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(71) Applicant: **Mizuno Corporation**
Osaka-shi, Osaka 541-8538 (JP)

(72) Inventors:
• **TAJIMA, Kazuya**
Osaka-shi, Osaka 559-8510 (JP)
• **SHIRAISHI, Atsushi**
Osaka-shi, Osaka 559-8510 (JP)

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(74) Representative: **Diehl & Partner GbR**
Patentanwälte
Erika-Mann-Strasse 9
80636 München (DE)

(54) **CLOTHING FABRIC AND CLOTHES USING THE SAME**

(57) Provided is a clothing fabric (1) including through holes (2) that pass through the fabric in a thickness direction, wherein the through holes (2) are arranged along one direction of the fabric. A water-repellent or hydrophobic region (3) is arranged at least at part of the fabric in contact with the through holes (2), and a hydrophilic region (4) is arranged at the other portions. A portion of the water-repellent or hydrophobic region (3) may form groove portions (5). The clothes of the present invention include the above-described clothing fabric, wherein the through holes that pass through a portion of the fabric in a thickness direction are arranged along a direction of a wearer' height. Accordingly, it is possible to provide a clothing fabric and clothes using the same that can, while being water-absorbing, suppress formation of a film of a liquid even when the fabric is wet, ensure air permeability of the fabric, and always allow sweat on the skin to be evaporated on the body surface, thereby increasing the effective sweat amount, preventing exercise performance from being lowered, and allowing a person to wear the clothes with comfort even when sweating.

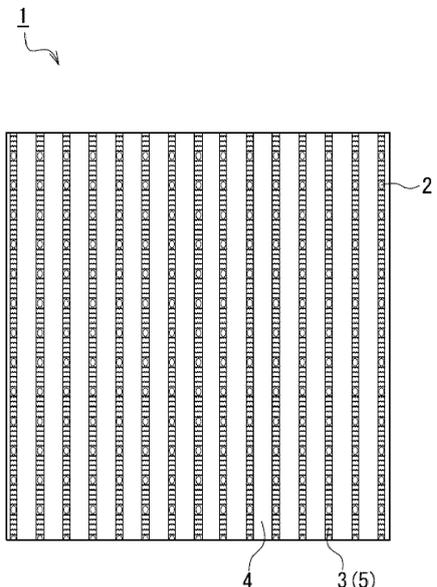


FIG. 3A

Description

Technical Field

5 **[0001]** The present invention relates to a clothing fabric and clothes using the same. More specifically, the invention relates to a clothing fabric and clothes using the same that can be worn with comfort even when sweating.

Background Art

10 **[0002]** It is comfortable to wear clothes with countermeasures against sweating while participating in sweaty sports. In conventional clothes, a film of a liquid (sweat) is formed on a fabric surface in a wet state such as when a wearer is sweating, thereby lowering the air permeability, and inhibiting evaporation of sweat on the skin. This state leads to problems in which ineffective sweating increases, exercise performance is lowered due to an increase in the core body temperature, and the clothes become more uncomfortable. Conventional techniques are proposed such as those in
15 Patent Documents 2 and 3 in which knitted fabrics are provided with meshes and those in Patent Documents 1 and 4 in which a water repellent is applied to mesh knitted fabrics.

Citation List

20 Patent Documents

[0003]

25 Patent Document 1: JP 2001-200452A
Patent Document 2: JP 2003-096648A
Patent Document 3: JP 2006-169648A
Patent Document 4: JP 2006-249610A

Disclosure of Invention

30 Problem to be Solved by the Invention
[0004] In conventional clothes, when the amount of sweat is large, a film of a liquid (sweat) is formed on a fabric surface, thereby lowering the air permeability, and inhibiting evaporation of sweat on the skin. This state leads to problems
35 in which ineffective sweating increases, exercise performance is lowered due to an increase in the core body temperature, and the clothes become more uncomfortable.

[0005] In order to address these conventional problems, the present invention provides a clothing fabric and clothes using the same that can, while being water-absorbing, suppress formation of a film of a liquid even when the fabric is wet, ensure air permeability of the fabric, and always allow sweat on the skin to be evaporated on the body surface,
40 thereby increasing the effective sweat amount, preventing exercise performance from being lowered, and allowing a person to wear the clothes with comfort even when sweating.

Means for Solving Problem

45 **[0006]** The present invention is directed to a clothing fabric including through holes that pass through the fabric in a thickness direction, wherein the through holes are arranged along one direction of the fabric, and a water-repellent or hydrophobic region is arranged at least at part of the fabric in contact with the through holes, and a hydrophilic region is arranged at the other portions.

50 **[0007]** Furthermore, the present invention is directed to clothes including the clothing fabric, wherein the through holes that pass through a portion of the fabric in a thickness direction are arranged along a direction of a wearer' height.

Effects of the Invention

55 **[0008]** According to the clothing fabric and the clothes using the same of the present invention, a water-repellent or hydrophobic region is arranged at least at part of the fabric in contact with the through holes, and a hydrophilic region is arranged at the other portions. Accordingly, moisture is likely to be transferred from the vicinity of the through holes to the hydrophilic region, and a film of a liquid is not formed in the vicinity of the through holes. That is to say, due to the synergistic effect of (1) a water-repellent or hydrophobic region being arranged at least at part of the fabric in contact

with the through holes and (2) a hydrophilic region being arranged at the other portions, it is possible to provide a clothing fabric and clothes using the same that can suppress formation of a film of a liquid even when the fabric is wet, ensure air permeability of the fabric, and always allow sweat on the skin to be evaporated on the body surface, thereby increasing the effective sweat amount, preventing exercise performance from being lowered, and allowing a person to wear the clothes with comfort even when sweating.

Brief Description of Drawings

[0009]

[FIG. 1] FIG. 1A is a schematic explanatory diagram showing transfer of sweat in a normal state of conventional clothes, FIG. 1B is a schematic explanatory diagram showing transfer of sweat in a heavily sweating state thereof, and FIG. 1C is a schematic explanatory diagram showing transfer of sweat in a heavily sweating state of clothes according to an embodiment of the present invention.

[FIG. 2] FIG. 2 is a photo showing a spread state of a clothing fabric according to the embodiment of the present invention (magnified by 2 times).

[FIG. 3] FIG. 3A is a diagram illustrating FIG. 2, and FIG. 3B is a schematic cross-sectional view thereof.

[FIG. 4] FIG. 4A is a photo showing a spread state of a clothing fabric according to another embodiment (magnified by 2 times), and FIG. 4B is a photo showing a back face thereof (magnified by 2 times).

[FIG. 5] FIG. 5A is a diagram illustrating FIG. 4A, and FIG. 5B is a diagram illustrating FIG. 4B.

[FIG. 6] FIG. 6 is a photo showing a spread state of a clothing fabric according to another embodiment (magnified by 2 times).

[FIG. 7] FIG. 7 is a diagram illustrating FIG. 6.

[FIG. 8] FIG. 8 shows clothing fabric samples according to examples and comparative examples of the present invention.

[FIG. 9] FIG. 9A is a schematic explanatory diagram illustrating a method for measuring the amount of heat transferred into the outside air in a wet state according to the examples of the present invention, and FIGS. 9B and 9C are photos showing a measuring apparatus therefor.

[FIG. 10] FIGS. 10A and 10B are explanatory diagrams illustrating a method for measuring the heat dissipation from clothes in a sweating state, as a measurement of the amount of heat transferred into the outside air in a wet state.

[FIG. 11] FIG. 11 is a graph showing wear test results of shirts according to the examples and comparative examples.

[FIG. 12] FIG. 12 is a graph showing wear test results of shirts according to the examples and comparative examples.

Description of the Invention

[0010] The present invention is directed to a clothing fabric including: through holes that pass through the fabric in the thickness direction, wherein the through holes are arranged along one direction of the fabric. The term "one direction" refers to any of a warp direction, a weft direction, and a diagonal direction of the fabric, but the through holes are preferably arranged along a warp or weft direction. The reason for this is that, when the fabric is formed into clothes, the through holes are preferably arranged along a warp direction. Even in the case where the through holes are arranged along a weft or diagonal direction, the performance of the present invention can be ensured by arranging the through holes so as to appear at constant intervals in a warp direction. The fabric may be any fabric such as a woven fabric or a knitted fabric. A water-repellent or hydrophobic region is arranged at least at part of the fabric in contact with the through holes, and a hydrophilic region is arranged at the other portions. In this description, "at least part of the fabric in contact with the through holes" refers to 10% or more, preferably 20% or more, and more preferably 30% or more. With this structure, moisture is likely to be transferred from the vicinity of the through holes to the hydrophilic region, and a film of a liquid is not formed in the vicinity of the through holes. As a result, it is possible to provide a clothing fabric and clothes using the same that can ensure air permeability of the through holes even when the clothing fabric is wet with sweat, thereby increasing the effective sweat amount, preventing exercise performance from being lowered, and allowing a person to wear the clothes with comfort even when sweating. The through holes may have any planar shape, such as a circle, an oval, a quadrangle, a rhombus, a triangle, a polygon, or an irregular shape.

[0011] According to the fabric of the present invention, a water-repellent or hydrophobic region is arranged at part of the through holes, and thus the surface tension increases due to capillary action of the through holes. Accordingly, moisture on the fabric surface is likely to be transferred, and a film of a liquid is not formed at the through holes. Furthermore, even when moisture is filled into the through hole, its surface tension differs from portion to portion because a hydrophilic region is arranged at a portion thereof and a water-repellent or hydrophobic region is arranged at another portion, and forces that are applied to the liquid at the through hole are not balanced, and thus a film of a liquid is not formed at the through hole. A water-repellent or hydrophobic region is preferably arranged around the through holes,

and at least in contact with part of the through holes. A hydrophilic region is arranged at part of the fabric so as to absorb sweat excreted from the body surface. The hydrophilic region is preferably arranged in an area of at least 10% or more. The water-repellent or hydrophobic region can be formed through knitting or weaving with a water-repellent or hydrophobic yarn, or by applying a water-repellent or hydrophobic resin to the fabric. The hydrophilic region can be formed through

knitting or weaving with a hydrophilic yarn, or by applying a hydrophilic resin to the fabric.
[0012] According to the fabric of the present invention, a water-repellent or hydrophobic yarn is arranged at part of the through holes, and thus the surface tension increases due to capillary action of the through holes. Accordingly, moisture on the fabric surface is likely to be transferred, and a film of a liquid is not formed at the through holes. A water-repellent or hydrophobic yarn is preferably arranged around the through holes, and at least in contact with part of the

through holes. A hydrophilic yarn is preferably arranged at part of the fabric so as to absorb sweat excreted from the body surface. The hydrophilic yarn is preferably arranged in an amount of at least 10% or more.
[0013] Lines for facilitating flow of a liquid in the vertical direction when the fabric is positioned vertical to the ground may be provided. The lines in the vertical direction are formed by continuously arranging the yarn density pattern, or water-repellent or hydrophobic region. The yarn density pattern is formed through methods such as the stitch density of the fabric, the number of twists of the yarn, the percentage of crimp, knitting techniques, embossing, or the like. In order to continuously arrange the water-repellent or hydrophobic region, it is necessary to realize a continuous arrangement of a water-repellent or hydrophobic yarn, such as a state in which a continuous yarn that is a water-repellent or hydrophobic yarn is knitted in warp knitting, or a state in which water-repellent or hydrophobic printing is performed in a stripe pattern or the like, for example. Lines in which lines with a constant length may regularly and repeatedly appear are not limited to straight lines, and may include curved lines in the shape of waves.

[0014] In the present invention, examples of at least one fiber yarn (I) selected from water-repellent fiber yarns and hydrophobic fiber yarns include: hydrophobic fiber yarns such as polypropylene fiber yarns, polyethylene fiber yarns, and polyester (PET, etc.) yarns; yarns obtained by subjecting organic fiber yarns (e.g., the above-described hydrophobic fiber yarn) to water-repellent treatment; and yarn portions obtained by subjecting yarns in a fabric state to water-repellent treatment through printing. Examples of a hydrophilic fiber yarn (II) include: cellulose fiber spun yarns such as cotton spun yarns and rayons; highly crosslinked polyacrylate-based fiber spun yarns; mixed spun yarns of these fibers and polyester (PET, etc.) fibers; composite spun yarns (including siro spun yarns) of these fibers and polyester (PET, etc.) multifilament yarns; nylon yarns; polyester (PET, etc.) fiber yarns and the like subjected to hydrophilic treatment; and yarn portions obtained by subjecting yarns in a fabric state to hydrophilic treatment through printing. For example, it is possible that the at least one fiber yarn (I) selected from water-repellent fiber yarns and hydrophobic fiber yarns is used as a fiber constituting the through holes, and the hydrophilic fiber yarn (II) is used for the base portions.

[0015] The portion using the hydrophilic fiber yarn preferably absorbs a liquid within 180 seconds as defined in the Dropping Test (JIS L 1907 A). It is more preferable to absorb a liquid within 60 seconds. When the Dropping Test (JIS L 1907 A) is performed, the fabric of the present invention is preferably such that the portion using the water-repellent or hydrophobic fiber yarn has higher water-retaining properties than the portion using the hydrophilic fiber yarn.

[0016] According to the fabric of the present invention, the ratio between the areas of the water-repellent or hydrophobic region (A) and the hydrophilic region (B) occupying the clothing fabric is preferably A: B = 1 : 99 to 90 : 10, more preferably 2 : 98 to 85 : 15, and even more preferably 2 : 98 to 80 : 20. In this case, the area of the water-repellent or hydrophobic region (A), in continuous arrangement of a water-repellent or hydrophobic yarn such as when a continuous yarn that is a water-repellent or hydrophobic yarn is knitted in warp knitting, refers to an area obtained by multiplying the thickness of the yarn in a fabric state without load as measured using a digital microscope (product number VH-Z25, manufactured by Keyence Corporation) by the number of yarns constituting the fabric per unit area. Furthermore, in the case where the water-repellent or hydrophobic region (A) is formed by applying a resin, the area refers to an area of the resin applied per unit area. The region other than the water-repellent or hydrophobic region (A) is taken as the hydrophilic region (B), based on which the area ratio between the water-repellent or hydrophobic region (A) and the hydrophilic region (B) is calculated. Furthermore, the mass ratio between the at least one fiber yarn (I) selected from water-repellent fiber yarns and hydrophobic fiber yarns and the hydrophilic fiber yarn (II) is preferably A: B = 1 : 99 to 90 : 10, more preferably 2 : 98 to 85 : 15, and even more preferably 2 : 98 to 80 : 20, when the clothing fabric is taken as 100 mass%. Accordingly, moisture is more likely to be transferred, and a film of a liquid is not formed in the vicinity of the through holes.

[0017] Preferably, when the clothing fabric of the present invention is suspended such that the through holes are arranged along the vertical direction in a state where the fabric whose weight is taken as 100% is wet with 300% of moisture, the through holes have voids therein.

[0018] The clothing fabric of the present invention is preferably such that grooves (lines) are formed in the same direction as the one direction along which the through holes are arranged. Accordingly, when the sweat amount increases, a liquid is likely to flow along the grooves (lines). The direction of the grooves (lines) preferably matches the direction of the wearer' height. Furthermore, the width of each of the grooves is preferably 0.1 to 30 mm, and more preferably 0.3 to 20 mm. The groove portions (lines) are preferably formed at fabric portions using at least one fiber yarn (I) selected from water-repellent fiber yarns and hydrophobic fiber yarns. The reason for this is for facilitating flowing of a liquid. The

groove portions may be formed at knitted fabric portions using the water-repellent or hydrophobic fiber yarn by forming the knitted fabric portions using the hydrophilic fiber yarn relatively thick and the knitted fabric portions using the water-repellent or hydrophobic fiber yarn relatively thin.

5 [0019] The size of each of the through holes is such that the average length in both the warp and weft directions is preferably 0.3 to 25 mm, and more preferably 0.3 to 20 mm. Accordingly, it is possible to provide a clothing fabric and clothes using the same that can further increase the effective sweat amount, prevent exercise performance from being lowered, and allow a person to wear the clothes with comfort even when sweating.

10 [0020] The opening percentage of the clothing fabric is preferably 1 to 50%, and more preferably 2 to 40%. Accordingly, it is possible to provide a clothing fabric and clothes using the same that can further increase the effective sweat amount, prevent exercise performance from being lowered, and allow a person to wear the clothes with comfort even when sweating. The opening percentage refers to a proportion of the through holes occupying the fabric.

15 [0021] The fiber yarn used in the clothing fabric of the present invention may be any yarn such as a spun yarn, a multifilament yarn, a crimping yarn obtained by treating a multifilament yarn, or the like. When a crimping yarn is used, yarns with different percentages of crimp are preferably arranged on the upper and lower sides. A high percentage of crimp increases the amount of water that can be retained, and a low percentage of crimp decreases the amount of water that can be retained. If these yarns are arranged on the upper and lower sides, liquid droplets become large, and transfer of the liquid droplets is repeatedly accelerated, and thus voids are ensured. When a twisted yarn is used, yarns of two or more types with numbers of twists that are different from each other by 100 times/m or more are preferably used.

20 [0022] The fabric of the present invention may be either a woven fabric or a knitted fabric. Examples of the woven fabric basically include a plain weave, a twill weave, a sateen weave, a plain derivative weave, a twill derivative weave, a sateen derivative weave, a derivative weave, a brocade, a half double weave, a double structure, a multi structure, a warp pile weave, a weft pile weave, a leno weave, and the like, wherein through holes are formed along one of the warp, weft, and diagonal directions. Examples of the knitted fabric include a circular knit, a weft knit, a warp knit (including a tricot knit and a raschel knit), a pile knit, and the like, and basically include a plain knit, a jersey knit, a rib knit, a smooth knit (interlock knit), a rubber knit, a pearl knit, a denbigh structure, a cord structure, an atlas structure, a chain structure, and an inlay structure, wherein through holes are formed along one of the warp, weft, and diagonal directions. Of these, a knitted fabric is preferable. In the case of a knitted fabric, woven stitches or knitted stitches stretch in planar directions when the fabric is wet, and the air permeability increases. Moreover, since the basis weight (weight per unit area) is small, a knitted fabric is suited to be used in a portion of clothes in which the amount of sweat is large. As a knitted fabric, knitted fabrics such as a warp knit (including a tricot knit and a raschel knit), a weft knit, a circular knit, and the like are preferable. In the present invention, the basis weight of the fabric is preferably 40 g/m² or more and less than 300 g/m². Since the fabric is used in a portion of clothes in which the amount of sweat is large, the fabric is preferably thin. The fabric of the present invention may be a one-way or two-way stretch fabric, and may include an elastic yarn made of polyurethane or the like.

35 [0023] The clothes of the present invention contain the above-described fabric, wherein through holes that pass through a portion of the fabric in the thickness direction are arranged along the wearer's height or diagonal direction. Accordingly, moisture of sweat is likely to flow in the warp direction, and the air permeability of the through holes is ensured. The clothes are preferably used as sportswear. The clothes are preferably used particularly as sportswear that is used in a hot season when the amount of sweat is large. The fabric is arranged at least corresponding to a portion of a human body where the amount of sweat is large, and is formed into clothes. For example, the fabric may be used in the whole or part (corresponding to the underarms or the back, etc.) of a sport shirt, a T-shirt, an inner shirt, a training warmer, briefs, an ordinary shirt, or the like.

40 [0024] Hereinafter, a clothing fabric according to a preferred embodiment of the present invention will be described with reference to the drawings. In the following drawings, the same reference numerals denote the same constituent elements. FIG. 1A is a schematic explanatory diagram showing transfer of sweat in a normal state of conventional clothes. Sweat 13a and 13b excreted from skin 11 is diffused toward the outside air via void portions of clothes 12a. 14 denotes an air flow. FIG. 1B is a schematic explanatory diagram showing transfer of sweat in a heavily sweating state of the conventional clothes. In a heavily sweating state, the clothes are wetter, a film of a liquid is formed, and the void portions of clothes 12b disappear or decrease. Accordingly, the sweat 13 and the air 14 remain on the surface of the skin 11, ineffective sweating increases, exercise performance is lowered due to an increase in the core body temperature, and the clothes become more uncomfortable.

50 [0025] On the other hand, FIG. 1C is a schematic explanatory diagram showing transfer of sweat in a heavily sweating state of clothes according to an embodiment of the present invention. Even when the clothes are wetter in a heavily sweating state, the voids of the through holes are maintained, and thus formation of a film of a liquid is suppressed. Accordingly, the air permeability of a fabric 12C is ensured, and sweat 13a and 13b excreted from the skin 11 is diffused toward the outside air via void portions of clothes 12c. Furthermore, since sweat on the skin is always allowed to be evaporated on the body surface, the effective sweat amount increases, the exercise performance is prevented from being lowered, and the clothes are worn with comfort even when sweating.

[0026] FIG. 2 is a photo showing a spread state of a clothing fabric according to the embodiment of the present invention (magnified by 2 times). FIG. 3A is a plan diagram illustrating FIG. 2, and FIG. 3B is a schematic cross-sectional view thereof. A fabric 1 has through holes 2 that pass through the fabric in the thickness direction, and the through holes 2 are arranged along the warp direction of the fabric 1. A water-repellent or hydrophobic fiber yarn 3 is arranged at least at part of the fabric in contact with the through holes 2, and a hydrophilic fiber yarn 4 is arranged at the other portions. The knitted fabric portions using the hydrophilic fiber yarn 4 are thick, and the knitted fabric portions using the water-repellent or hydrophobic fiber yarn 3 are thin, and thus groove portions (lines) 5 are formed in the warp direction. The portions in which the water-repellent or hydrophobic fiber yarn 3 is arranged form water-repellent or hydrophobic regions, and the portions in which the hydrophilic fiber yarn 4 is arranged form hydrophilic regions.

[0027] FIG. 4A is a photo showing a spread state of a clothing fabric according to another embodiment (magnified by 2 times), and FIG. 4B is a photo showing a back face thereof (magnified by 2 times). FIG. 5A is a diagram illustrating FIG. 4A, and FIG. 5B is a diagram illustrating FIG. 4B. A fabric 6 has through holes 2 that pass through the fabric in the thickness direction, and the through holes 2 are arranged along the warp direction of the fabric 6. A water-repellent or hydrophobic fiber yarn 3 is arranged at least at part of the fabric in contact with the through holes 2, and a hydrophilic fiber yarn 4 is arranged at the other portions. FIG. 6 is a photo showing a spread state of a clothing fabric according to another embodiment (magnified by 2 times). FIG. 7 is a diagram illustrating FIG. 6. A fabric 7 has through holes 2 that pass through the fabric in the thickness direction, and the through holes 2 are arranged along the warp direction of the fabric 7. A water-repellent or hydrophobic fiber yarn 3 is arranged at least at part of the fabric in contact with the through holes 2, and a hydrophilic fiber yarn 4 is arranged at the other portions. The knitted fabric portions using the hydrophilic fiber yarn 4 are thick, and the knitted fabric portions using the water-repellent or hydrophobic fiber yarn 3 are thin, and thus the groove portions (lines) 5 are formed in the warp direction.

Examples

[0028] Hereinafter, a more specific description will be given by way of examples. Note that the present invention is not to be interpreted as being limited to the following examples.

Examples 1 to 5 and Comparative Examples 1 to 4

[0029] Fabrics with compositions as shown in Table 1 were produced. A water-repellent or hydrophobic yarn I was used to form fabric portions including through holes, and a hydrophilic yarn II was used to form the other portions. Example 1 (development article A), Example 2 (development article B), Comparative Example 1 (comparative article a), Comparative Example 3 (comparative article c), and Comparative Example 4 (comparative article d) were for shirts, and Example 3 (development article C), Example 5 (development article E), and Comparative Example 2 (comparative article b) were for inner shirts. In Table 1, PET denotes a polyethylene terephthalate fiber yarn, PP denotes a polypropylene fiber yarn, and PU denotes a polyurethane fiber yarn. Furthermore, T denotes dicitex, f denotes the number of filaments, Count denotes the metric count, SD denotes semidull. The front faces and back faces of the fabrics according to development articles A to E of Examples 1 to 5 were as shown in FIG. 8. In Example 1, Example 2, Example 3, Example 5, and Comparative Example 4, a water-repellent yarn obtained by subjecting the surface of a PET fiber yarn to water-repellent treatment was used. Furthermore, in Example 4, a hydrophobic PP fiber yarn, and a mixed spun yarn of PET fibers and highly crosslinked polyacrylate-based fibers as a hydrophilic yarn were used.

Table 1

Type	Composition	Yarns used (I: water-repellent or hydrophobic yarn) (II: hydrophilic yarn)	I: II area ratio	Basis weight (g/m ²)	Thickness (mm)	
Example 1 (dev.article A)	Circular (double)	PET 100%	I: 66T/48f (water-repellent yarn)	I: 10% II: 90%	136	0.80
			II: 44T/36f, SD83d/36f (hydrophilic yarn)			
Example 2 (dev.article B)	Warp (tricot)	PET 100%	I: 84T/72f (water-repellent yarn)	I: 46% II: 54%	131	0.65
			II: 84T/36f (hydrophilic yarn)			

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(continued)

	Type	Composition	Yarns used (I: water-repellent or hydrophobic yarn) (II: hydrophilic yarn)	I: II area ratio	Basis weight (g/m ²)	Thickness (mm)	
5	Example 3 (dev.article C)	PET 95%	I: 33T/36f (PET water-repellent yarn)	I: 2%	183	0.99	
10		PU 5%	II: 110T/144f, 44T/84f (hydrophilic yarn)	II: 98%			
15	Example 4 (dev.article D)	PP 75%	I: 84T paralleled (PP: hydrophobic yarn)	I: 75%	72	0.80	
20		PET 20%	II: 40 count (spun yarn: hydrophilic yarn)	II: 25%			
25	Example 5 (dev.article E)	Highly crosslinked polyacrylate-based fiber 5%	PET 100%	I: 66T/48f (PET water-repellent yarn)	I: 10%	80	0.63
30			II: 48T/36f, 56T/72f (hydrophilic yarn)	II: 90%			
35	Com. Example 1 (com.article a)	PET 100%	II: 84T/72F, 84T/48F (only hydrophilic yarn)	II: 100%	125	0.74	
40	Com.Example 2 (com.article b)	PET 84% PU 16%	II: 56T/48F, 33T/36F, 22T (only hydrophilic yarn)	II: 100%	184	0.57	
45	Com. Example 3 (com.article c)	PET 100%	II: 84T/72F (only hydrophilic yarn)	II: 100%	129	0.75	
50	Com.Example 4 (com.article d)	PET 100%	I: 84T/72f (only water-repellent yarn)	I: 100%	127	0.74	

[0030] The opening percentages of the articles according to Examples 1 to 5 and Comparative Examples 1 and 2 were measured. The opening percentages were measured as follows.

- (1) An image of a fabric is printed, and a quadrangular region defined by segments linking the centers of four through holes is cut.
- (2) A paper weight W_1 of the cut quadrangular portion is measured.
- (3) Through holes contained in the cut quadrangular portion are cut, and their paper weight W_2 is measured.
- (4) Opening percentage = $(1 - W_2/W_1) \times 100$ is calculated.

[0031] Table 2 shows the opening percentages of the fabrics.

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Table 2

	Opening percentage (%)								
Example 1,5 (dev.article A, E)	6	Example 2 (dev.article B)	5	Example 3 (dev.article C)	17	Example 4 (dev.article D)	30	Com.Example 1 (com.article a)	0
								Com.Example 2 (com.article b)	0
								Com.Example 3 (com.article c)	7
								Com.Example 4 (com.article d)	7

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[0032] The ventilation resistances in a dry state and a wet state were measured. The measurement was performed using an Air Permeability Tester KES-F8 (manufactured by Kato Tech Co., Ltd.). The measurement was performed by releasing and sucking air into and from the atmosphere, detecting the pressures during the release and suction, and calculating a ventilation resistance R.

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Ventilation: 4 cc/cm²/sec. (constant ventilation method)
Vent area: 2 πcm²

[0033] The ventilation resistance in a dry state was measured at a temperature of 20°C and a relative humidity of 65%R.H. in a state where each fabric was dried.

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[0034] The ventilation resistance in a wet was measured while air was released and sucked parallel to the ground in a state where each fabric whose weight was taken as 100% was wet with 300% of moisture. The temperature and the humidity were as described above. The measuring method was as follows.

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- (1) A fabric is held vertical to the ground.
- (2) The sample immersed in a water tank is taken out and the fabric is set in the tester.
- (3) Measurement is performed using the method as defined in the KES test manual.

[0035] Table 3 shows the ventilation resistance values of the fabrics.

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Table 3

	Example 1 (dev.article A)	Example 2 (dev.article B)	Example 3 (dev.article C)	Example 4 (dev.article D)	Example 5 (dev.article E)	Com. Example 1 (com.article a)	Com. Example 2 (com.article b)	Com. Example 3 (com.article c)	Com. Example 4 (com.article d)
Dry ventilation resistance (kPa.s/m ²)	0.017	0.026	0.001	0.0008	0.021	0.035	0.092	0.019	0.020
Wet ventilation resistance (kPa.s/m ²)	0.073	0.03	0.002	0.0014	0.072	15.5	21.34	0.17	0.19

[0036] As is clear from Table 3, the articles according to the examples had lower ventilation resistance values in both the dry state and the wet state than those according to the comparative examples, and had significantly low ventilation resistance values especially in the wet state. If the ventilation resistance value in a wet state is 0.1 kPa·s/m² or less, the wearer feels moisture escaping from the inside of the clothes to the outside of the clothes.

[0037] The heat dissipations from the clothes in a sweating state were measured as measurement of the amounts of heat transferred into the outside air in a wet state. The conditions were set such that constant temperature and humidity vessel: 80°C, relative humidity: 95%R.H., and apparatus used: heat flow sensor Z (product number: 2015TC, manufactured by Hioki E.E. Corporation). The measuring apparatus was as shown in FIGS. 9A to 9C, and the measuring method was as follows.

- (1) A sample is placed over the edge of a cup such that the back face of the fabric is on the constant temperature and humidity vessel side.
- (2) The sample is immersed in ion exchange water for 1 minute or more.
- (3) The sample is taken out of the liquid such that the warp direction of the fabric matches the vertical direction, and is set within 5 seconds at an air outlet of the constant temperature and humidity vessel.
- (4) Measurement is started 5 seconds after the sample is taken out of the liquid.
- (5) Measurement is ended in 1 minute and 30 seconds in total.
- (6) Analysis is performed by calculating integral values from 1 to 15 seconds after the start of the measurement.

[0038] Table 4 (shirt fabrics) and Table 5 (inner shirt fabrics) show the heat flow values of the fabrics.

Table 4

	Example 1 (dev.article A)	Example 2 (dev.article B)	Example 4 (dev.article D)	Example 5 (dev.article E)	Com. Example 1 (com.article a)	Com. Example 3 (com.article c)	Com. Example 4 (com.article d)
Heat flow (Wm ²)	395.04	426.67	481.5	393.98	297.39	317.3	308.1

Table 5

	Example 3 (dev.article C)	Com. Example 2 (com.article b)
Heat flow (Wm ²)	438.21	300.13

[0039] As shown in Tables 4 and 5, the articles according to Examples 1 to 5 (development articles A to E) had high heat flow values, and thus it seems that they can be worn with comfort.

[0040] Next, the heat dissipations from the clothes in a sweating state were measured as measurement of the amounts of heat transferred into the outside air in a wet state. In the measurement, a heat flow sensor Z (product number: 2015TC, manufactured by Hioki E.E. Corporation) was used.

- (1) A sample in which a comparative article and a development article are respectively arranged on the left and right sides is produced, and the heat flow sensors are attached thereto as shown in FIG. 10. At that time, the heat flow sensors are spaced away from the clothes by 3 mm, and the direction in which heat is transferred from the inside of the clothes to the outside is taken as +.
- (2) The wearer runs for 30 minutes on a treadmill set to a speed of 5 min/km, in an environmental test lab set to an environmental temperature of 28°C and 80%RH. Wind at a speed of 2.5 m/s is blown against the wearer from the front relative to the running.
- (3) Analysis is performed by calculating integral values of the amounts of heat transferred in 5 minutes in total from 25 to 30 minutes after the start of the measurement.

[0041] Table 6 shows the results.

Table 6

	Addition of transfer averages in periods					
	Comparative article a	Development article A	Comparative article a	Development article B	Comparative article b	Development article C
Integral value (w/m ²)	-1302.87	2648.56	-4908	6197.96	-801.78	4135.99

[0042] In the case of the comparative articles, transfer of heat from the inside of the clothes to the outside air stopped 15 to 20 minutes after the start of the running when the article was wet with the sweat of a subject, and thus these articles showed minus values. On the other hand, in the case of the articles according to the examples (development articles), even when the article was wet with sweat, the air permeability was maintained, and thus the sweat was allowed to evaporate. Accordingly, heat was dissipated to the outside, and thus these articles always showed plus values.

[0043] Next, each fabric was sewn into a shirt, and the wear test was performed. The wear test was performed by causing a subject who was wearing the development articles and the comparative articles to perform exercise in the Kansai district in August. The comfort in a heavily sweating state was evaluated by a sensory evaluation (SD method, bipolar scale, five grades).

- The subject was a Japanese healthy male in his 20s to 40s.
- Monitoring was performed during running at 5 min/km for 30 minutes.
- Evaluation was performed while taking the sensation during an ordinary exercise as a reference (Fair).
- The subject wore nothing on the skin side under the development articles.
- Evaluation was performed in terms of (1) Wet area of fabric (a larger area means a poorer result), (2) Sweat absorption and quick dry, (3) Stickiness, (4) Air permeability, (5) Sweating timing (an earlier timing means a poorer result), and (6) Wear comfortability. The evaluation criteria were set to -2 (Poor), -1 (Slightly poor), 0 (Fair), 1 (Slightly good), and 2 (Good).

[0044] FIGS. 11 and 12 are graphs showing wear test results of shirts according to the examples and comparative examples. It is seen from FIGS. 11 and 12 that the development articles outperformed the comparative articles in terms of the air permeability when the wear was wet with sweat, and the wearer of the development articles actually felt the concept of the articles according to the present invention.

Industrial Applicability

[0045] The fabric of the present invention may be used, for example, in the whole or part (corresponding to the underarms or the back, etc.) of a sport shirt, a T-shirt, an inner shirt, briefs, tights, an ordinary shirt, or the like.

List of Reference Numerals

[0046]

- | | |
|---------------|---|
| 1, 6, 7 | Clothing fabric |
| 2 | Through hole |
| 3 | Water-repellent or hydrophobic fiber yarn |
| 4 | Hydrophilic fiber yarn |
| 5 | Groove portion (line) |
| 11 | Skin |
| 12a, 12b, 12c | Clothes |
| 13a and 13b | Sweat |
| 14 | Air flow |

Claims

1. A clothing fabric (1, 6, 7) comprising through holes (2) that pass through the fabric in a thickness direction, wherein the through holes (2) are arrayed along one direction of the fabric, and

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a water-repellent or hydrophobic region is arranged at least at part of the fabric in contact with the through holes (2), and a hydrophilic region is arranged at the other portions.

- 5 **2.** The clothing fabric (1, 6, 7) according to claim 1, wherein a ratio between areas of the water-repellent or hydrophobic region, A, and the hydrophilic region, B, occupying the clothing fabric is $A : B = 1 : 99$ to $90 : 10$.
- 10 **3.** The clothing fabric (1, 6, 7) according to claim 1 or 2, wherein, when the clothing fabric is suspended such that the through holes (2) are arrayed along a vertical direction in a state where the fabric whose weight is taken as 100% is wet with 300% of moisture, the through holes (2) maintain voids therein.
- 15 **4.** The clothing fabric (1, 6, 7) according to any one of claims 1 to 3, further comprising lines for facilitating flowing of a liquid in a vertical direction when the fabric is positioned vertical to the ground.
- 20 **5.** The clothing fabric (1, 6, 7) according to any one of claims 1 to 3, wherein at least one fiber yarn selected from water-repellent fiber yarns and hydrophobic fiber yarns (3) is arranged in the water-repellent or hydrophobic region, and a hydrophilic fiber yarn (4) is arranged in the hydrophilic region.
- 25 **6.** The clothing fabric (1, 6, 7) according to claim 5, wherein a mass ratio between the at least one fiber yarn, I, selected from water-repellent fiber yarns and hydrophobic fiber yarns (3) and the hydrophilic fiber yarn (4), II, is $I : II = 1 : 99$ to $90 : 10$, when the clothing fabric is taken as 100 mass%.
- 30 **7.** The clothing fabric (1, 6, 7) according to any one of claims 1 to 6, wherein a size of each of the through holes (2) is such that an average length in both warp and weft directions is 0.3 to 25 mm.
- 35 **8.** The clothing fabric (1, 6, 7) according to any one of claims 1 to 7, wherein an opening area percentage of the through holes (2) of the clothing fabric is 1 to 50%.
- 40 **9.** The clothing fabric (1, 6, 7) according to any one of claims 1 to 8, wherein the water-repellent or hydrophobic region forms at least part of groove portions.
- 45 **10.** The clothing fabric (1, 6, 7) according to claim 9, wherein the groove portions each have a width of 0.1 to 30 mm.
- 50 **11.** An article of clothing comprising the clothing fabric according to any one of claims 1 to 10, wherein the through holes (2) that pass through a portion of the fabric in a thickness direction are arrayed along a direction of a wearer's height.
- 55 **12.** The article of clothing according to claim 11, wherein the article is sportswear.
- 60 **13.** Use of the clothing fabric (1, 6, 7) according to one of claims 1 to 10 for manufacturing an article of clothing (12a, 12b, 12c), in particular the article according to claim 11 or 12.

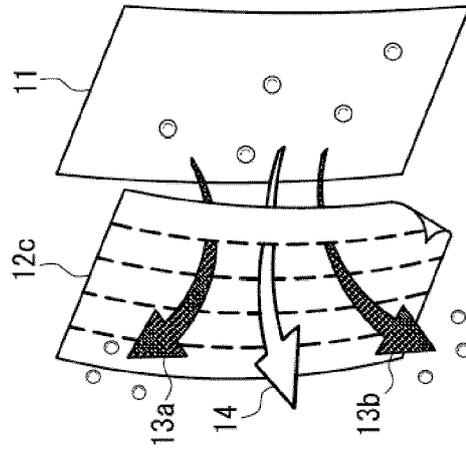


FIG. 1A

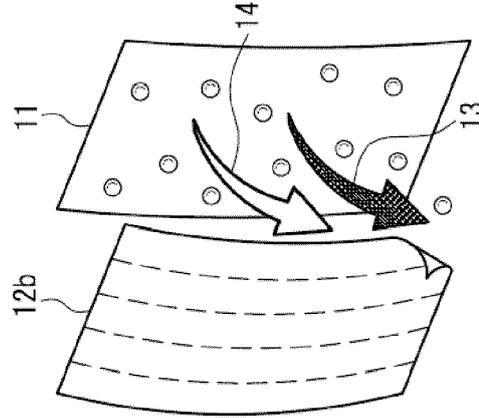


FIG. 1B

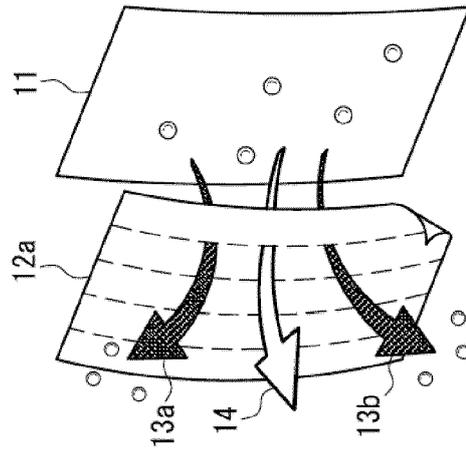


FIG. 1C

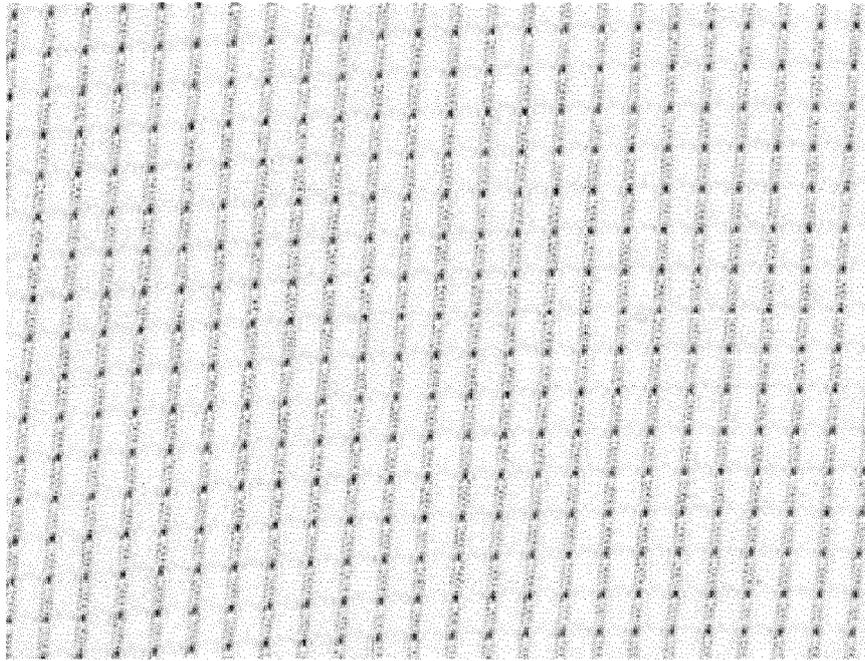


FIG. 2

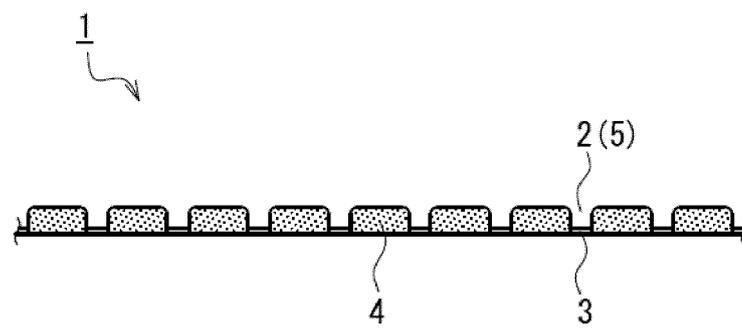
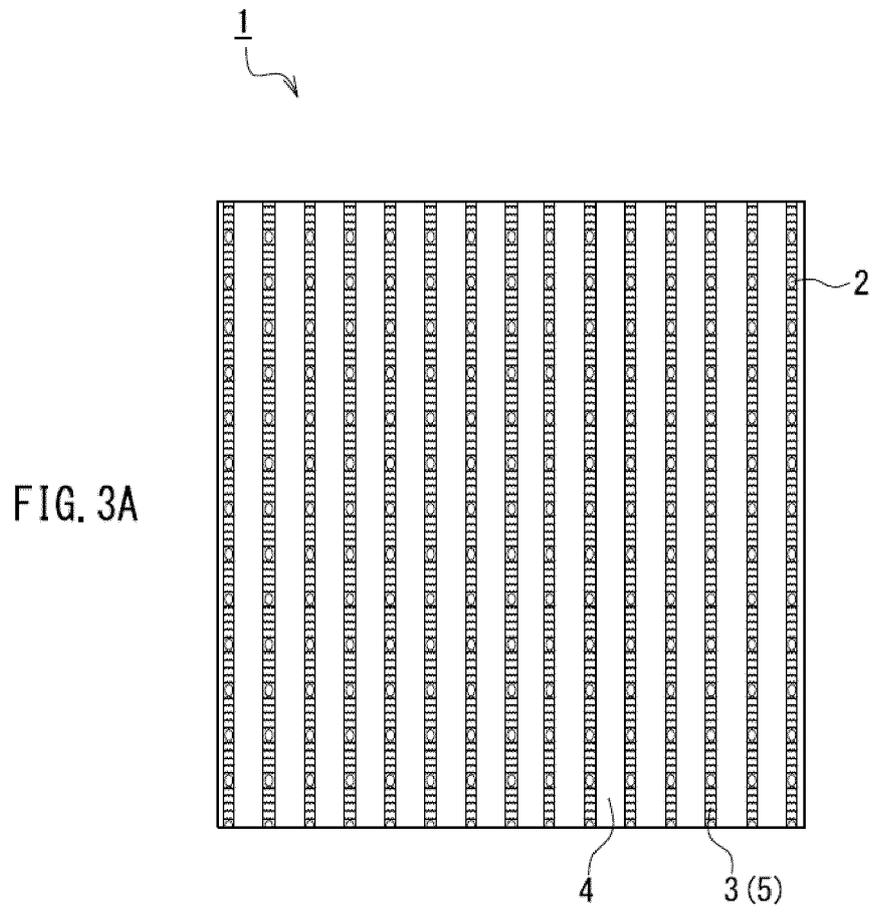


FIG. 3B

FIG. 4A

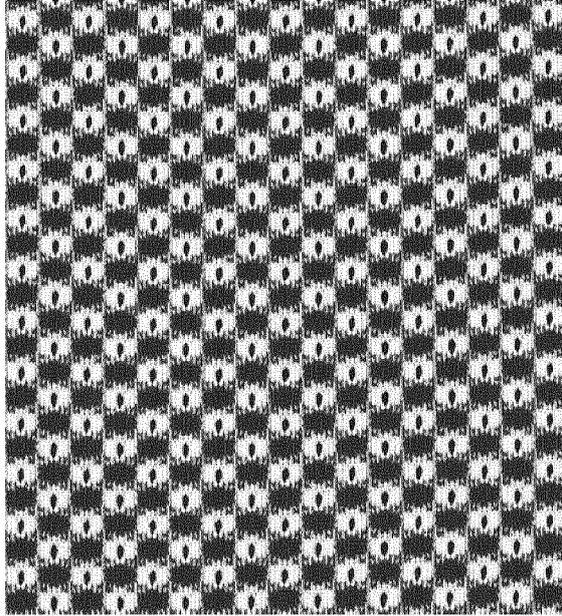
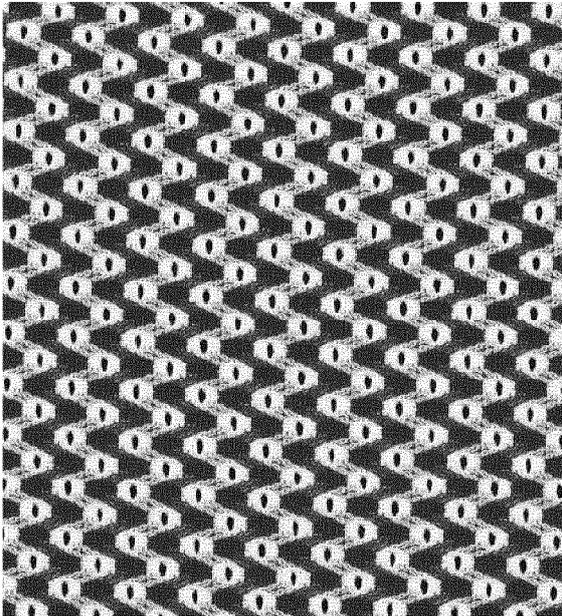
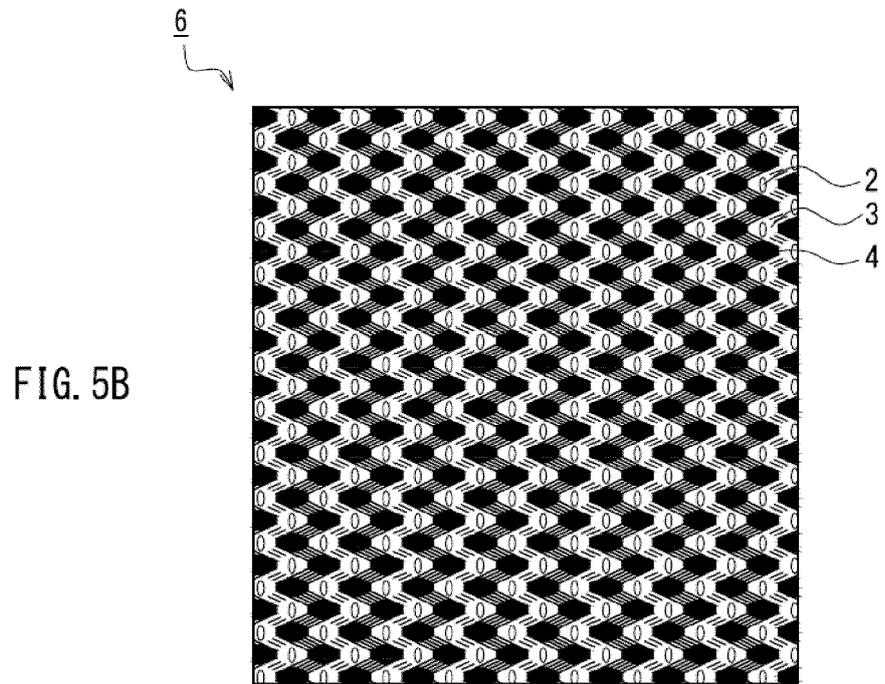
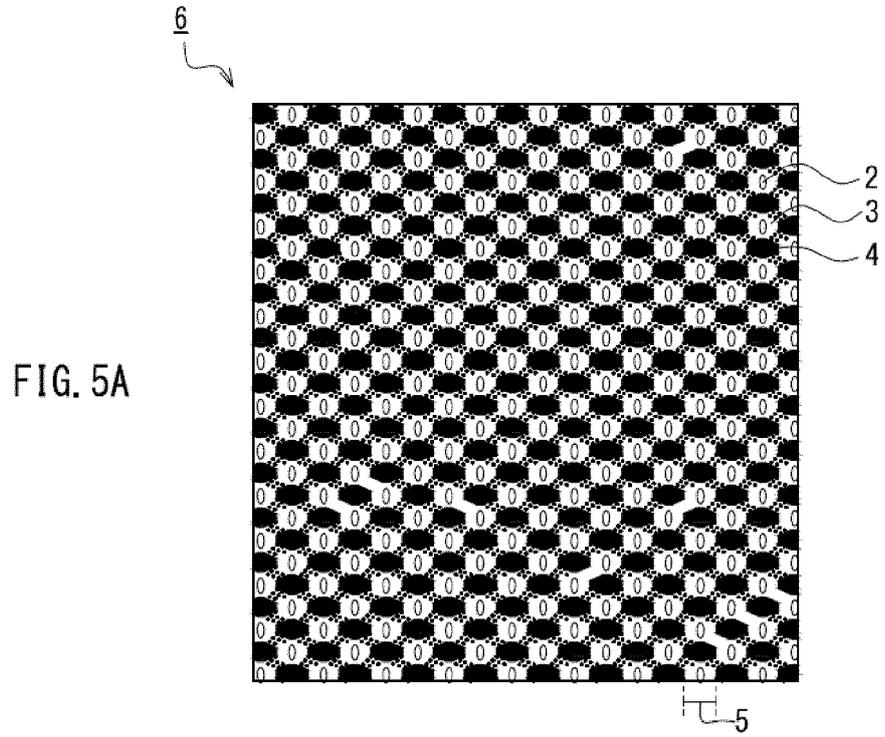


FIG. 4B





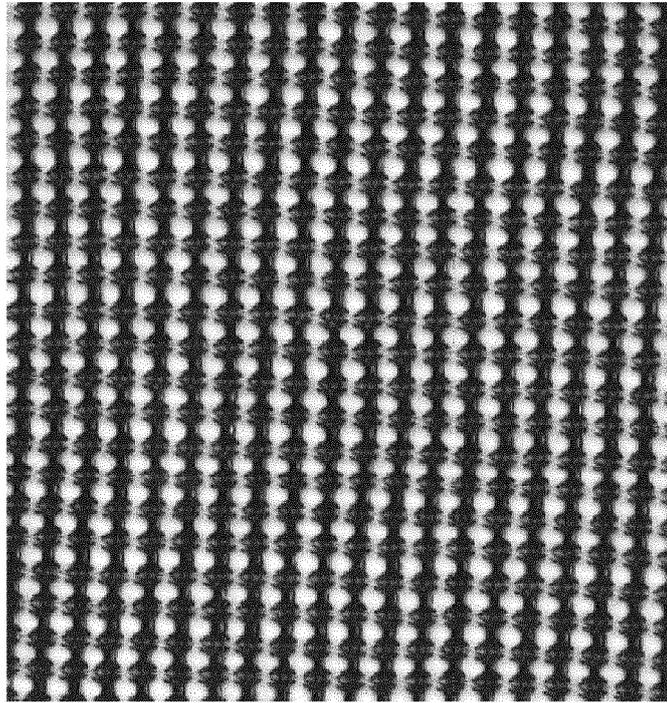


FIG. 6

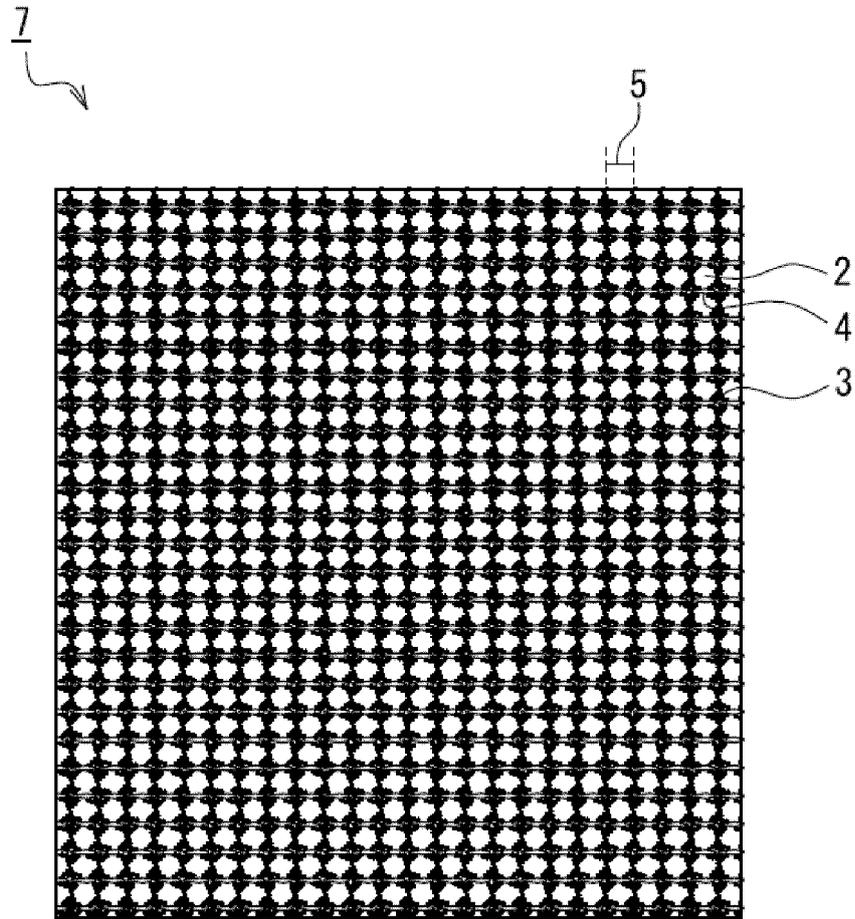


FIG. 7

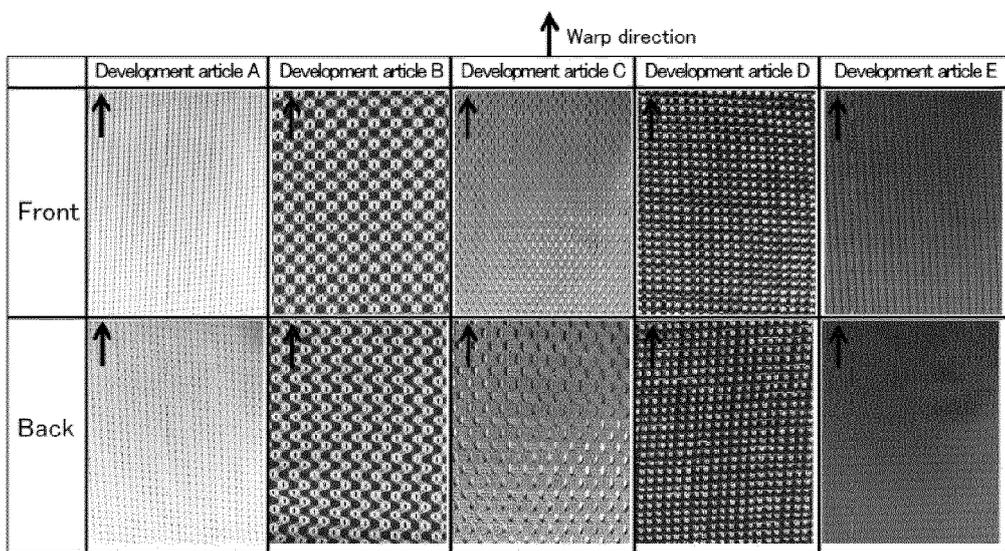


FIG. 8

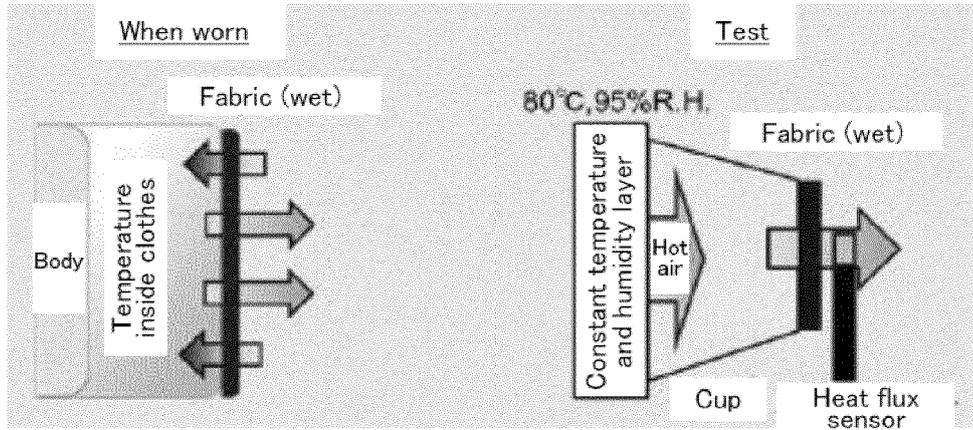


FIG. 9A

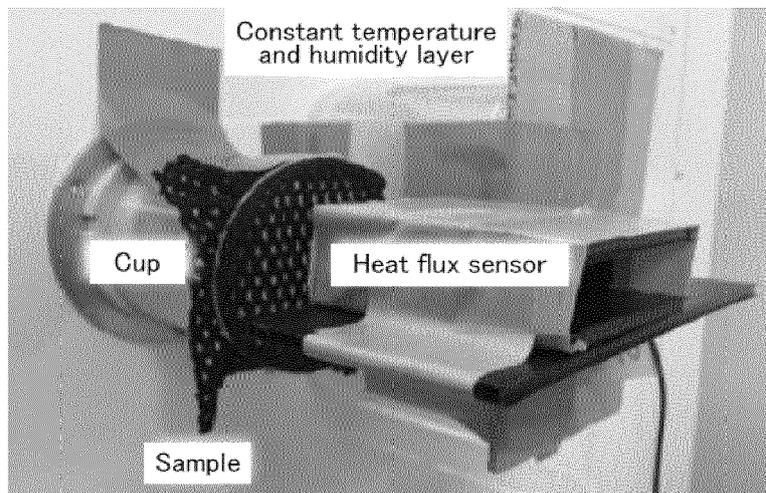


FIG. 9B

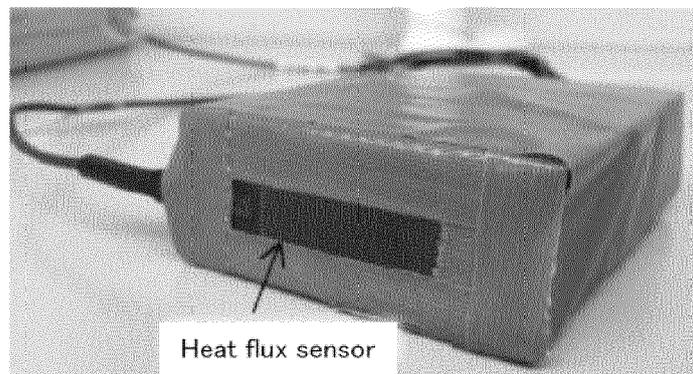


FIG. 9C

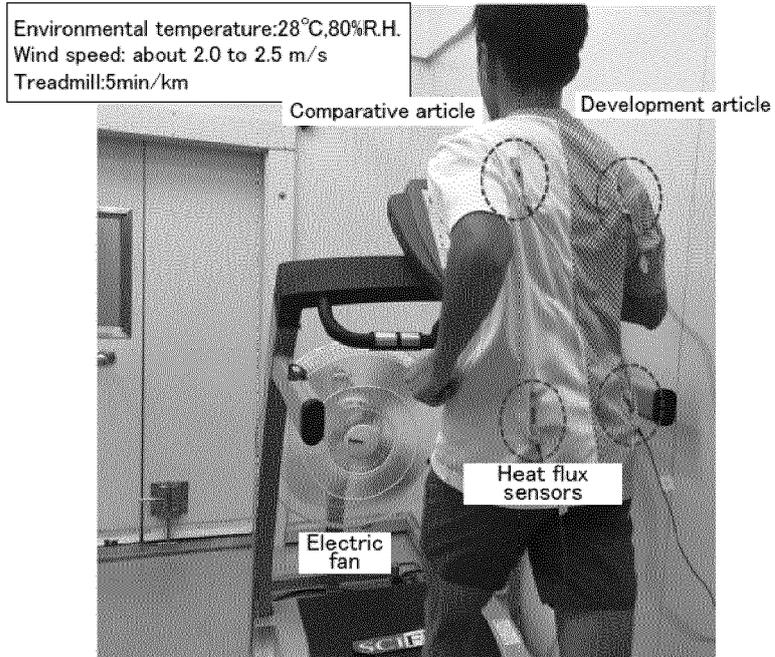


FIG. 10A

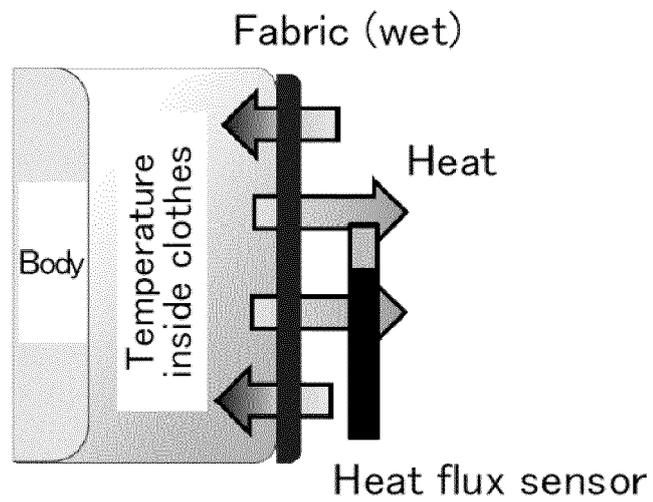


FIG. 10B

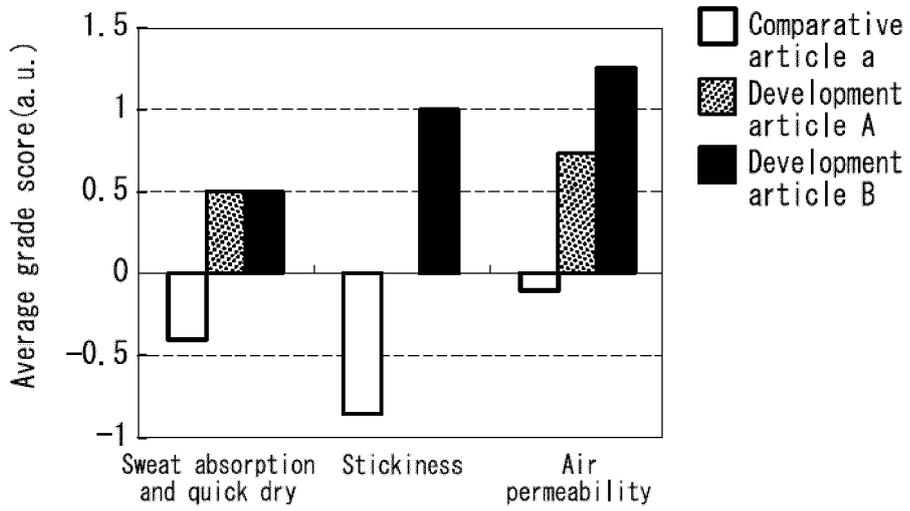


FIG. 11

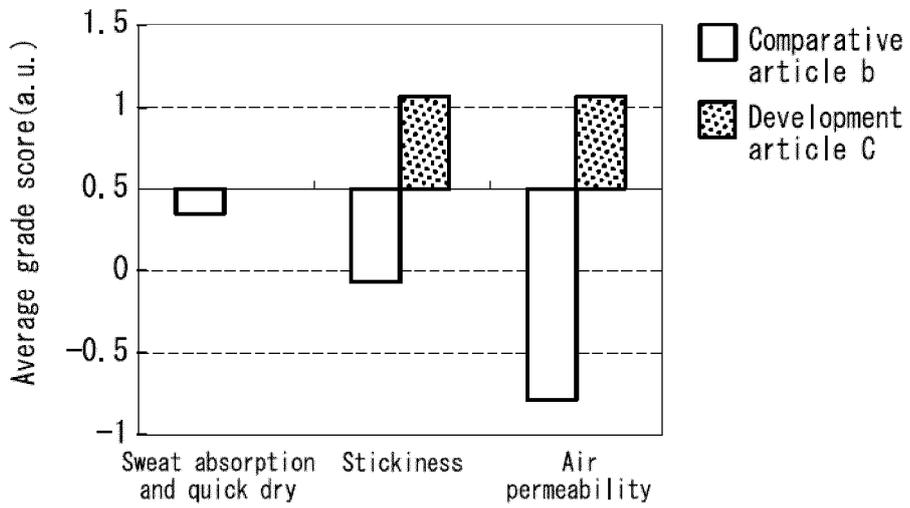


FIG. 12



EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2014/109282 A1 (WHITE THOMAS [US] ET AL) 24 April 2014 (2014-04-24) * page 1, line 3 - line 5; figure 1 * * page 4, line 29 * * page 5, line 8 - line 14 * * page 5, line 32 - line 33 * * page 6, line 14 - line 16 *	1-13	INV. A41D27/28 A41D31/14 A41D31/12
X	WO 2007/091023 A1 (UMBRO INTERNAT LTD [GB]; BLANCH DAVID [GB]) 16 August 2007 (2007-08-16) * figures 1,2 *	1-13	
			TECHNICAL FIELDS SEARCHED (IPC)
			A41D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 March 2019	Examiner van Voorst, Frank
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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15-03-2019

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