool contact feeling even if a sensory test is performed.

In this description, the heat conductivity can be calculated by measuring the heat loss speed after a heat plate is layered on a sample put on a sample stand and the temperature of the heat plate is stabilized at a prescribed temperature and performing calculation by the following formula (2).

$$\text{Heat conductivity } (W/cm/℃) = W \cdot D/A/\Delta T \qquad (2)$$

W: heat flow quantity (J/sec)
D: thickness of a sample (cm)
A: heat plate surface area (cm^2)
ΔT: temperature difference (°C) between the sample stand and the heat plate

[0022] The preferable lower limit of the wet slippage starting angle of the fiber excellent in cool contact feeling of the invention is 20°, and the preferable upper limit of that is 25°. If the angle is less than 20°, the hand and skin touch may possibly be deteriorated and if it is more than 25°, the releasing property from the skin in the case the fiber is used for underwear may possibly be deteriorated. The wet slippage starting angle can be calculated by measuring the slippage starting angle by a gradient method according to JIS P 8147.

[0023] The preferable lower limit of the wet slippage resistance value of the fiber excellent in cool contact feeling of the invention is 1.28 CN/cm^2, and the preferable upper limit of that is 1.58 CN/cm^2. If it is less than 1.28 CN/cm^2, the hand and skin touch may possibly be deteriorated and if it is more than 1.58 CN/cm^2, the releasing property from the skin may possibly be deteriorated in the wet state. The wet slippage resistance value is the electrostatic resistance value in the wet state and can be measured by a gradient method according to JIS P 8147.

[0024] The fiber excellent in cool contact feeling of the invention may be used in form of a composite fiber comprising the thermoplastic elastomer and another resin and is particularly preferable to have a core-sheath structure and comprises a core part containing a dyeable resin and a sheath part containing a thermoplastic elastomer resin, a thickness of the sheath part being 20 μm or thinner (hereinafter referred to as a core-sheath type composite yarn in some cases).

[0025] The fiber excellent in cool contact feeling of the invention can be a fiber having the core-sheath structure having good dyeability, keeping excellent properties of the thermoplastic elastomer such as cool contact feeling by using such a dyeable resin for the core part and the thermoplastic elastomer having the cool contact feeling and excellent in the flexibility for the sheath part.

[0026] Generally, a thermoplastic elastomer has no dyeing sites necessary for dyeing or a very few if it has the dyeing sites and therefore, it has been difficult to dye it with an acidic dye or a cationic dye. To deal with such problems, a method of dyeing a thermoplastic elastomer such as polyurethane by using a disperse dye is disclosed in Japanese Kokai Publication 2003-247177. Also, various methods such as a method of making dyeing possible by introducing dyeing sites into a thermoplastic elastomer type resin, a method of coloring by coloring a raw material by adding an

inorganic type pigment to pellets of a thermoplastic elastomer type resin, and a method of making dyeing possible by blending a polyamide type resin with a polyamide type elastomer resin as the thermoplastic elastomer type resin, have been investigated. However, any method cannot sufficiently solve the dyeing problems.

[0027] On the contrary, in the case dyeing is carried out using the core-sheath type composite yarn, a dye permeates the sheath part containing the thermoplastic elastomer scarcely having the dyeing sites and dyes the core part containing the dyeable resin. Accordingly, in the case dyeing is carried out using the core-sheath type composite yarn, dyeing can be carried out preferably even with a dye such as an acidic dye or a cationic dye and as compared with a fiber using solely the thermoplastic elastomer, it exhibits excellent dyeability.

[0028] The core-sheath type composite yarn is preferable to contain a dyeable resin in the core part. The dyeable resin is not particularly limited if it can be dyed and is usable as a fiber and examples are polyamide type resins such as nylon 6, nylon 66, and nylon 12, polyester type resins such as PET, PBT, and PTT, rayon, acrylic resins and the like. Particularly preferable resins among them are polyamide type resins. They may be used alone or two or more of them may be used in combination.

[0029] With respect to the core-sheath type composite yarn, although it differs depending on the resin to be used, the preferable lower limit of the content of the dyeable resin in the core part is 5% by weight. If it is less than 5% by weight, the dyeability may possibly be decreased.

[0030] The core-sheath type composite yarn may contain various additives, based on the necessity, in the core part besides the dyeable resin. The additives are not particularly limited, and examples are an antioxidant, a preserver, an antistatic agent, a stabilizer, an oxidization preventing agent, a delustering agent, a light fastness improving agent, a lubricant, a fragrance, a plasticizer, a surfactant, and a flame retardant.

[0031] The core-sheath type composite yarn is preferable to contain the thermoplastic elastomer and inorganic filler in the sheath part.

With respect to the core-sheath type composite yarn, although it differs depending on the resin to be used, the preferable lower limit of the content of the thermoplastic elastomer in the sheath part is 15% by weight. If it is less than 15% by weight, the cool contact feeling may possibly be decreased.

[0032] The core-sheath type composite yarn may contain various additives, based on the necessity, in the sheath part besides the thermoplastic elastomer. The additives are not particularly limited, and examples are an antioxidant, a preserver, an antistatic agent, a stabilizer, an oxidization preventing agent, a delustering agent, a light fastness improving agent, a lubricant, a fragrance, a plasticizer, a surfactant, and a flame retardant.

[0033] The form of the core-sheath type composite yarn is not particularly limited and the crass-sectional shape formed in the case the fiber is cut perpendicularly to the longitudinal direction of the fiber may be true round, elliptical and the like. Also, the fiber may have a concentric core-sheath type structure in which the core part and sheath part are formed concentrically or an eccentric core-sheath type structure in which the core part and sheath part are formed eccentrically. Also, the fiber may have a structure in which multiple core parts exist in the case the fiber is cut perpendicularly to the longitudinal direction of the fiber.

[0034] In the core-sheath type composite yarn, the preferable upper limit of the thickness of the sheath part is 20 μm. If it is more than 20 μm, it becomes difficult for a dye to permeate the sheath part at the time of dyeing and the dyeability may possibly become insufficient. The preferable lower limit of the thickness of the sheath part is 2 μm. If it is less than 2 μm, the sheath part is too thin to exhibit the cool contact feeling effect.

[0035] In the case the fiber has the concentric core-sheath type structure in which the core part and sheath part are formed concentrically, the preferable lower limit of the ratio of the diameter of the core part and the thickness of the sheath part (core part/sheath part) is 5/20, and the preferable upper limit of that is 46/2. If it is less than 5/20, the rate of the sheath part is so high as to make the dyeability insufficient and if it is more than 46/2, cool contact feeling and flexibility may possibly be deteriorated.

[0036] The preferable lower limit of a q_{max} value of the core-sheath type composite yarn is 0.17 J/sec/cm^2. If the q_{max} value is less than 0.17 J/sec/cm^2, it is almost same as those of polyesters and nylon and most subjects may not feel cool contact feeling even if a sensory test is performed. The more preferable lower limit is 0.18 J/sec/cm^2 and further preferable 0.19 J/sec/cm^2.

[0037] The preferable lower limit of the heat conductivity of the core-sheath type composite yarn is 0.9×10^{-3}°C/W·m^2. If the heat conductivity is less than 0.9×10^{-3}°C/W·m^2, most subjects may not feel cool contact feeling even if a sensory test is performed.

[0038] A method of producing the fiber excellent in cool contact feeling of the invention is not particularly limited and conventionally known methods such as a method of producing it by producing resin pellets containing the thermoplastic elastomer and the inorganic filler and melting and spinning, using the obtained resin pellets, may be employed. The core-sheath type composite yarn may also be produced by, for example, loading resin pellets containing the dyeable resin, the thermoplastic elastomer, and the inorganic filler into a composite spinning apparatus and melting and spinning them.

[0039] The fiber excellent in cool contact feeling of the invention may be used in form of a woven fabric such as a

knit, a textile, and a bonded textile. The woven fabric excellent in cool contact feeling which is obtainable by using the fiber excellent in cool contact feeling of the invention also constitutes the invention.

The woven fabric excellent in cool contact feeling of the invention may solely comprise the fiber excellent in cool contact feeling of the invention and also comprise the fiber and another fiber twisted together for improving the factors required for underwear such as skin touch within an extent that the aim of the invention is not inhibited.

Such another fiber is not particularly limited and examples are polyamide type resins such as nylon 6 and nylon 12, polyesters, cotton, and rayon.

[0040] The fiber excellent in cool contact feeling of the invention and the woven fabric excellent in cool contact feeling of the invention are used for producing clothing, so that clothing preventing the unpleasant feeling at the time of wetting and excellent in the hand and skin touch can be produced. The clothing excellent in cool contact feeling also constitutes the invention.

Since the clothing excellent in cool contact feeling of the invention contains the thermoplastic elastomer, it can cause sensation of cool feeling at the time of wearing and give refreshing feeling. Also, addition of the inorganic filler makes the clothing free from sticky feeling at the time of wetting and excellent in hand and skin touch and suitable for underwear.

[0041] The clothing excellent in cool contact feeling of the invention may be produced using the fiber excellent in cool contact feeling entirely and it is particularly preferable to be clothing excellent in cool feeling comprising a woven fabric having a reversible structure and excellent in refreshing feeling, 30 to 70% by number of total loops comprising the fiber excellent in cool contact feeling, the loops comprising the fiber excellent in cool contact feeling being arranged in a skin contact side (hereinafter, also referred to as refreshing clothing).

[0042] With respect to the clothing comprising a woven fabric having a reversible structure as clothing excellent in cool contact feeling of the invention, the ratio of the number of loops comprising the fiber excellent in cool contact feeling is controlled within a prescribed range and such loops comprising the fiber excellent in cool contact feeling are arranged only in the skin contact side, so that the clothing can have an effect of preventing unpleasant feeling caused by much sweating.

[0043] In recent years, various kinds of clothing having improved functions as underwear to be put on in an occasion of sweating in summer, in the case of exercises, sports and the like, have been developed and proposed, and such functional clothing is suggested, for example, clothing produced from hydrophobic fibers such as polyester. Also, a method of increasing the air permeability by using a hydrophilic fiber in combination with cotton and a method of increasing the air permeability by forming a mesh structure for a cloth or by forming a moss knitting of a derivative weave of a plain knitting and warp knitting, have been investigated, and Japanese Kokai Publication 2003-155669 discloses a reformed cloth by depositing a hydrophilic chemical substance on the surface of a hydrophobic fiber composing the cloth. However, in the case of clothing comprising such hydrophobic fibers, although the generated heat can efficiently be released, it causes unpleasant feeling due to wet feeling in the case the skin or the clothing is wetted because of sweating and at the same time the woven fabric tends to be stuck to the skin to cause the problem that the clothing restrains the movement.

[0044] On the other hand, with respect to the refreshing clothing comprising the woven fabric having a reversible structure, it can cause sensation of cool feeling at the time of wearing and give refreshing feeling and simultaneously it can prevent unpleasant feeling due to wet feeling at the time of sweating and prevent sticking of the woven fabric to the skin due to deterioration of the separation from the skin by controlling the ratio of the number of loops comprising the fiber excellent in cool contact feeling to be within a prescribed range. Also, the loops comprising the fiber excellent in cool contact feeling are arranged only in the skin side, so that the fiber excellent in cool contact feeling can be brought into direct contact with the skin and clothing with further improved refreshing feeling and cool contact feeling can be produced.

[0045] In the refreshing clothing, the preferable lower limit of the ratio of the loops of the fiber excellent in cool contact feeling is 30% of the total number of loops, and the preferable upper limit of that is 70% of the total number of loops. If it is less than 30%, the effect to cause refreshing feeling and cool contact feeling becomes insufficient in some cases and if it is less than 70%, it causes unpleasant feeling due to wet feeling in the case the skin or the clothing is wetted because of sweating and at the same time the woven fabric tends to be stuck to the skin to cause the problem that the clothing restrains the movement. The more preferable lower limit is 33%, and the more preferable upper limit is 67%.

Also, in the case the skin side of the refreshing clothing comprises only loops of the fiber excellent in cool contact feeling, the preferable lower limit of the ratio of the loops of the fiber excellent in cool contact feeling is 50% of the total number of loops, and the preferable upper limit of that is 70% of the total number of loops, and in the case the skin side of that comprises the fiber excellent in cool contact feeling and a hydrophobic fiber, the preferable lower limit of the ratio of the loops of the fiber excellent in cool contact feeling is 30% of the total number of loops, and the preferable upper limit of that is 50% of the total number of loops.

Additionally, in the refreshing clothing, the fiber excellent in cool contact feeling is preferable to have a q_{max} value of 0.07 J/sec/cm^2 or more.

[0046] The refreshing clothing is preferable to contain the thermoplastic elastomer and inorganic filler.

In this case, among fibers containing the thermoplastic elastomer, fibers containing a resin mixture of a polyamide type

elastomer A whose hard segment is polyamide 12 and soft segment is polyethylene glycol and a polyamide type elastomer B whose hard segment is polyamide 12 and soft segment is polytetramethylene glycol provide extremely excellent cool contact feeling and are excellent in the damp-absorbing and desorbing property and diffusion property and therefore they are preferable.

Preferable examples as a fiber containing the thermoplastic elastomer are fibers containing 60% by weight or more of Pebax 1014 SA 01 (manufactured by ATOFINA Japan Co., Ltd.), which is a polyether block amide copolymer; fibers made porous and subjected to treatment for making the surface hydrophilic; and fibers with improved cool contact feeling by adding 1 to 5% by weight of an inorganic substance such as titanium oxide to synthetic fibers such as polyesters and nylon.

[0047] In the refreshing clothing, in the case the thickness of the woven fabric is to be made as thin as possible, the fiber excellent in cool contact feeling may be used in combination with another fiber. In this case, the preferable lower limit of the content of the thermoplastic elastomer in the fiber excellent in cool contact feeling is 50% by weight. If it is less than 50% by weight, sufficient cool contact feeling cannot be caused in some cases.

[0048] In the refreshing clothing, the loops comprising the fiber excellent in cool contact feeling are preferable to be arranged only in the skin side. Arrangement in such a manner makes the loops comprising the fiber excellent in cool contact feeling have mainly contact with the skin and causes the cool contact feeling and refreshing feeling, and as described later, arrangement of loops comprising a hydrophobic fiber in the outside improves the diffusion and evaporating property of the heat and water emitted from the skin.

[0049] In the refreshing clothing, the loops other than the loops comprising the fiber excellent in cool contact feeling are preferably the loops comprising a hydrophobic fiber.

In the refreshing clothing, as described, since the loops comprising the fiber excellent in cool contact feeling are arranged only in the skin side, the loops comprising a hydrophobic fiber are arranged mainly in the outside. Accordingly, the sweat evaporation is promoted and the generated heat can emitted efficiently.

[0050] In this description, the hydrophobic fiber means a chemical fiber having a official water percentage of 5.0% or less. Practically, fibers comprising polypropylenes (official water percentage: 0%), polyesters (0.4%), acrylic resins (2.0%), nylon (4.5%), and vinylon (5.0%) can be exemplified. They may be used alone or two or more kinds of them may be used in combination. In this connection, the official water percentage means water percentage at 20˚C and 65% RH.

[0051] The refreshing clothing may contain natural fibers such as cotton and flax, and semi-synthesized fibers such as rayon and acetate based on the necessity besides the fiber excellent in cool contact feeling and the hydrophobic fiber.

[0052] Fig. 1 shows a schematic view of one example of the refreshing clothing. Fig. 1(a) is a plane view observing the refreshing clothing from the skin side and Fig. 1(b) is a cross-sectional view in which the outside is set upper and the skin side is set lower.

As shown in Fig. 1, the refreshing clothing 11 is composed of the part 12 formed by weaving the fiber excellent in cool contact feeling and the part 13 formed by weaving the hydrophobic fiber and the part 12 formed by weaving the fiber excellent in cool contact feeling has a linear form which alternately has a rectangular part. The part formed by weaving the fiber excellent in cool contact feeling means the part having loops comprising the fiber excellent in cool contact feeling and the part formed by weaving the hydrophobic fiber means the part having no loop comprising the fiber excellent in cool contact feeling but having only loops comprising the hydrophobic fiber.

The part 12 formed by weaving the fiber excellent in cool contact feeling is arranged only in the skin side (lower side) and in the case the refreshing clothing is put on, the part 12 formed by weaving the fiber excellent in cool contact feeling is mainly to be brought into contact with the skin.

[0053] Fig. 2 shows a schematic view of another example of the refreshing clothing. Fig. 2(a) is a plane view observing the refreshing clothing from the skin side and Fig. 2(b) is a cross-sectional view in which the outside is set upper and the skin side is set lower.

As shown in Fig. 2, the refreshing clothing 21 is composed of the part 22 formed by weaving the fiber excellent in cool contact feeling and the part 23 formed by weaving the hydrophobic fiber. And the part 22 formed by weaving the fiber excellent in cool contact feeling is arranged only in the skin side (lower side) and in the case the refreshing clothing is put on, the part 22 formed by weaving the fiber excellent in cool contact feeling is mainly to be brought into contact with the skin.

[0054] Fig. 3 is a schematic view showing the flow of heat and steam emitted from the skin in the case the refreshing clothing is put on.

As shown in Fig. 3, heat and steam emitted from the skin at first pass the part 12 formed by weaving the fiber excellent in cool contact feeling and at that time the fiber excellent in cool contact feeling absorbs the heat and steam. The heat and water which are not absorbed by the fiber excellent in cool contact feeling are diffused by passing the part 13 formed by weaving the hydrophobic fiber and then released and evaporated outside. Fig. 3 shows only a portion having both of the part formed by weaving the fiber excellent in cool contact feeling and the part formed by weaving the hydrophobic fiber, however in a portion having only the part formed by weaving the hydrophobic fiber, the heat and steam emitted

from the skin are diffused and successively released and evaporated outside.
In the refreshing clothing, since the ratio of the portion having both of the part formed by weaving the fiber excellent in cool contact feeling and the part formed by weaving the hydrophobic fiber is controlled within a proper range, it can cause sensation of cool feeling and refreshing feeling at the time of wearing and simultaneously it can prevent unpleasant feeling due to wet feeling at the time of sweating and prevent sticking of the woven fabric to the skin due to deterioration of the separation from the skin.

[0055] The preferable lower limit of the air permeability of the refreshing clothing is 200 $cm^3/cm^2/sec$, and the preferable upper limit of that is 500 $cm^3/cm^2/sec$. If it is less than 200 $cm^3/cm^2/sec$, the air permeability is deteriorated and the diffusion of heat and evaporation of sweat emitted from the skin may possibly be inhibited and if it is more than 500 $cm^3/cm^2/sec$, transfer of the heat and water through the clothing cannot be carried out sufficiently and contrarily the outer air may penetrate.
The air permeability can be measured by using a fragile type air permeability tester according to JIS L 1096 A method.

[0056] In the refreshing clothing, the preferable lower limit of the weight per square-meter is 90 g/m^2 and the preferable upper limit of that is 200 g/m^2. If it is less than 90 g/m^2, the heat and water transfer becomes difficult and the refreshing effect may possibly be deteriorated and if it is more than 200 g/m^2, the cooling feeling may possibly be deteriorated because of increase of the weight and the heat transmission resistance.

[0057] The woven fabric having with the reversible structure can be produced by using a rib stitch machine and the like, adjusting the quantity of weaving needles in forming loops. Practically, it can be produced by the method of weaving while adjusting the number of the weaving needles for forming the loops of the fiber excellent in cool contact feeling to be 30 to 70%.

[0058] A method of producing the clothing excellent in cool contact feeling of the invention is not particularly limited and for example, conventionally known methods such as a method of producing clothing by weaving the fiber excellent in cool contact feeling of the invention can be employed.
Also, the refreshing clothing can be produced by the conventionally known methods of sewing, cutting and the like, using the woven fabrics with the reversible structure obtained by the above-mentioned manner.

[0059] Underwear excellent in cool contact feeling can be produced by using the fiber excellent in cool contact feeling of the invention or the woven fabric excellent in cool contact feeling of the invention. Also, the clothing excellent in cool contact feeling of the invention can be used as underwear.
The underwear excellent in cool contact feeling also constitutes the invention.

[0060] Since the underwear excellent in cool contact feeling of the invention contains the thermoplastic elastomer, it can cause sensation of cool feeling at the time of wearing and give refreshing feeling. Also, since the underwear contains the inorganic filler, it does not cause sticky feeling at the time of wetting and is excellent in the hand and skin touch. The underwear excellent in cool contact feeling of the invention is brought into direct contact with the skin and therefore, it can cause a particularly excellent effect.

[0061] Besides the underwear excellent in cool contact feeling of the invention, stockings, gloves, face masks, mufflers and the like can be produced by using the fiber excellent in cool contact feeling of the invention or the woven fabric excellent in cool contact feeling of the invention. They are brought into direct contact with the skin and therefore, they can cause a particularly excellent effect.

EFFECT OF THE INVENTION

[0062] According to the invention, a fiber excellent in cool contact feeling which is excellent in hand and skin touch and capable of preventing unpleasant feeling in the wet state and a woven fabric, clothing, and underwear excellent in cool contact feeling and obtainable by using the fiber excellent in cool contact feeling can be provided.

BEST MODE FOR CARRYING OUT THE INVENTION

[0063] Hereinafter, the invention will be described more in detail with reference to examples, however it is not intended that the invention be limited to these examples.

(Example 1)

[0064] After 2% by weight of titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was added to 98% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema), which is a thermoplastic polyamide type elastomer, the mixture was melted and mixed and palletized by a pelletizer to obtain resin pellets.
Next, using obtained resin pellets, a raw yarn was obtained by spinning by a melt spinning method. The obtained yarn was woven to produce a woven fabric.

(Example 2)

[0065] A woven fabric was produced in the same manner as Example 1, except the addition amount of the titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was 4% by weight and the addition amount of the polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema) was 96% by weight.

(Example 3)

[0066] A woven fabric was produced in the same manner as Example 1, except the addition amount of the titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was 6% by weight and the addition amount of the polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema) was 94% by weight.

(Example 4)

[0067] After 2% by weight of titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was added to 98% by weight of a polyether ether copolymer (Hytrel 8171, manufactured by Du pont-Toray Co., Ltd.), which is a thermoplastic polyamide type elastomer, the mixture was melted and mixed and palletized by a pelletizer to obtain resin pellets.
Next, using obtained resin pellets, a raw yarn was obtained by spinning by a melt spinning method. The obtained yarn was woven to produce a woven fabric.

(Example 5)

[0068] After 2% by weight of barium sulfate (B-30NC, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.3 μm) was added to 98% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema), which is a thermoplastic polyamide type elastomer, the mixture was melted and mixed and palletized by a pelletizer to obtain resin pellets.
Next, using obtained resin pellets, a raw yarn was obtained by spinning by a melt spinning method. The obtained yarn was woven to produce a woven fabric.

(Example 6)

[0069] After 2% by weight of zinc oxide (fine zinc flower, manufactured by The Honjo Chemical Corporation; average particle diameter 0.3 μm) was added to 98% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema), which is a thermoplastic polyamide type elastomer, the mixture was melted and mixed and palletized by a pelletizer to obtain resin pellets.
Next, using obtained resin pellets, a raw yarn was obtained by spinning by a melt spinning method. The obtained yarn was woven to produce a woven fabric.

(Example 7)

[0070] After 2% by weight of silica particles (Excelica SH-03, manufactured by Tokuyama Corp.; average particle diameter 0.2 μm) was added to 98% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema), which is a thermoplastic polyamide type elastomer, the mixture was melted and mixed and palletized by a pelletizer to obtain resin pellets.
Next, using obtained resin pellets, a raw yarn was obtained by spinning by a melt spinning method. The obtained yarn was woven to produce a woven fabric.

(Example 8)

[0071] After 30% by weight of ferrite powder (average particle diameter 0.88 μm) was added to 70% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema), which is a thermoplastic polyamide type elastomer, the mixture was melted and mixed and palletized by a pelletizer to obtain resin pellets.
Next, using obtained resin pellets, a raw yarn was obtained by spinning by a melt spinning method. The obtained yarn was woven to produce a woven fabric.

(Comparative Example 1)

[0072] Using pellets of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema), which is a thermoplastic polyamide type elastomer, a raw yarn was obtained by spinning by a melt spinning method. The obtained yarn was woven to produce a woven fabric.

(Evaluation)

[0073] The woven fabrics obtained in Examples 1 to 8 and Comparative Example 1 were evaluated by the following methods. The results are shown in Table 1.

[0074]

(1) Measurement of the wet slippage starting angle
The wet slippage starting angle was measured by a gradient method according to JIS P 8147.
Practically, a slide was inclined at a raising speed of 2˚/s and a weight with 93.37 g was used, and the gradient angle at the moment when the weight to which each wet sample was attached, started moving was measured.

[0075]

(2) Measurement of wet slippage resistance
The wet slippage starting angle was measured by a gradient method according to JIS P 8147.
Practically, a slide was inclined at a raising speed of 2˚/s and a weight with 93.37 g was used and the static friction resistance value at the moment when the weight to which each wet sample was attached started moving was measured.

[0076]

(3) Measurement of q_{max} value
Each woven fabric was put on a sample stand set at 20.5˚C and immediately after a heat plate heated at 32.5˚C was overlapped on the fabric with a contact pressure of 0.098 N/cm^2, the peak value of the heat quantity of the stored heat transferred to the sample fabric at a lower temperature was measured. THERMO LABO II type Precise and Prompt Thermal-Property Measuring Instrument (manufactured by Kato Tech. Co. Ltd.) was employed for the measurement.

(4) Measurement of heat conductivity

[0077] Each woven fabric was put on a sample stand set at 20.5˚C and a heat plate heated was overlapped on the fabric with a contact pressure of 0.059 N/cm^2 and the temperature of the heat plate was adjusted and stabilized at 32.5˚C. The heat loss speed at the time when the heat plate temperature was stabilized at a prescribed temperature was measured by THERMO LABO II type Precise and Prompt Thermal-Property Measuring Instrument (manufactured by Kato Tech. Co. Ltd.). The heat conductivity was calculated from the measured value.

(5) Spinning property

[0078] The number of disconnection of filament in the extrusion, drawing, and thermosetting steps was counted in the case the resin pellets used for Examples and Comparative Examples were continuously melted and spun for 24 hours and the spinning property was evaluated based on the following criteria.
◎: the number of disconnection of filaments was 0 time
○: the number of disconnection of filaments was 1 to 3 times
Δ: the number of disconnection of filaments was 4 times or more

(6) Sensory test

[0079] A sensory test was carried out by 10 subjects for cool contact feeling at the moment of touching each woven fabric and the separation of the woven fabric from the skin when the fabric was slipped on the skin and the evaluation was carried out based on the following criteria. Also, ◎ was scored at 3 point, ○ was scored at 2 point, Δ was scored at 1 point, and × was scored at 0 point and the total points of 10 subjects were calculated to give the evaluation points.
◎: cool and the separation of the fabric from the skin was good in both dry and wet states:

○: cool but the separation of the fabric from the skin was ordinary in both dry and wet states;
Δ: cool but the separation of the fabric from the skin was inferior in wet state; and
x: cool but the separation of the fabric from the skin was inferior.

[0080]

[Table 1]

	Slippage starting angle (degree)	Wet slippage resistance value (CN/cm^2)	q_{max} value ($J/s/cm^2$)	Heat conductivity ($W/cm/^{\circ}C \times 10^{-3}$)	Spinning property	Sensory test										
						evaluation by subjects										evaluation points
Example1	24	1.52	0.215	1.11	◎	◎	○	△	△	○	◎	△	△	○	△	17
Example2	24	1.52	0.210	1.04	◎	◎	◎	○	○	○	◎	△	○	◎	△	23
Example3	22	1.40	0.206	1.01	◎	◎	◎	◎	○	○	◎	◎	○	◎	○	26
Example4	24	1.52	0.211	1.03	◎	◎	◎	△	△	○	○	△	△	△	○	17
Example5	25	1.58	0.203	1.01	◎	○	○	△	△	○	○	△	△	○	○	16
Example6	24	1.52	0.211	1.03	◎	○	○	○	△	○	△	△	△	○	○	16
Example7	23	1.46	0.214	1.08	◎	○	○	○	△	○	△	△	△	○	○	16
Example8	20	1.28	0.220	0.99	○	◎	◎	○	○	◎	○	◎	○	◎	◎	26
Comparative Example1	28	1.75	0.212	1.06	△	○	○	△	△	△	△	△	×	○	△	11

[0081] As shown in Table 1, the woven fabrics using raw yarns containing the thermoplastic elastomers and inorganic fillers produced in Examples 1 to 8 were found having high q_{max} value and heat conductivity and therefore excellent in cool contact feeling and having not so high wet slippage resistance values, so that in the case they were used for clothing, the separation from the skin in wet state was good.
On the other hand, the woven fabric using raw yarns produced in Comparative Example 1 was found having high q_{max} value and heat conductivity and therefore excellent in cool contact feeling, however it was also found having so high wet slippage resistance value to deteriorate the separation from the skin in wet state in the case it was used for clothing.

(Example 9)

[0082] As a resin for a core part, 85% by weight of nylon 12 (UBESTA 3014U, manufactured by Ube Industries, Ltd.), which is a polyamide resin, and as a resin for a sheath part, 15% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema) to which 5% by weight of titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was added were loaded to a composite spinning apparatus and spinning was carried out by a melt spinning method to obtain a core-sheath type composite yarn with a diameter of 50 μm. The cross-section of the obtained core-sheath type composite yarn was photographed by an electron microscope and the thickness of the sheath part was measured to find it was 2 μm.
The obtained core-sheath type composite yarn was woven to obtain a woven fabric.

(Example 10)

[0083] As a resin for a core part, 65% by weight of nylon 12 (UBESTA 3014U, manufactured by Ube Industries, Ltd.), which is a polyamide resin, and as a resin for a sheath part, 35% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema) to which 5% by weight of titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was added were loaded to a composite spinning apparatus and spinning was carried out by a melt spinning method to obtain a core-sheath type composite yarn with a diameter of 50 μm. The cross-section of the obtained core-sheath type composite yarn was photographed by an electron microscope and the thickness of the sheath part was measured to find it was 5 μm.
The obtained core-sheath type composite yarn was woven to obtain a woven fabric.

(Example 11)

[0084] As a resin for a core part, 50% by weight of nylon 12 (UBESTA 3014U, manufactured by Ube Industries, Ltd.), which is a polyamide resin, and as a resin for a sheath part, 50% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema) to which 5% by weight of titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was added were loaded to a composite spinning apparatus and spinning was carried out by a melt spinning method to obtain a core-sheath type composite yarn with a diameter of 50 μm. The cross-section of the obtained core-sheath type composite yarn was photographed by an electron microscope and the thickness of the sheath part was measured to find it was 7 μm.
The obtained core-sheath type composite yarn was woven to obtain a woven fabric.

(Example 12)

[0085] As a resin for a core part, 35% by weight of nylon 12 (UBESTA 3014U, manufactured by Ube Industries, Ltd.), which is a polyamide resin, and as a resin for a sheath part, 65% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema) to which 5% by weight of titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was added were loaded to a composite spinning apparatus and spinning was carried out by a melt spinning method to obtain a core-sheath type composite yarn with a diameter of 50 μm. The cross-section of the obtained core-sheath type composite yarn was photographed by an electron microscope and the thickness of the sheath part was measured to find it was 10 μm.
The obtained core-sheath type composite yarn was woven to obtain a woven fabric.

(Example 13)

[0086] As a resin for a core part, 5% by weight of nylon 12 (UBESTA 3014U, manufactured by Ube Industries, Ltd.), which is a polyamide resin, and as a resin for a sheath part, 95% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema) to which 5% by weight of titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was added were loaded to a composite spinning apparatus and

spinning was carried out by a melt spinning method to obtain a core-sheath type composite yarn with a diameter of 50 μm. The cross-section of the obtained core-sheath type composite yarn was photographed by an electron microscope and the thickness of the sheath part was measured to find it was 20 μm.
The obtained core-sheath type composite yarn was woven to obtain a woven fabric.

[0087] Hereinafter, to make it clear that it is possible to produce woven fabrics excellent in the dyeability because the core-sheath type composite yarns obtained in Examples 9 to 13 have a prescribed core-sheath structure, Experimental Examples of woven fabrics obtainable by using the fiber excellent in cool contact feeling of the invention but having no prescribed core-sheath structure will be shown.

(Experimental Example 1)

[0088] Using a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema) to which to which 5% by weight of titanium titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was added, spinning was carried out by a melt spinning method, and a raw yarn was obtained. The raw yarn was woven to obtain a woven fabric.

(Experimental Example 2)

[0089] As a resin for a core part, 3% by weight of nylon 12 (UBESTA 3014U, manufactured by Ube Industries, Ltd.), which is a polyamide resin, and as a resin for a sheath part, 97% by weight of a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema) to which 5% by weight of titanium titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) was added were loaded to a composite spinning apparatus and spinning was carried out by a melt spinning method to obtain a core-sheath type composite yarn with a diameter of 60 μm.
The cross-section of the obtained core-sheath type composite yarn was photographed by an electron microscope and the thickness of the sheath part was measured to find it was 25 μm.
The obtained core-sheath type composite yarn was woven to obtain a woven fabric.

(Evaluation)

[0090] The woven fabrics obtained in Examples 9 to 13 and Experimental Examples 1 and 2 were dyed with an acidic dye (Nylosan, manufactured by Clariant Japan K.K.) and evaluations were carried out by the following methods. The results are shown in Table 2.

(1) Dyeability

[0091] After each woven fabric was dyed and the clearness was evaluated by 5 subjects with eye observation and compared. The results were comprehensively determined and evaluated according to the following four grades.
◎: clearness and evenness are very good
○: clearness is good
△: clearness is inferior
×: clearness is bad

(2) Measurement of q_{max} value

[0092] Each woven fabric was put on a sample stand set at 20.5˚C and immediately after a heat plate heated at 32.5˚C was overlapped on the fabric with a contact pressure of 0.098 N/cm^2, the peak value of the heat quantity of the stored heat transferred to the sample fabric at a lower temperature was measured. THERMO LABO II type Precise and Prompt Thermal-Property Measuring Instrument (manufactured by Kato Tech. Co. Ltd.) was employed for the measurement.

(3) Measurement of heat conductivity

[0093] Each woven fabric was put on a sample stand set at 20.5˚C and a heat plate heated was overlapped on the fabric with a contact pressure of 0.059 N/cm^2 and the temperature of the heat plate was adjusted and stabilized at 32.5˚C. The heat loss speed at the time when the heat plate temperature was stabilized at a prescribed temperature was measured by THERMO LABO II type Precise and Prompt Thermal-Property Measuring Instrument (manufactured by Kato Tech. Co. Ltd.). The heat conductivity was calculated from the measured value.

[0094]

[Table 2]

	Thickness of sheath part (μm)	Dyeability	q_{max} value (J/s/cm^2)	Heat conductivity (W/cm/°C×10^{-3})
Example9	2	◎	0.173	0.91
Example 10	5	◎	0.180	0.93
Example 11	10	◎	0.187	0.96
Example 12	15	○	0.192	0.98
Examplw13	20	○	0.215	1.11
Experimental Example1	no core part	×	0.256	1.29
Experimental Example2	25	Δ	0.225	1.08

(Example 14)

[0095] While a fiber excellent in cool contact feeling containing a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema), which is a thermoplastic polyamide type elastomer, and titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) as an inorganic filler was arranged only in the skin side and a polyester fiber (Technofine, manufactured by Asahi Chemical Industry Co., Ltd.), which is a hydrophilic fiber, was arranged mainly in the outside, the fibers were woven to produce a woven fabric having the reversible structure according to the structure drawing 1 as shown in Fig. 4 by a rib stitch machine and a T-shirt was produced using it.
In the obtained T-shirt, the number of loops comprising the fiber excellent in cool contact feeling was 50% of the total number of the loops and the number of loops comprising the hydrophobic fiber was 50% of the total number of the loops. The ratio of the loops of the hydrophobic fiber was 100% in the outside of the T-shirt and the ratio of the loops comprising the fiber excellent in cool contact feeling was 100% in the skin side. Further, the weight per square-meter of the obtained T-shirt was 184 g/m^2.
The air permeability of the obtained T-shirt was measured according to JIS L 1096A by using a fragile type air permeability tester (TEXTIEL AIR PERMEABILITY TESTER, manufactured by Yamaguchi Kagaku Sangyo Co., Ltd.) to find it was 326 cm^3/m^2/sec.

(Example 15)

[0096] A fiber excellent in cool contact feeling containing a polyether block amide copolymer (Pebax 1041SA01, manufactured by Arkema), which is a thermoplastic polyamide type elastomer and titanium oxide (D918, manufactured by Sakai Chemical Industry Co., Ltd.; average particle diameter 0.26 μm) as an inorganic filler to compose the loops of the skin side and a polyester fiber (Technofine, manufactured by Asahi Chemical Industry Co., Ltd.), to compose the loops of the outside were woven to produced a woven fabric having the reversible structure according to the structure drawing 2 as shown in Fig. 5 by a rib stitch machine and a T-shirt was produced using it.
In the obtained T-shirt, the number of loops comprising the fiber excellent in cool contact feeling was 33.3% of the total number of the loops and the number of loops comprising the hydrophobic fiber was 66.7% of the total number of the loops. The ratio of the loops comprising the hydrophobic fiber was 100% in the outside of the T-shirt and the ratio of the loops comprising the fiber excellent in cool contact feeling was 50% and the ratio of the loops of the hydrophobic fiber was 50% in the skin side. Further, the weight per square-meter of the obtained T-shirt was 152 g/m^2.
The air permeability of the obtained T-shirt was measured by the same method as Example 14 to find it was 397.6 cm^3/m^2/sec.

(Comparative Example 2)

[0097] A commercialized polyester fiber (Sophista, manufactured by KURARAY Co., Ltd.) whose surface was made hydrophilic was woven into a mesh-like woven fabric by warp knitting to produce T-shirt(manufactured by MIZUNO), and the T-shirt was used.

(Comparative Example 3)

[0098] A T-shirt obtained by plain weaving using a commercialized cotton, was used.

(Evaluation)

[0099] The T-shirts obtained in Examples 14 and 15 and Comparative Examples 2 and 3 were evaluated by the following methods.

(1) Evaluation in environment control room

[0100] Simulating early morning walking in summer, subjects put on the T-shirts obtained in Example 14 and Comparative Examples 2 ad 3 a environment control room in 28˚Cx65% RH environments, sit still on a chair for 15 minutes, walked for 30 minutes in a tread mill while frontward being blown with a wind at 1 m/sec velocity, and successively sit still on a chair for 30 minutes for recovery and the temperature fluctuation in the inside of the clothing, the humidity fluctuation in the inside of the clothing, and the oxygen intake were measured. The results are shown in Fig. 6.
The measurement was carried out for 6 healthy male adults and the average values are shown.
From Fig. 6, it was found that increase of the temperature and the humidity in the inside of the clothing in the case the T-shirt of Example 14 was put on was suppressed as compared with those in the case the T-shirts produced in Com-

parative Examples 2 and 3 were put on. Also, the oxygen intake during the walking in the case the T-shirt of Example 14 was put on was also suppressed to low as compared with those in the case the T-shirts produced in Comparative Examples 2 and 3 were put on. It is supposed that since the T-shirt produced in Example 14 brought comfortable inner environments of the clothing as compared with the T-shirts produced in Comparative Examples 2 and 3, the exercise load was lessened and the exercise could be performed with lessened energy consumption.

(2) Sensory evaluation 1

[0101] A sensory evaluation was carried out by subjects in a manner that the subjects putting on the T-shirt obtained in Example 14 and the T-shirt obtained in Comparative Example 2 participated the family walking event (hosted by Kyoto Walking Kyokai) held in July 2004 in Kyoto city and later answered to questionnaires as compared with commonly wearing T-shirts. The results are shown in Fig. 7. The sensory evaluation was carried out by 9 healthy male adults and the average values are shown.
The measurements of temperature in the rectum and temperature in the inside of the clothing were also carried out by 2 subjects among the 9 subjects by whom the sensory evaluation was carried out. The results are shown in Fig. 7.
As being made clear from Fig. 7, it was found that the T-shirt produced in Example 14 was evaluated highly in all items as compared with the commonly wearing T-shirts and was particularly excellent in the easiness for moving and the skin touch. On the other hand, the T-shirt produced in Comparative Example 2 was evaluated to be inferior in the sweat absorbing property and the separation from the skin at the time of sweating. Also, in the case the T-shirt produced in Example 14 was put on, the temperature in the rectum and the temperature in the inside of the clothing were both lower than those in the case of the T-shirt produced in Comparative Example 2 was put on.

(3) Sensory evaluation 2

[0102] A sensory evaluation was carried out by male university students belonging in an athletic club in a manner that the students putting on the T-shirt produced in Example 15 and Comparative Example 2 did running on November 2004 and later answered to questionnaires as compared with commonly wearing T-shirts. The results are shown in Fig. 8. The sensory evaluation was carried out by 29 students and the average values are shown.
From Fig. 8, it was found that the T-shirt produced in Example 15 gained the highest scores in all 13 items and the scores in 11 items among them significantly exceeded those of the T-shirt produced in Comparative Example 2. Particularly, the T-shirt produced in Example 15 was evaluated highly in the items of sticky feeling, easiness for movement, following property, lightness, skin touch, and wearing feeling.

INDUSTRIAL APPLICABILITY

[0103] According to the invention, a fiber excellent in cool contact feeling which is excellent in hand and skin touch and capable of preventing unpleasant feeling in the wet state and a woven fabric, clothing, and underwear excellent in cool contact feeling and obtainable by using the fiber excellent in cool contact feeling can be provided.

BRIEF DESCRIPTION OF DRAWINGS

[0104]

Fig. 1(a) is a schematic view showing one example of clothing excellent in cool contact feeling of the invention. Fig. 1(b) is a schematic view showing one example of clothing excellent in cool contact feeling of the invention.
Fig. 2(a) is a schematic view showing one example of clothing excellent in cool contact feeling of the invention.
Fig. 2(b) is a schematic view showing one example of clothing excellent in cool contact feeling of the invention.
Fig. 3 is a schematic view showing the flow of heat and steam emitted from the skin in the case the refreshing clothing is put on.
Fig. 4 is a structure drawing showing the woven fabric having a reversible structure formed in Example 14.
Fig. 5 is a structure drawing showing the woven fabric having a reversible structure formed in Example 15.
Fig. 6 is a graph showing the evaluation results in the environment control room carried out in Examples.
Fig. 7 is a graph showing the evaluation results of the sensory evaluation 1 carried out in Examples.
Fig. 8 is a graph showing the evaluation results of the sensory evaluation 2 carried out in Examples.

EXPLANATION OF SYMBOLS

[0105]

11, 21: refreshing clothing
12, 22: part formed by weaving fibers excellent in cool contact feeling
13, 23: part formed by weaving hydrophobic fibers

Claims

1. A fiber excellent in cool contact feeling,
which contains a thermoplastic elastomer and an inorganic filler.

2. The fiber excellent in cool contact feeling according to claim 1,
which has a core-sheath structure and comprises a core part containing a dyeable resin and a sheath part containing a thermoplastic elastomer resin and an inorganic filler, a thickness of the sheath part being 20 μm or thinner.

3. The fiber excellent in cool contact feeling according to claim 1 or 2,
wherein the thermoplastic elastomer is a polyamide elastomer and/or a polyester elastomer.

4. The fiber excellent in cool contact feeling according to claim 1, 2 or 3,
wherein the thermoplastic elastomer is a polyether block amide copolymer.

5. The fiber excellent in cool contact feeling according to claim 1, 2, 3 or 4,
which contains 2 to 30% by weight of the inorganic filler.

6. A woven fabric excellent in cool contact feeling,
which is obtainable by using the fiber excellent in cool contact feeling according to claim 1, 2, 3, 4 or 5.

7. Clothing excellent in cool contact feeling,
which is obtainable by using the fiber excellent in cool contact feeling according to claim 1, 2, 3, 4 or 5, or the woven fabric excellent in cool contact feeling according to claim 6.

8. The clothing excellent in cool contact feeling according to claim 7,
which is clothing excellent in cool contact feeling comprising a woven fabric having a reversible structure and excellent in refreshing feeling,
30 to 70% by number of total loops comprising the fiber excellent in cool contact feeling, the loops comprising the fiber excellent in cool contact feeling being arranged in a skin contact side.

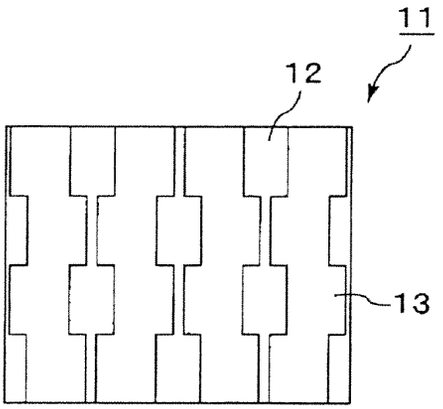
9. The clothing excellent in cool contact feeling according to claim 7 or 8,
wherein the fiber excellent in cool contact feeling contains 50% by weight or more of a thermoplastic elastomer.

10. The clothing excellent in cool contact feeling according to claim 8 or 9,
wherein the loops other than the loops comprising the fiber excellent in cool contact feeling comprises a hydrophobic fiber.

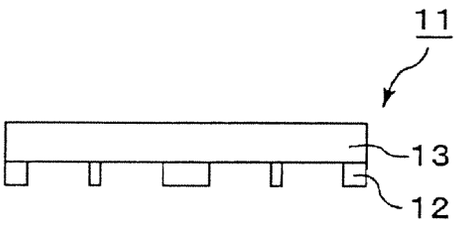
11. Underwear excellent in cool contact feeling,
which is obtainable by using the fiber excellent in cool contact feeling according to claim 1, 2, 3, 4 or 5, the woven fabric excellent in cool contact feeling according to claim 6, or the clothing excellent in cool contact feeling according to claim 7, 8, 9 or 10.

[Fig.1]

(a)

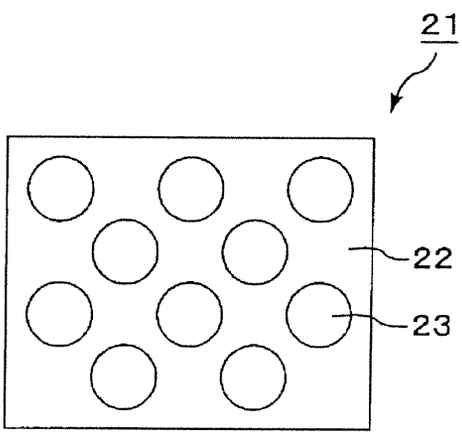


(b)

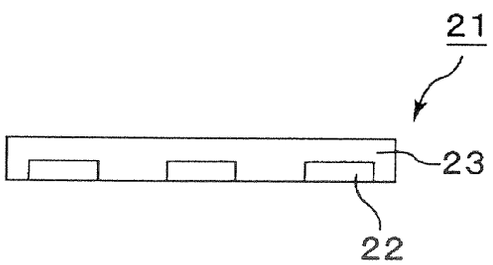


[Fig.2]

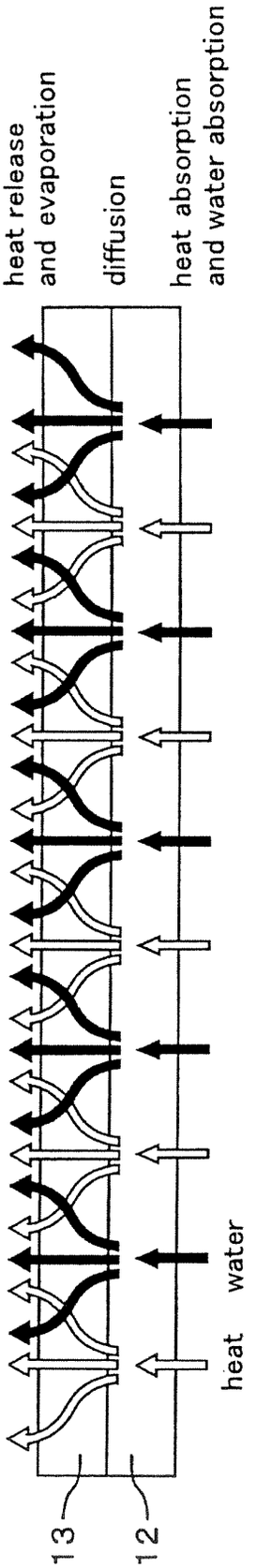
(a)



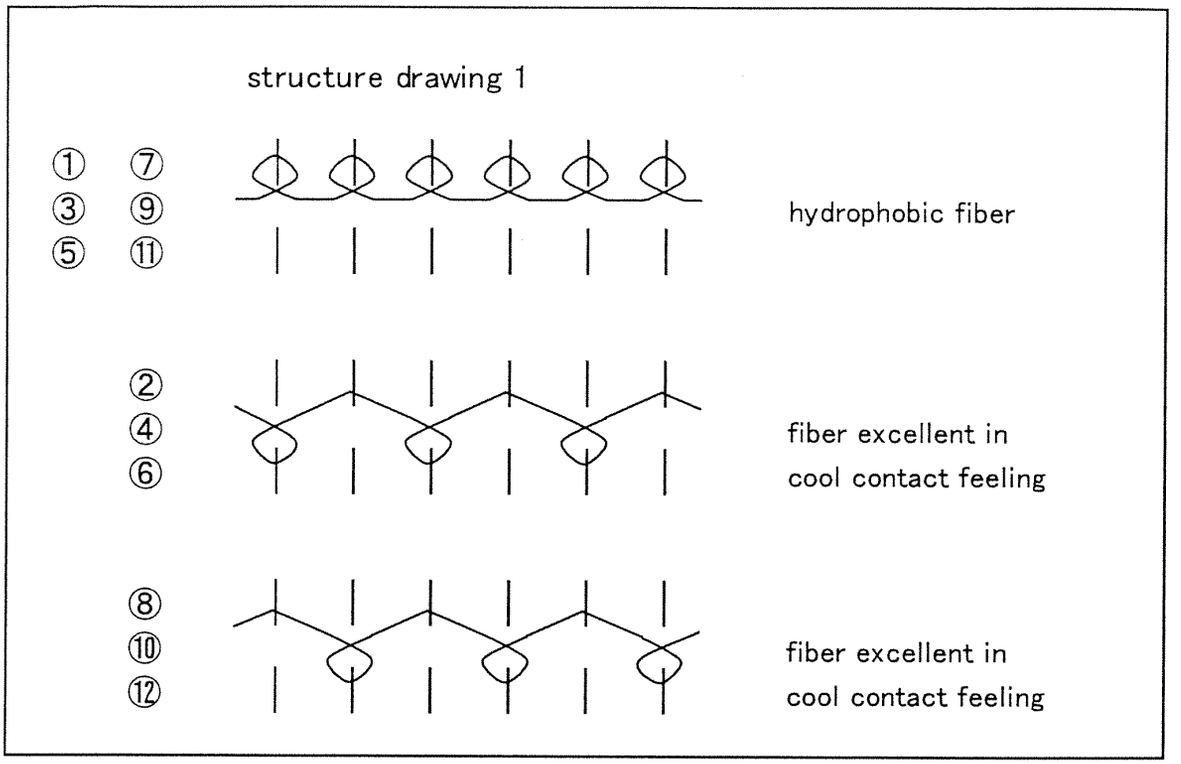
(b)



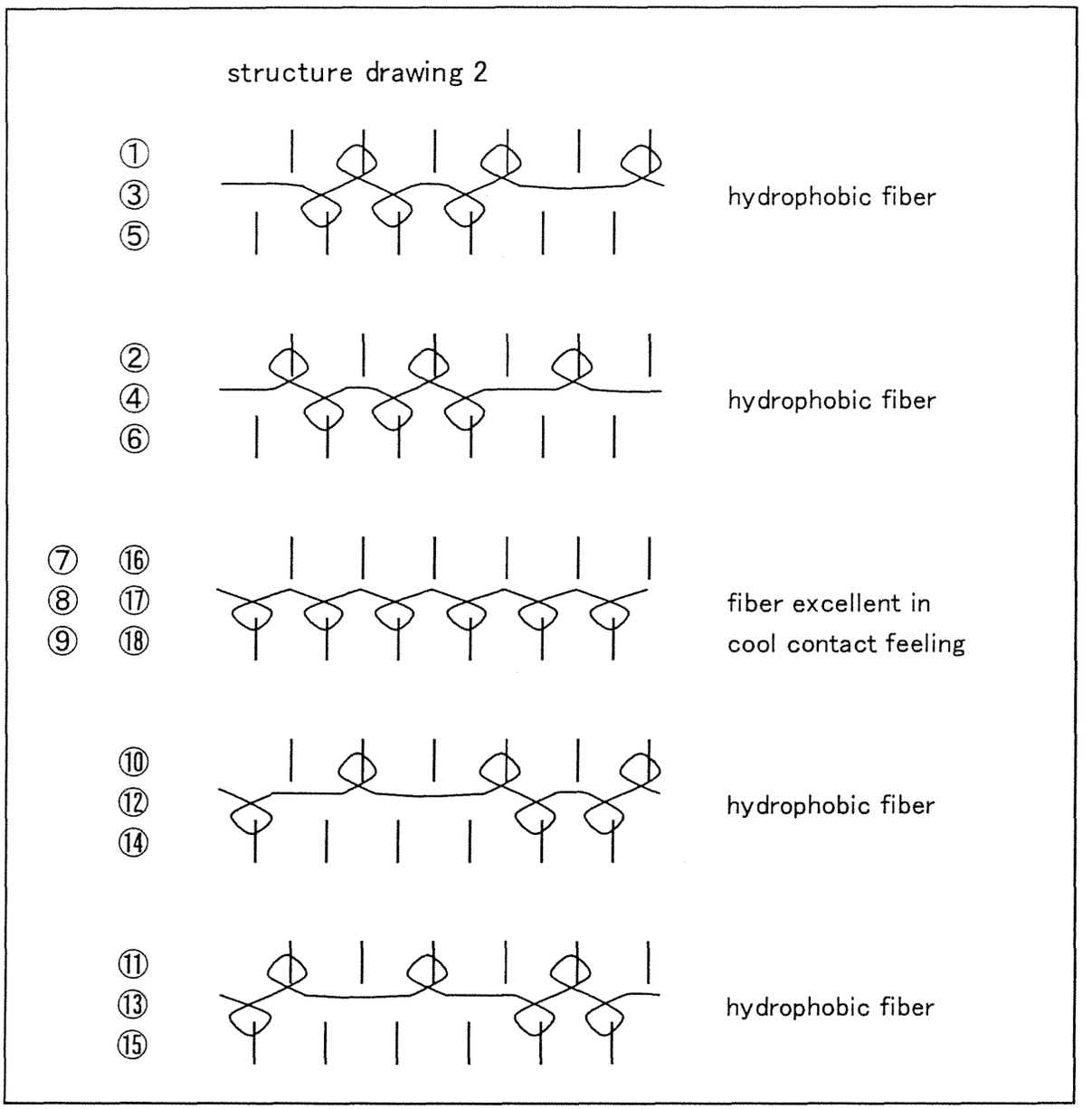
[Fig.3]


heat release
and evaporation
diffusion
heat absorption
and water absorption
heat
water
13
12

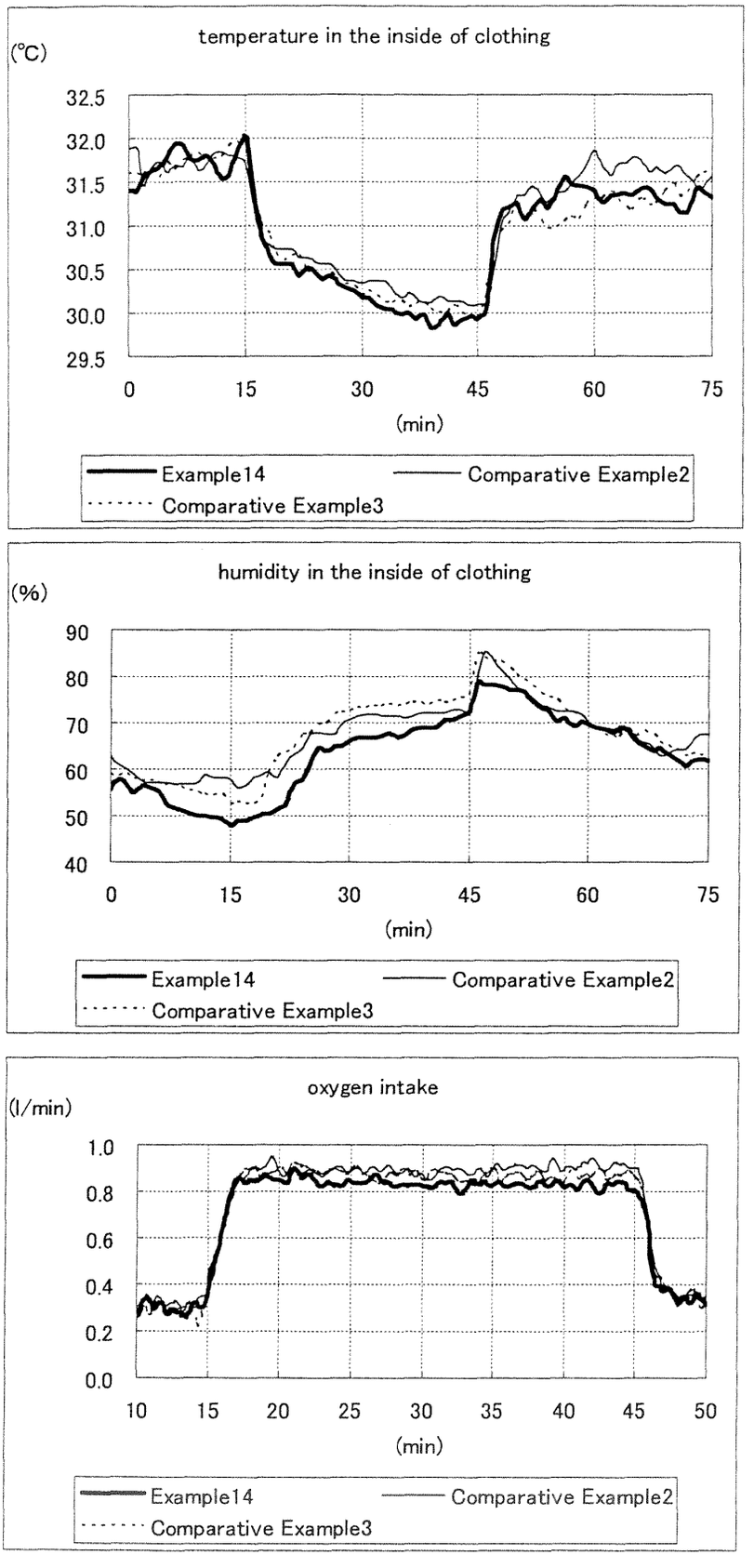
[Fig.4]


structure drawing 1
① ⑦
③ ⑨
⑤ ⑪
hydrophobic fiber
② ④ ⑥
fiber excellent in cool contact feeling
⑧ ⑩ ⑫
fiber excellent in cool contact feeling

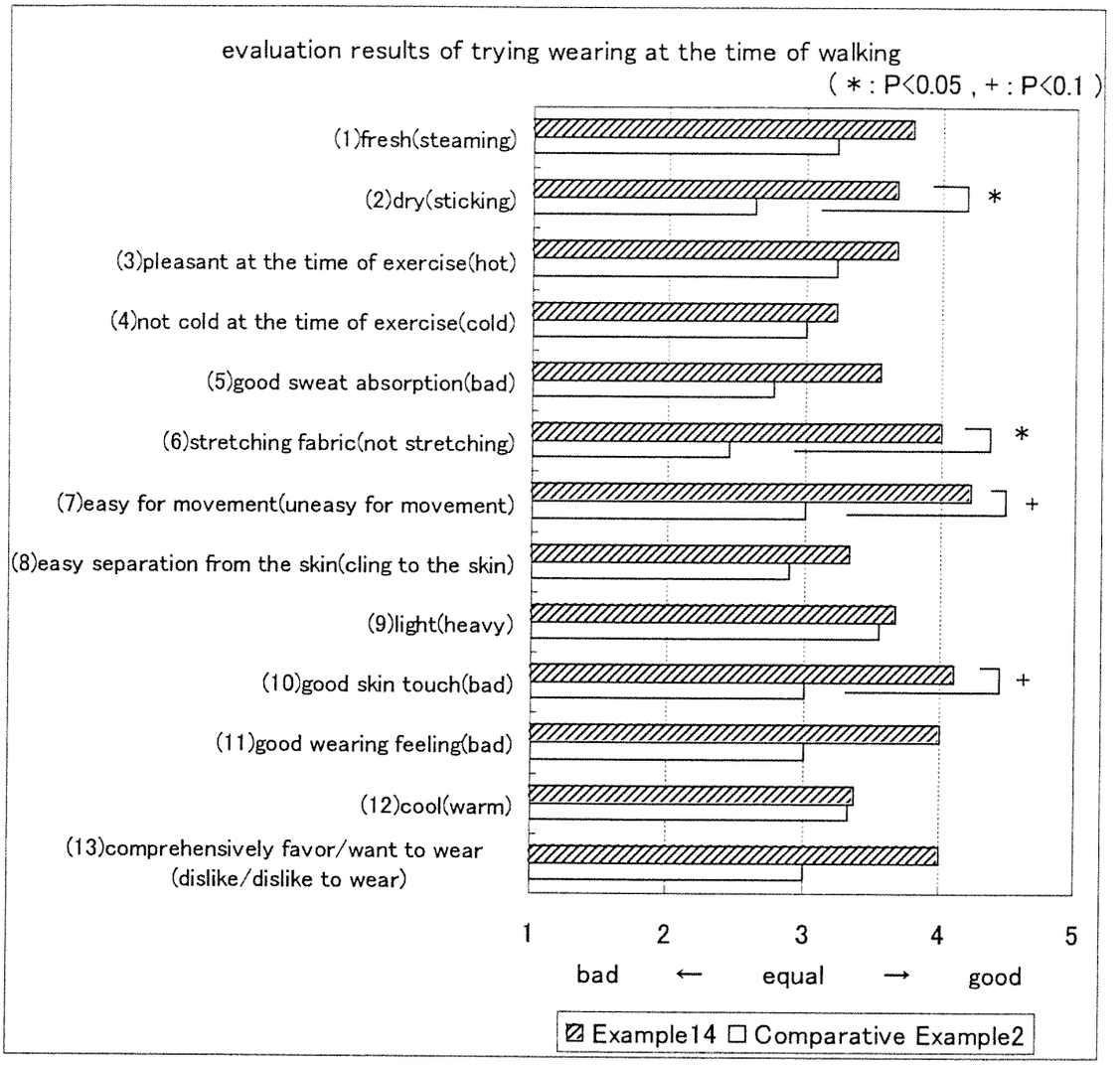
[Fig.5]

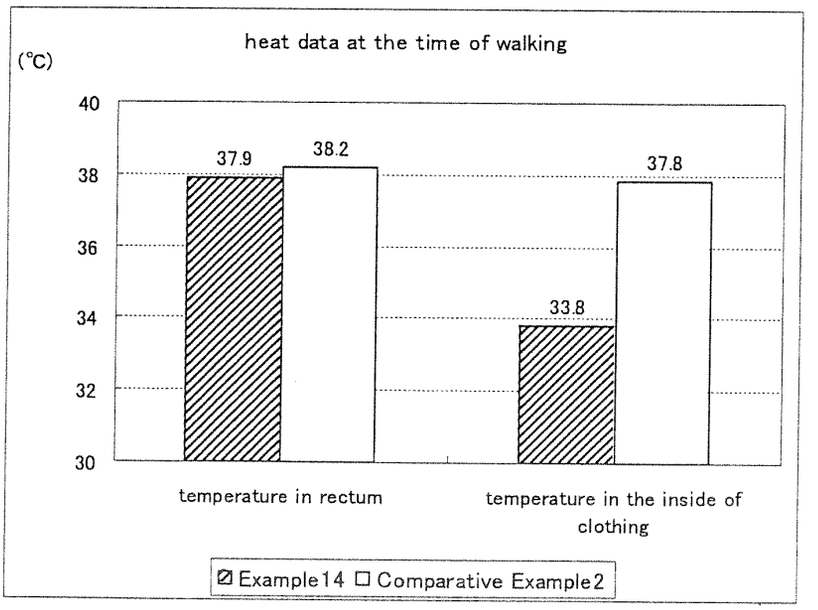

structure drawing 2
①
③
⑤
hydrophobic fiber
②
④
⑥
hydrophobic fiber
⑦ ⑯
⑧ ⑰
⑨ ⑱
fiber excellent in
cool contact feeling
⑩
⑫
⑭
hydrophobic fiber
⑪
⑬
⑮
hydrophobic fiber

[Fig.6]

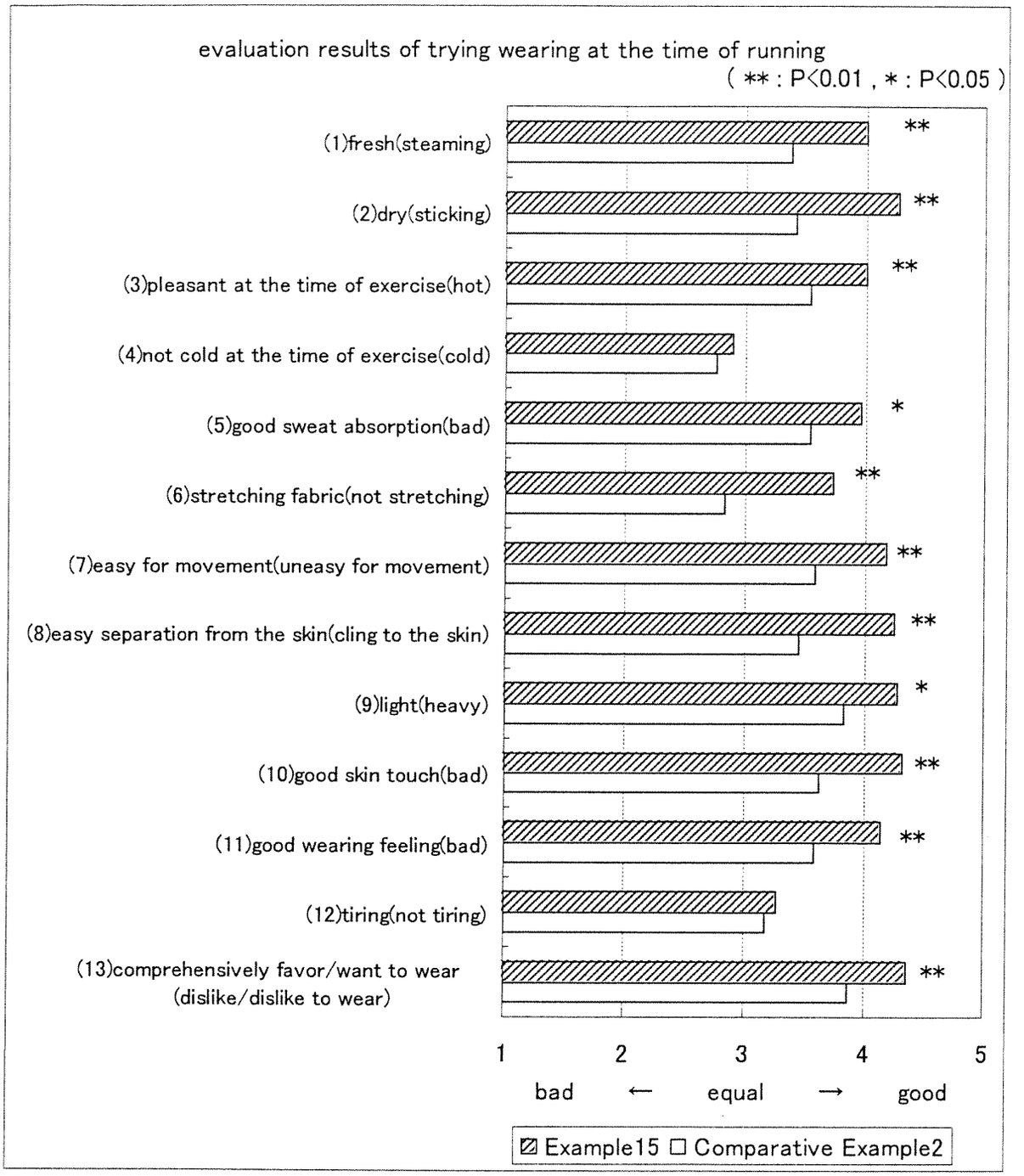

temperature in the inside of clothing
(℃)
32.5
32.0
31.5
31.0
30.5
30.0
29.5
0
15
30
45
60
75
(min)
Example14
Comparative Example2
Comparative Example3
humidity in the inside of clothing
(%)
90
80
70
60
50
40
0
15
30
45
60
75
(min)
Example14
Comparative Example2
Comparative Example3
oxygen intake
(l/min)
1.0
0.8
0.6
0.4
0.2
0.0
10
15
20
25
30
35
40
45
50
(min)
Example14
Comparative Example2
Comparative Example3

[Fig.7]


evaluation results of trying wearing at the time of walking
(* : P<0.05 , + : P<0.1)
(1)fresh(steaming)
(2)dry(sticking)
(3)pleasant at the time of exercise(hot)
(4)not cold at the time of exercise(cold)
(5)good sweat absorption(bad)
(6)stretching fabric(not stretching)
(7)easy for movement(uneasy for movement)
(8)easy separation from the skin(cling to the skin)
(9)light(heavy)
(10)good skin touch(bad)
(11)good wearing feeling(bad)
(12)cool(warm)
(13)comprehensively favor/want to wear (dislike/dislike to wear)
*
*
+
+
1
2
3
4
5
bad ← equal → good
Example14 Comparative Example2


heat data at the time of walking
(℃)
40
38
36
34
32
30
37.9
38.2
33.8
37.8
temperature in rectum
temperature in the inside of clothing
Example14 Comparative Example2

[Fig.8]


evaluation results of trying wearing at the time of running
(** : P<0.01 , * : P<0.05)
(1)fresh(steaming)
(2)dry(sticking)
(3)pleasant at the time of exercise(hot)
(4)not cold at the time of exercise(cold)
(5)good sweat absorption(bad)
(6)stretching fabric(not stretching)
(7)easy for movement(uneasy for movement)
(8)easy separation from the skin(cling to the skin)
(9)light(heavy)
(10)good skin touch(bad)
(11)good wearing feeling(bad)
(12)tiring(not tiring)
(13)comprehensively favor/want to wear (dislike/dislike to wear)
**
**
**
*
**
**
**
*
**
**
**
1
2
3
4
5
bad ← equal → good
Example15
Comparative Example2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/308043

A. CLASSIFICATION OF SUBJECT MATTER
D01F6/82(2006.01), ***A41D31/00***(2006.01), ***D01F6/90***(2006.01), ***D01F8/12***(2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D01F1/00-9/04, A41D31/00, A41B9/00-9/16, 17/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2006
Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 10-8324 A (Tosoh Corp.), 13 January, 1998 (13.01.98), Par. No. [0051] (Family: none)	1,3-5 2,6-11
X Y	JP 10-140420 A (Japan Exlan Co., Ltd.), 26 May, 1998 (26.05.98), Par. Nos. [0006], [0014], [0054] & US 5928785 A1 & EP 841415 A2	1,3,5-7,9,11 2,4,8,10
Y	JP 2004-270075 A (Gunze Ltd.), 30 September, 2004 (30.09.04), All references (Family: none)	1-11

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 May, 2006 (02.05.06)	16 May, 2006 (16.05.06)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/308043

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-36361 A (Gunze Ltd.), 10 February, 2005 (10.02.05), All references (Family: none)	1-11
Y	JP 2003-293202 A (Toray Industries, Inc.), 15 October, 2003 (15.10.03), All references (Family: none)	1-11

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2002235278 A **[0004]**
- JP 2003247177 A **[0026]**
- JP 2003155669 A **[0043]**