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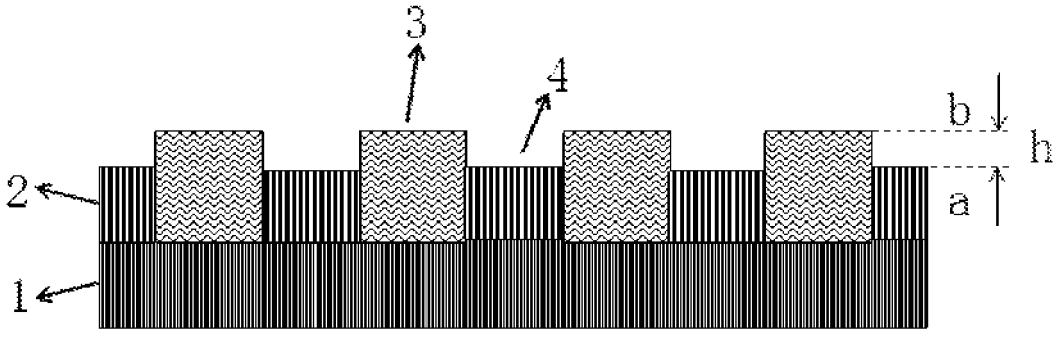
(54) **DOUBLE-SIDED KNITTED FABRIC**

(57) A double-sided knitted fabric comprises a surface layer (1) and an inner layer (2), which are connected in a looping manner. The inner layer (2) has a concavo-convex structure, and at least one of the longitudinal and lateral directions of each convex portion unit (3) is composed of 3 to 10 loops. The skin-contact surface of the double-sided knitted fabric has excellent dry performance, has good comfort for wearing, and is especially suitable for production of T-shirts, POLO shirts and the like.

FIG. 1



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Description

Field of the Invention

[0001] The present invention relates to a double-sided knitted fabric, specifically to a double-sided knitted fabric which can maintain the dry feeling of human skin.

Background of the Invention

[0002] With the increasing advancement of science and technology, new design concepts are constantly applied to the development of garment materials. In hot summer, sweat treatment has become an important issue in the field of clothing. In hot summer, the temperature of human body is generally reduced to a comfortable temperature by excreting sweat. However, when the human body sweats a lot, the clothing is easily soaked by the sweat and adheres to the skin, thus hindering further perspiration and cooling of the human body, and causing discomfort such as stuffiness and pressure.

[0003] At present, there are many technologies on the market for water absorption and perspiration, which have certain effects on treating a small amount of sweat, but when the human body sweats a lot, the fabric still adheres to the skin, causing discomfort. For example, a three-dimensional water-conducting single-sided double-layer knitted fabric was disclosed in the patent document CN204281985U, wherein the surface layer is a moisture-absorbing and quick-drying layer formed by hydrophilic modified polyester low-elastic yarn fibers, the inner layer is a water-repellent layer formed by nylon coated yarns, the moisture-absorbing and quick-drying layer protrudes to the water-repellent layer to form a U-shaped structure, the fabric absorbs sweat through the U-shaped structure, while the water-repellent layer prevents the fabric from adhering to the skin when sweating, thus, the fabric has a certain dry effect. However, when the human body produces a large amount of sweat, the thickness of the water-repellent layer is insufficient to prevent the surface layer of the fabric from adhering to human skin due to the use of the single-sided structure, and further, the convex U-shaped structure itself is in contact with the skin, so the fabric soaked with sweat is more likely to adhere to the skin; in addition, because the inner layer is a water-repellent layer, the sweat absorption capacity is insufficient, and the sweat is difficult to discharge in time.

[0004] For another example, a fabric for clothing was disclosed in Japanese Patent Laid-Open No. 2011-226026A, wherein the inner layer is formed with lateral or longitudinal grooves, the convex portions between the grooves are formed by water-repellent yarns, and sweat on the skin can flow through the convex portions to the grooves and flow out through the grooves by means of the gravity of the sweat itself, so the fabric brings a dry effect to the skin surface to a certain extent. However, because the convex portions are formed by the water-repellent yarns, the sweat absorption performance is low, and sweat cannot be conducted to the surface in time when sweating a lot; in addition, the continuous convex portions cause the skin to have strong tactile sensations and the wearing comfort is insufficient.

[0005] For another example, a double-sided knitted fabric having an evaporation layer and a moisture-conducting layer was disclosed in the patent document CN204281985U, wherein a certain air circulation space is formed between the skin and the fabric by providing a concavo-convex structure for the moisture-conducting layer, to bring a cool feeling to the human body; at the same time, through the linear density difference between the evaporation layer and the moisture-conducting layer, the unidirectional moisture conduction of the fabric is increased, and the quick-drying effect is improved. However, the concavo-convex structure is connected and formed by tucking, and the concave portion has no moisture-conducting loops, so that the perspiration performance of the fabric is greatly reduced; further, when the human body produces a large amount of sweat, if the sweat conduction and perspiration simply depend on the convex portion in contact with the skin, the problem that the fabric adheres to the skin still cannot be effectively solved.

[0006] Therefore, it is very significant to develop a fabric which can still maintain a dry feeling of the skin surface in the case of excessive sweating.

Summary of the Invention

[0007] In view of the above problems, the object of the present invention is to provide a double-sided knitted fabric which is simple in processing and does not adhere to the skin while maintaining a dry feeling of the skin surface in the case of excessive sweating. The technical solution of the present invention is as follows:
A double-sided knitted fabric according to the present invention includes a surface layer and an inner layer which are connected in a looping manner, the inner layer has a concavo-convex structure, and at least one of the longitudinal and lateral directions of each convex portion unit is composed of 3 to 10 loops.

[0008] The fabric of the present invention is obtained by forming a specific concavo-convex structure in the inner layer with the use of a double-sided full-looping structure. The specific concavo-convex structure discharges sweat in time, so that the problem that the fabric adheres to the skin is effectively solved, the dry performance of the skin-contact surface can be maintained even in the case of excessive sweating, and the fabric has good comfort for wearing and is

especially suitable for production of T-shirts, POLO shirts and the like.

Brief Description of the Drawings

[0009]

Fig. 1 is a structure diagram of a double-sided knitted fabric according to the present invention, wherein 1 represents a surface layer, 2 represents an inner layer, 3 represents a convex portion of the inner layer, 4 represents a concave portion of the inner layer, and h represents the height of the convex portion of the inner layer.

Fig. 2 is a schematic diagram of a concavo-convex structure unit, wherein 5 represents the number of lateral loops of a convex portion unit, 6 represents the number of longitudinal loops of the convex portion unit, 7 represents the number of lateral loops of a concave portion unit, and 8 represents the number of longitudinal loops of the concave portion unit.

Detailed Description of the Embodiments

[0010] In view of the fact that a single-sided structure is too thin to effectively prevent a fabric soaked with sweat from adhering to the skin, a double-sided structure having a surface layer and an inner layer, which is knitted using a double-sided circular knitting machine, is used in the present invention. In the double-sided circular knitted fabric, the surface layer and the inner layer are connected in three manners. The first is tucking, that is, two sides of both a dial and a work drum tuck loops, the connected yarns are sandwiched between the two layers, and when the human body perspires, since the surface of the inner layer is relatively flat, sweat is easily diffused in the inner layer, so that it is difficult to obtain a dry feeling on the skin surface. The second is looping, that is, both the dial and the work drum form loops, the connected yarns have loops on two sides, and a surface having a concavo-convex structure can be obtained by a structure design or a length difference of knitted yarns, so that the fabric and the skin form point contact to increase the air circulation space therebetween, and the human body has a refreshing feeling; in addition, sweat can be quickly conducted out of the surface through the concave portion formed by connecting yarns on the inner layer to achieve a dry feeling of the skin surface. The third is a combination of tucking and looping, that is, the dial implements looping and the work drum implements tucking, or the dial implements tucking and the work drum implements looping, and the connected yarns form meshes on one side of the loops; although such a mesh structure can increase the air circulation space between the fabric and the skin to some extent, loops that can be used for conducting sweat are not formed at the pores of the meshes, and the perspiration can only depend on the non-mesh portion in contact with the human skin, so that the dry effect is greatly reduced. Accordingly, the present invention uses the looping manner to connect the surface layer and the inner layer.

[0011] In the present invention, the arrangement of the concavo-convex structure is not particularly limited, and the concavo-convex structure may be continuous or discontinuous. However, in view of the convenience of knitting, the concavo-convex structure is preferably arranged continuously.

[0012] In addition, in the concavo-convex structure, the size of the convex portion unit also affects the dry effect of the fabric. When the number of respective longitudinal and lateral loops constituting the convex portion unit is less than three, the fabric in direct contact with the skin per unit area is too small, so it is difficult to form an effective air circulation passage in the clothing, and the dry effect is poor. When the number of respective longitudinal and lateral loops constituting the convex portion unit is more than 10, a large convex portion is formed in the inner layer, so the skin contact feeling is poor, sweat easily spreads and stays in the convex portion, and it is difficult to improve the dry effect. Therefore, in the concavo-convex structure of the present invention, at least one of the longitudinal and lateral directions of each convex portion unit is composed of 3 to 10 loops, and more preferably, both the longitudinal and lateral directions are composed of 3 to 10 loops.

[0013] The size of the concave portion unit in the concavo-convex structure is not particularly limited in the present invention. In view of the fact that when the number of respective longitudinal and lateral loops constituting the concave portion unit is less than three, the sweat-conducting capability declines, and the sweat may stay in the inner layer of the fabric; when the number of respective longitudinal and lateral loops constituting the concave portion unit is more than 10, although the sweat-conducting performance is improved, the probability of contact between the concave portion and the fabric increases, so that the fabric may adhere to the skin after the sweat is absorbed. Therefore, at least one of the longitudinal and lateral directions of each concave portion unit is preferably composed of 3 to 10 loops in the present invention, and more preferably, both the longitudinal and lateral directions are composed of 3 to 10 loops.

[0014] In view of the fact that the height of the convex portion unit has certain influence on the dry effect of the fabric in the concavo-convex structure of the inner layer of the fabric, the height of the convex portion unit is preferably 0.05 to 0.40 mm, and more preferably 0.10 to 0.30 mm. When the height of the convex portion unit is less than 0.05 mm, the contact area between the fabric and the skin tends to increase, and the fabric may be soaked by sweat and adhere to

the skin after sweating. Generally, the higher the convex portion unit is, the more it can block the contact between the fabric and the skin, and the better the dry effect is. However, when the height of the convex portion unit is more than 0.40 mm, there may be a feeling of itching when wearing, and the wearing comfort is lowered.

[0015] In the present invention, the convex portion fibers forming the reverse side of the fabric are very critical. Mainly considering from two aspects, on the one hand, if non-polyester fibers such as cellulose fibers and nylon fibers are used, as these fibers have a superior hygroscopic property, the reverse side of the fabric easily absorbs a large amount of moisture, and some of the moisture is difficult to diffuse to the surface in time, so that the water retention on the reverse side may increase, the wearing comfort may be reduced, and a sultry feeling may be produced; and on the other hand, if non-elastic polyester fibers are used, yarns contract little during processing after knitting, so that desired convex portion height may not be obtained, and the quick-drying effect is not obvious. Therefore, the convex portion fibers for the reverse side of the fabric according to the present invention are preferably polyester elastic fibers.

[0016] The polyester elastic fibers used in the present invention are preferably elastic fibers having a contractile recovery ratio (CR value) of 30 to 70%. The polyester elastic fibers having a CR value within this range have a good curling property, the convex portion height of the reverse side of the fabric formed by the polyester elastic fibers is proper, and even in the case of excessive sweating, the fabric is unlikely to adhere to the skin and can always keep a dry feeling in contact with the skin. The CR value is more preferably 40 to 60%.

[0017] The type of the polyester-based elastic fibers used in the present invention is not particularly limited, and they may be single-component elastic fibers, double-component side-by-side elastic fibers, high-elastic false-twisted yarns or the like, preferably polybutylene terephthalate (PBT), polytrimethylene terephthalate (PTT), polybutylene terephthalate/polyethylene terephthalate (PBT/PET), polytrimethylene terephthalate/polyethylene terephthalate (PTT/PET), and high-viscosity PET/ low-viscosity PET. However, in view of the fact that the double-component side-by-side elastic fibers have a better bundling property than the single-component elastic fibers and are more advantageous for improving the yarn hooking resistance of the fabric, the double-component side-by-side elastic fibers are preferred. In addition, the form of the elastic fibers is not particularly limited, and the elastic fibers may be fully-drawn yarns (FDY) or draw textured yarns (DTY).

[0018] The fineness of the polyester elastic fibers used in the present invention is preferably 50 to 200 denier (D), more preferably 60 to 80 denier (D), to ensure the gram weight and soft handfeel of the fabric.

[0019] In the present invention, yarns of the surface layer, yarns of the concave portion of the inner layer and connecting yarns may be made of the same or different fiber raw materials, which is not particularly limited. The different fiber raw materials may be cellulose fibers such as cotton and viscose, synthetic fibers such as non-elastic ordinary polyester fibers and nylon fibers, or protein fibers such as wool and silk.

[0020] In order to endow excellent elasticity to the fabric, bare spandex yarns may also be used for mixed knitting in the present invention. The fineness of the bare spandex yarns is preferably 20 to 70 D. The larger the fineness of the spandex is, the larger the shrinkage of the fabric is, and the thicker the fabric is. In order to ensure the light weight of the fabric, the fineness of the bare spandex yarns in the present invention is more preferably 20 to 40 D.

[0021] In the knitted fabric of the present invention, the water retention rate of the inner layer is preferably 10% or less, and more preferably 5% or less. The ratio of the water retention rates of the surface and inner layers is preferably 3.0 or more, and more preferably 3.0 to 40.0. The larger the ratio of the water retention rates of the surface and inner layers is, and the smaller the water retention rate of the inner layer is, the better the dry performance of the fabric is. Even in the case of excessive sweating, the sweat can be quickly absorbed and spread to the surface in time, and the surface in contact with the skin can always maintain a dry feeling without affecting the comfort of continuous wearing.

[0022] The present invention will be further illustrated below with examples and comparative examples. The properties in the examples were tested and obtained by the following methods.

(1) Height of the convex portion in the concavo-convex structure of the inner layer of the fabric

[0023] First, cut a 1.0cm*0.5cm sample according to the knitted grains of the fabric, and stick the sample to a convex sample stage (the longitudinal direction of the fabric is perpendicular to the surface of the convex sample stage); and second, observe the cross section of the prepared sample using a KEYENCE VHX-2000C microscope. Specifically, adjust the magnification of the microscope to 150 times, perform depth synthesis and 3D display at an observed position, then select a straight line a tangent to the surfaces of two adjacent concave portions, select another straight line b parallel to the straight line a and tangential to two adjacent convex portions, and measure the distance h between the two straight lines a and b, that is, the height of the convex portion;

According to this method, measure 10 positions of the sample fabric respectively, remove two largest values and two smallest values to obtain six intermediate values, and calculate an average value of the six intermediate values, the average value being the height of the convex portion in the concavo-convex structure of the inner layer of the fabric.

(2) Ratio of the water retention rate of the inner layer to the water retention rate of the surface layer

[0024]

1. Cut three pieces of 10cm*10cm sample fabric from the fabric, select six pieces of filter paper of the same size, and select one piece of organic glass of the same size; weigh the organic glass (W_0) and the weight (W_1) of the sample fabric at a temperature of 20°C and a humidity of 65% (retaining three decimal places);
2. measure 2 ml of distilled water with a syringe, put the distilled water on the organic glass, quickly place the sample fabric on the water for 1 minute, and then weigh the sample fabric (W_2) after water absorption (retaining three decimal places);
3. weigh the organic glass and the remaining distilled water (W_3) after the test (retaining three decimal places);
4. weigh two pieces of filter paper (wl, w3) before the water absorption (retaining three decimal places);
5. place the sample fabric after the water absorption between the two pieces of filter paper, place a 500-gram object on it for 1 minute, and then directly measure the weights (w2, w4) of the surface filter paper and the inner filter paper (retaining three decimal places);
6. calculate the ratio of the surface and inner water retention rates by the following formula (retaining one decimal place),

$$\text{Surface water retention rate (\%)} = (w2-w1) / (W_2-W_1) * 100$$

$$\text{Inner water retention rate (\%)} = (w4-w3) / (W_2-W_1) * 100$$

$$\text{Ratio of surface and inner water retention rates} = \text{surface water retention rate (\%)} / \text{inner water retention rate (\%)}$$

W_0: weight (g) of the organic glass before water absorption
W_1: weight (g) of the sample fabric before water absorption
W_2: weight (g) of the sample fabric after water absorption
W_3: weight (g) of the organic glass and the remaining distilled water after water absorption
w1: weight (g) of the surface filter paper before water absorption
w2: weight (g) of the surface filter paper after water absorption
w3: weight (g) of the inner filter paper before water absorption
w4: weight (g) of the inner filter paper after water absorption.

(3) Contractile recovery rate (CR) value

[0025]

a. First, humidify yarns to be tested under standard atmospheric pressure for 12 hours;
b. select 10m long yarns (10 loops * 1 m / loop) to be tested using a measuring reel, knot yarn heads and yarn tails, tie the reeled yarns with color marking threads for marking, and hang the yarns on a test rack;
c. place the reeled yarns in the standard atmospheric condition and equilibrate for more than 12 hours before heat treatment;
d. add a certain amount of soft water to a thermostatic water bath to ensure that the sample can be completely submerged and cannot touch the wall of the water bath, and set the temperature of the water bath to 90°C; fold the sample two times, put the sample in a relaxed state into a mesh bag, carefully put the mesh bag filled with the sample into hot water, uniformly stir with a glass rod for 20 minutes, carefully take the mesh bag out with a clip after the heat treatment and put it into a tray, hang the sample loosely without tension after the mesh bag is cooled, and equilibrate in standard atmosphere after the heat treatment;
e. calculate an initial load and a constant load: initial load (g): 0. 002 g/ D×D×2× loops, constant load (g): 0.1 g/ D×D×2× loops, D: yarn fineness (denier);
f. put soft water into a large test measuring cylinder one day in advance, and adjust the temperature to 20°C * 12 hours under standard atmospheric pressure;

g. hang the sample on a yarn hanging hook, sequentially hang the initial load and the constant load on the color marking threads at the other end (pay attention to the adjustment of the tension), put the sample into the soft water in the large test measuring cylinder, meanwhile, time with a stopwatch, and read the length L of the sample with a ruler to nearest 1 mm after 2 minutes; take the constant load down with a hook, keep the state of the initial load, place for 2 minutes, and read the length L1 of the sample with the ruler after 2 minutes to nearest 1 mm, wherein the calculation formula of contractile recovery rate (i.e., yarn CR value) is:

$$CR = \frac{L - L1}{L} \times 100$$

in which:

CR: contractile recovery rate, %;
L: length of the sample under the initial load and the constant load, mm;
L1: length of the sample under the initial load after the constant load is removed, mm.

(4) Elasticity

[0026] Test elastic elongation according to a JIS L 1096: 2010D method, wherein
elastic elongation ≥ 60% is judged to be excellent, indicated by A;
45% ≤ elastic elongation < 60% is judged to be good, indicated by B;
elastic elongation < 45% is judged to be ordinary, indicated by C.

(5) Yarn hooking resistance

[0027] Test yarn hooking resistance according to a JIS L1058: 2011 method, wherein
yarn hooking resistance ≥ Level 4 is judged to be excellent, indicated by A;
level 3 ≤ yarn hooking resistance < Level 4 is judged to be good, indicated by B;
yarn hooking resistance< Level 3 is judged to be ordinary, indicated by C.

Example 1

[0028] On a 28-needle double-sided circular knitting machine, 75D-72f-common PET DTY (Toray Synthetic Fiber (Nantong) Co., Ltd.) in odd rows and 60D-24f-PBT DTY (CR value: 49%, Toray Synthetic Fiber (Nantong) Co., Ltd.) in even rows were knitted under a 12-row knitting cycle to obtain a gray fabric, and then pretreatment (refining agent lg/L, temperature 95°C), dyeing (disperse dye, 130°C *30 min) and after-treatment (hydrophilic resin 10 g/L, neutralization acid lg/L) were performed on the gray fabric to obtain a knitted fabric of the present invention. The specific properties were shown in Table 1.

[0029] During knitting, in the 1st, 3rd and 5th rows, all needles on a dial fully looped yarns to form a surface layer, and the 4th to 6th needles on a work drum looped yarns to form a concave portion of an inner layer; in the 7th, 9th and 11th rows, all the needles on the dial fully looped yarns to form a surface layer, and the 1st to 3rd needles on the work drum looped yarns to form a concave portion of next cycle; in the 2nd, 4th and 6th rows, the 1st to 3rd needles on the work drum looped yarns and the 4th to 6th needles floated over yarns to form a convex portion of the inner layer; and in the 8th, 10th and 12th rows, the 1st to 3rd needles on the work drum floated over yarns and the 4th to 6th needles looped yarns to form a convex portion of next cycle.

Example 2

[0030] 20 rows of yarns as a knitting cycle were knitted to obtain a gray fabric. During knitting, in the 1st, 3rd, 5th, 7th and 9th rows, all needles on a dial fully looped yarns to form a surface layer, and the 4th to 6th needles on a work drum looped yarns to form a concave portion of an inner layer; in the 11th, 13th, 15th, 17th and 19th rows, all the needles on the dial fully looped yarns to form a surface layer, and the 1st to 3rd needles on the work drum looped yarns to form a concave portion of next cycle; in the 2nd, 4th, 6th, 8th and 10th rows, the 1st to 10th needles on the work drum looped yarns and the 11th to 15th needles floated over yarns to form a convex portion of the inner layer; in the 12th, 14th, 16th, 18th and 20th rows, the 1st to 5th needles on the work drum floated over yarns and the 6th to 15th needles looped yarns to form a convex portion of next cycle, the rest was the same as Example 1, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 3

[0031] 12 rows of yarns as a knitting cycle were knitted to obtain a gray fabric. During knitting, in the 1st, 3rd and 5th rows, all needles on a dial fully looped yarns to form a surface layer, and the 6th to 8th needles on a work drum looped yarns to form a concave portion of an inner layer; in the 7th, 9th and 11th rows, all the needles on the dial fully looped yarns to form a surface layer, and the 1st to 3rd needles on the work drum looped yarns to form a concave portion of next cycle; in the 2nd, 4th and 6th rows, the 1st to 5th needles on the work drum looped yarns and the 6th to 8th needles floated over yarns to form a convex portion of the inner layer; and in the 8th, 10th and 12th rows, the 1st to 3rd needles on the work drum floated over yarns and the 4th to 8th needles looped yarns to form a convex portion of next cycle. The rest was the same as Example 1, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 4

[0032] 60S cotton spun yarns (Jiangsu Wuxi First Cotton Spinning Factory) in odd rows and 75D-48f-PBT/PET DTY (CR value: 41%, Toray Synthetic Fiber (Nantong) Co., Ltd.) in even rows were knitted under a 20-row knitting cycle to obtain a gray fabric. During knitting, in the 1st, 3rd, 5th, 7th and 9th rows, all needles on a dial fully looped yarns to form a surface layer, and the 6th to 9th needles on a work drum looped yarns to form a concave portion of an inner layer; in the 11th, 13th, 15th, 17th and 19th rows, all the needles on the dial fully looped yarns to form a surface layer, and the 1st to 4th needles on the work drum looped yarns to form a concave portion of next cycle; in the 2nd, 4th, 6th, 8th and 10th rows, the 1st to 5th needles on the work drum looped yarns and the 6th to 9th needles floated over yarns to form a convex portion of the inner layer; in the 12th, 14th, 16th, 18th and 20th rows, the 1st to 4th needles on the work drum floated over yarns and the 5th to 9th needles looped yarns to form a convex portion of next cycle, the rest was the same as Example 1, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 5

[0033] 40D-24f-nylon FDY (Toray Synthetic Fiber (Nantong) Co., Ltd.) in odd rows and 50D-24f-PTT DTY (CR value: 31%, Toray Synthetic Fiber (Nantong) Co., Ltd.) in even rows were knitted under a 20-row knitting cycle to obtain a gray fabric. During knitting, in the 1st, 3rd, 5th, 7th and 9th rows, all needles on a dial fully looped yarns to form a surface layer, and the 6th to 8th needles on a work drum looped yarns to form a concave portion of an inner layer; in the 11th, 13th, 15th, 17th and 19th rows, all the needles on the dial fully looped yarns to form a surface layer, and the 1st to 3rd needles on the work drum looped yarns to form a concave portion of next cycle; in the 2nd, 4th, 6th, 8th and 10th rows, the 1st to 5th needles on the work drum looped yarns and the 6th to 8th needles floated over yarns to form a convex portion of the inner layer; in the 12th, 14th, 16th, 18th and 20th rows, the 1st to 3rd needles on the work drum floated over yarns and the 4th to 8th needles looped yarns to form a convex portion of next cycle, the rest was the same as Example 1, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 6

[0034] 60S polyester/ viscose blended spun yarns (Jiangsu Wuxi First Cotton Spinning Factory) in odd rows and 50D-24f-PTT/PET FDY (CR value: 40%, Toray Synthetic Fiber (Nantong) Co., Ltd.) in even rows were knitted under a 16-row knitting cycle to obtain a gray fabric. During knitting, in the 1st, 3rd, 5th and 7th rows, all needles on a dial fully looped yarns to form a surface layer, and the 7th to 10th needles on a work drum looped yarns to form a concave portion of an inner layer; in the 9th, 11th, 13th and 15th rows, all the needles on the dial fully looped yarns to form a surface layer, and the 1st to 4th needles on the work drum looped yarns to form a concave portion of next cycle; in the 2nd, 4th, 6th and 8th rows, the 1st to 6th needles on the work drum looped yarns and the 7th to 10th needles floated over yarns to form a convex portion of the inner layer; in the 10th, 12th, 14th and 16th rows, the 1st to 4th needles on the work drum floated over yarns and the 5th to 10th needles looped yarns to form a convex portion of next cycle, the rest was the same as Example 1, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 7

[0035] 60D-24f-PBT DTY (CR value: 35%, Toray Synthetic Fiber (Nantong) Co., Ltd.) were used in even rows, the rest was the same as Example 3, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 8

[0036] 60D-36f-ordinary PET DTY (CR value: 20%, Toray Synthetic Fiber (Nantong) Co., Ltd.) were used in even rows, the rest was the same as Example 3, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 9

[0037] 75D-72f-ordinary PET DTY (Toray Synthetic Fiber (Nantong) Co., Ltd.) and 30D polyurethane (Invista) in odd rows and 75D-36f-high-elastic PET DTY (CR value: 30%, Toray Synthetic Fiber (Nantong) Co., Ltd.) in even rows were used, the rest was the same as Example 3, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 10

[0038] 75D-72f-ordinary PET DTY (Toray Synthetic Fiber (Nantong) Co., Ltd.) in odd rows and 75D-48f-PBT/DTY (CR value: 41%, Toray Synthetic Fiber (Nantong) Co., Ltd.) in even rows were used, the rest was the same as Example 4, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 11

[0039] 75D-72f-ordinary PET DTY (Toray Synthetic Fiber (Nantong) Co., Ltd.) in odd rows and 50D-24f-PTT DTY (CR value: 31%, Toray Synthetic Fiber (Nantong) Co., Ltd.) in even rows were used, the rest was the same as Example 5, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 12

[0040] 75D-72f-ordinary PET DTY (Toray Synthetic Fiber (Nantong) Co., Ltd.) in odd rows and 50D-24f-PTT/PET FDY (CR value: 40%, Toray Synthetic Fiber (Nantong) Co., Ltd.) in even rows were used, the rest was the same as Example 6, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 13

[0041] 8 rows of yarns as a knitting cycle were knitted to obtain a gray fabric. During knitting, in the 1st and 3rd rows, all needles on a dial fully looped yarns to form a surface layer, and the 4th and 5th needles on a work drum looped yarns to form a concave portion of an inner layer; in the 5th and 7th rows, all the needles on the dial fully looped yarns to form a surface layer, and the 1st and 2nd needles on the work drum looped yarns to form a concave portion of next cycle; in the 2nd and 4th rows, the 1st to 3rd needles on the work drum looped yarns and the 4th and 5th needles floated over yarns to form a convex portion of the inner layer; in the 6th and 8th rows, the 1st and 2nd needles on the work drum floated over yarns and the 3rd to 5th needles looped yarns to form a convex portion of next cycle, the rest was the same as Example 1, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 14

[0042] 12 rows of yarns as a knitting cycle were knitted to obtain a gray fabric. During knitting, in the 1st, 3rd and 5th rows, all needles on a dial fully looped yarns to form a surface layer, and the 3rd to 5th needles on a work drum looped yarns to form a concave portion of an inner layer; in the 7th, 9th and 11th rows, all the needles on the dial fully looped yarns to form a surface layer, and the 1st to 3rd needles on the work drum looped yarns to form a concave portion of next cycle; in the 2nd, 4th and 6th rows, the 1st and 2nd needles on the work drum looped yarns and the 3rd to 5th needles floated over yarns to form a convex portion of the inner layer; in the 8th, 10th and 12th rows, the 1st to 3rd needles on the work drum floated over yarns and the 4th and 5th needles looped yarns to form a convex portion of next cycle, the rest was the same as Example 1, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 15

[0043] Intermediate setting (temperature: 190°C, speed: 20 m/min) was added between the pretreatment and the dyeing, the rest was the same as Example 3, and a knitted fabric of the present invention was obtained. The specific

properties were shown in Table 1.

Example 16

[0044] 30D-24f-PBT DTY (CR value: 49%, Toray Synthetic Fiber (Nantong) Co., Ltd.) were used in even rows, the rest was the same as Example 3, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 17

[0045] 250D-96f-PBT DTY (CR value: 49%, Toray Synthetic Fiber (Nantong) Co., Ltd.) were used in even rows, the rest was the same as Example 3, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Example 18

[0046] 75D-48f-PBT DTY (CR value: 41%, Toray Synthetic Fiber (Nantong) Co., Ltd.) were used in even rows, the rest was the same as Example 10, and a knitted fabric of the present invention was obtained. The specific properties were shown in Table 1.

Comparative Example 1

[0047] 6 rows of yarns as a knitting cycle were knitted to obtain a gray fabric. During knitting, 75D-72f-ordinary PET DTY (Toray Synthetic Fiber (Nantong) Co., Ltd.) in the 1st and 4th rows formed a surface layer in a full looping manner, 60D-24f-PBT DTY (CR value: 49%, Toray Synthetic Fiber (Nantong) Co., Ltd.) in the 3rd and 6th rows formed an inner layer in a full looping manner, 75D-72f-ordinary PET DTY (Toray Synthetic Fiber (Nantong) Co., Ltd.) in the 2nd and 5th rows connected the surface layer and the inner layer on a dial and a work drum in a tucking manner, the rest was the same as Example 1, a knitted fabric was obtained, and the specific properties were shown in Table 1.

Comparative Example 2

[0048] During knitting, all needles on a dial looped yarns in the 1st, 3rd, 5th, 7th and 9th rows to form a surface layer; the 3rd needle on a work drum tucked yarns in the 2nd, 4th and 6th to connect the surface layer and an inner layer and form meshes of the inner layer; the 6th needle on the work drum tucked yarns in the 8th, 10th and 12th rows to connect the surface layer and the inner layer and form meshes of next cycle, the rest was the same as Example 1, and a knitted fabric was obtained. The specific properties were shown in Table 1.

Comparative Example 3

[0049] During knitting, 8 rows of yarns as a knitting cycle were knitted. All needles on a dial fully looped yarns in the 1st, 3rd, 5th and 7th rows to form a surface layer, the 3rd and 4th needles on a work drum looped yarns in the 1st and 3rd rows to form a concave portion of an inner layer, the 1st and 2nd needles on the work drum looped yarns in the 5th and 7th rows to form a concave portion of next cycle, the 1st and 2nd needles on the work drum looped yarns in the 2nd and 4th rows and the 3rd and 4th needles floated over yarns to form a convex portion of the inner layer; the 1st and 2nd needles on the work drum floated over yarns in the 6th and 8th rows and the 3rd and 4th needles looped yarns to form a convex portion of next cycle, the rest was the same as Example 1, and a knitted fabric was obtained. The specific properties were shown in Table 1.

Comparative Example 4

[0050] During knitting, 48 rows of yarns as a knitting cycle were knitted. All odd rows of yarns were fully looped on a dial to form a surface layer, and the odd rows of yarns among the 1st to 24th rows were looped by the 13th to 21st needles on a work drum to form a concave portion of an inner layer; the odd rows of yarns among the 25th to 48th rows were looped by the 1st to 9th needles on the work drum to form a concave portion of next cycle; the even rows of yarns among the 1st to 24th rows were looped by the 1st to 12th needles on the work drum and floated over the 13th to 21st needles to form a convex portion of the inner layer; the even rows of yarns among the 25th to 48th rows floated over 1st to 9th needles on the work drum and were looped by the 10th to 21st needles to form a convex portion of next cycle, the rest was the same as Example 1, and a knitted fabric was obtained. The specific properties were shown in Table 1.

Table 1

	Concavo-convex structure														
	Convex portion loops	loops (pieces)	Concave portion loops	loops (pieces)	Convex portion				Concave portion fibers	Surface and inner connection	Gram weight (g/m^2)	Water retention rate of inner layer (%)	Ratio of surface and inner water retention rates	Elasticity	Yarn hooking resistance
	Lateral	Longitudinal	Lateral	Longitudinal	Height (mm)	Raw fibers	CR value	Fineness (D)							
Ex. 1	3	3	3	3	0.05	PBT	49%	60	Ordinary PET	Looping	163	12.1	6.2	B	B
Ex. 2	10	5	5	5	0.35	PBT	49%	60	Ordinary PET	Looping	172	3.3	23.4	B	B
Ex. 3	5	3	3	3	0.40	PBT	49%	60	Ordinary PET	Looping	159	2.6	26.3	B	B
Ex. 4	5	5	4	5	0.12	PBT/PET	41%	75	Cotton spun fibers	Looping	185	15.2	4.8	B	A
Ex. 5	4	5	3	5	0.22	PTT	31%	50	Nylon	Looping	146	12.5	5.3	B	B
Ex. 6	6	4	4	4	0.17	PTT/PET	40%	50	PET/ viscose	Looping	161	13.5	4.9	B	A
Ex. 7	5	3	3	3	0.30	PBT	35%	60	Ordinary PET	Looping	154	4.2	20.3	B	B
Ex. 8	5	3	3	3	0.01	Ordinary PET	20%	60	Ordinary PET	Looping	175	15.8	2.9	B	B
Ex. 9	5	3	3	3	0.38	High-elastic PET	30%	75	Ordinary PET, spandex	Looping	191	3.0	24.6	A	B
Ex. 10	5	5	4	5	0.14	PBT/PET	41%	75	Ordinary	Looping	181	10.1	8.7	B	A
Ex. 11	4	5	3	5	0.20	PTT	31%	50	Ordinary PET	Looping	163	9.3	12.4	B	B
Ex. 12	6	4	4	4	0.18	PTT/PET	40%	50	Ordinary PET	Looping	156	9.7	9.8	B	A

(continued)

	Concavo-convex structure									Surface and inner connection	Gram weight (g/m^2)	Water retention rate of inner layer (%)	Ratio of surface and inner water retention rates	Elasticity	Yarn hooking resistance
	Convex portion loops	loops (pieces)	Concave portion loops	loops (pieces)	Convex portion				Concave portion fibers						
	Lateral	Longitudinal	Lateral	Longitudinal	Height (mm)	Raw fibers	CR value	Fineness (D)							
Ex. 13	3	2	3	2	0.04	PBT	49%	60	Ordinary PET	Looping	161	15.3	4.5	B	B
Ex. 14	2	3	2	3	0.05	PBT	49%	60	Ordinary PET	Looping	162	14.9	4.6	B	B
Ex. 15	5	3	3	3	0.30	PBT	49%	60	Ordinary PET	Looping	159	3.7	23.7	B	B
Ex. 16	5	3	3	3	0.17	PBT	49%	30	Ordinary PET	Looping	98	12.7	9.6	B	C
Ex. 17	5	3	3	3	0.40	PBT	49%	250	Ordinary	Looping	362	2.3	27.3	C	B
Ex. 18	5	5	4	5	0.15	PBT	41%	75	Ordinary	Looping	184	9.7	9.7	B	B
Comp. Ex. 1	-	-	-	-	-	-	-	-	-	Tucking	188	18.4	1.0	C	B
Comp. Ex. 2	-	-	-	-	-	-	-	-	-	Surface looping Inner tucking	162	16.4	1.2	C	B
Comp. Ex. 3	2	2	2	2	0.06	PBT	49%	60	Ordinary PET	Looping	165	16.3	1.6	B	B
Comp. Ex. 4	12	12	9	12	0.35	PBT	49%	60	Ordinary PET	Looping	181	17.4	1.9	B	B

[0051] In the above table,

(1) It can be seen from Example 3 and Example 1 that under the same condition, comparing the knitted fabric with each convex portion unit having 5 loops in the lateral direction with the knitted fabric with each convex portion unit having 3 loops in the lateral direction, the convex portion height of the former is greater than that of the latter, the inner water retention rate of the former is lower than that of the latter, and the ratio of the surface and inner water retention rates of the former is higher than that of the latter, so the water absorption and quick drying properties of the former are superior to those of the latter.

(2) It can be seen from Example 3 and Example 7 that under the same condition, comparing the knitted fabric with each convex portion formed by PBT fibers having a CR value of 49% with the knitted fabric with each convex portion formed by PBT fibers having a CR value of 35%, the convex portion height of the former is greater than that of the latter, the inner water retention rate of the former is lower than that of the latter, and the ratio of the surface and inner water retention rates of the former is higher than that of the latter, so the water absorption and quick drying properties of the former are superior to those of the latter.

(3) It can be seen from Example 10 and Example 4, Example 11 and Example 5, as well as Example 12 and Example 6 that under the same condition, comparing the knitted fabric with each concave portion of hydrophobic yarns with the knitted fabric with each concave portion of hydrophilic yarns, the convex portion heights of the both are equivalent, but the inner water retention rate of the former is lower than that of the latter, and the ratio of the surface and inner water retention rates of the former is higher than that of the latter, so the water absorption and quick drying properties of the former are superior to those of the latter.

(4) It can be seen from Example 3 and Example 8 that under the same condition, comparing the knitted fabric with each convex portion formed by PBT fibers with the knitted fabric with each convex portion formed by ordinary PET fibers, the convex portion height of the former is greater than that of the latter, the inner water retention rate of the former is lower than that of the latter, and the ratio of the surface and inner water retention rates of the former is higher than that of the latter, so the water absorption and quick drying properties of the former are superior to those of the latter.

(5) It can be seen from Example 1 and Example 13, as well as Example 1 and Example 14 that under the same condition, comparing the knitted fabric with each convex portion unit having 3 loops in both the lateral and longitudinal directions with the knitted fabric with each convex portion unit having 3 loops in only one direction, the convex portion heights of the both are equivalent, but the inner water retention rate of the former is lower than that of the latter, and the ratio of the surface and inner water retention rates of the former is higher than that of the latter, so the water absorption and quick drying properties of the former are superior to those of the latter.

(6) It can be seen from Example 3 and Example 15 that under the same condition, comparing the knitted fabric having a convex portion height of 0.40 mm with the knitted fabric having a convex portion height of 0.30 mm, the inner water retention rate of the former is lower than that of the latter, and the ratio of the surface and inner water retention rates of the former is higher than that of the latter, so the water absorption and quick drying properties of the former are superior to those of the latter.

(7) It can be seen from Example 3 and Example 16 that under the same condition, comparing the knitted fabric with each convex portion formed by PBT fibers having a fineness of 60 D with the knitted fabric with each convex portion formed by PBT fibers having a fineness of 30 D, the convex portion height of the former is greater than that of the latter, the inner water retention rate of the former is lower than that of the latter, and the ratio of the surface and inner water retention rates of the former is higher than that of the latter, so the water absorption and quick drying properties of the former are superior to those of the latter; and the yarn hooking resistance of the former is also superior to that of the latter.

(8) It can be seen from Example 3 and Example 17 that under the same condition, comparing the knitted fabric with each convex portion formed by PBT fibers having a fineness of 60 D with the knitted fabric with each convex portion formed by PBT fibers having a fineness of 250 D, the convex portion height of the former is greater than that of the latter, the inner water retention rate of the former is lower than that of the latter, and the ratio of the surface and inner water retention rates of the former is higher than that of the latter, so the water absorption and quick drying properties of the former are superior to those of the latter; and the elasticity of the former is superior to that of the latter.

(9) It can be seen from Example 10 and Example 18 that under the same condition, comparing the fabric with each convex portion formed by PBT/PET fibers with the fabric with each convex portion formed by PBT fibers, the convex portion height of the former is slightly smaller than that of the latter, the inner water retention rate of the former is slightly higher than that of the latter, and the ratio of the surface and inner water retention rates of the former is slightly lower than that of the latter, so the water absorption and quick drying properties of the former are slightly inferior to those of the latter; but the yarn hooking resistance of the former is superior to that of the latter.

(10) It can be seen from Comparative Example 1 and Example 1 that under the same condition, comparing the knitted fabric formed in a full tucking connection manner with the knitted fabric formed in a full looping connection

manner, the former does not form a concavo-convex structure, the inner water retention rate of the former is higher than that of the latter, and the ratio of the surface and inner water retention rates of the former is further lower than that of the latter, so the water absorption and quick drying properties of the former are further inferior to those of the latter.

(11) It can be seen from Comparative Example 2 and Example 1 that under the same condition, comparing the knitted fabric formed in a surface looping and inner tucking connection manner with the knitted fabric formed in a full looping connection manner, the former does not form a concavo-convex structure, the inner water retention rate of the former is higher than that of the latter, and the ratio of the surface and inner water retention rates of the former is further lower than that of the latter, so the water absorption and quick drying properties of the former are further inferior to those of the latter.

(12) It can be seen from Comparative Example 3 and Example 1 that under the same condition, comparing the knitted fabric with each convex portion unit having 2 loops in both the lateral and longitudinal directions with the knitted fabric with each convex portion unit having 3 loops in the lateral and longitudinal directions, the convex portion heights of the both are equivalent, but the inner water retention rate of the former is higher than that of the latter, and the ratio of the surface and inner water retention rates of the former is further lower than that of the latter, so the water absorption and quick drying properties of the former are further inferior to those of the latter.

(13) It can be seen from Comparative Example 4 and Example 1 that under the same condition, comparing the knitted fabric with each convex portion unit having 12 loops in both the lateral and longitudinal directions with the knitted fabric with each convex portion unit having 3 loops in the lateral and longitudinal directions, the convex portion height of the former is greater than that of the latter, but the inner water retention rate of the former is higher than that of the latter, and the ratio of the surface and inner water retention rates of the former is further lower than that of the latter, so the water absorption and quick drying properties of the former are further inferior to those of the latter.

Claims

1. A double-sided knitted fabric, comprising a surface layer and an inner layer, which are connected in a looping manner, wherein the inner layer has a concavo-convex structure, and in the concavo-convex structure, at least one of the longitudinal and lateral directions of each convex portion unit is composed of 3 to 10 loops.

2. The double-sided knitted fabric according to claim 1, wherein in the concavo-convex structure, the height of the convex portion unit is 0.05 to 0.40 mm.

3. The double-sided knitted fabric according to claim 1 or 2, wherein in the concavo-convex structure, the fibers forming the convex portion unit are polyester elastic fibers.

4. The double-sided knitted fabric according to claim 3, wherein the polyester elastic fibers are side-by-side composite fibers.

5. The double-sided knitted fabric according to claim 3, wherein the fineness of the polyester elastic fibers is 50 to 200 denier.

6. The double-sided knitted fabric according to claim 1 or 2, wherein the double-sided knitted fabric further contains bare Spandex yarns.

7. The double-sided knitted fabric according to claim 1 or 2, wherein the ratio of surface and inner water retention rates of the double-sided knitted fabric is 3.0 or more.

FIG. 1

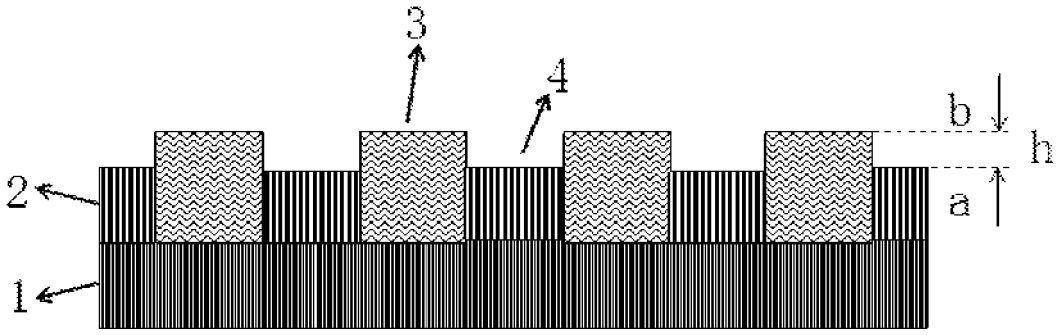
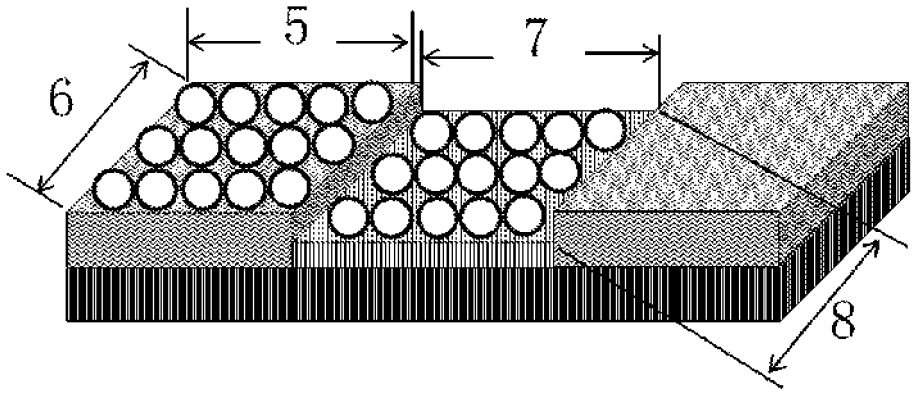


FIG. 2



INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2017/077787

A. CLASSIFICATION OF SUBJECT MATTER

D04B 1/16 (2006.01) i

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)

D04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

CNKI, CNABS, CNTXT, VEN: moisture absorption, quick drying, drainage, polyester, moisture, hydroscopic, dry, polyester, PET, PBT, PTT, concave, convex, protrud+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 102134776 A (ZHU, Jianrong) 27 July 2011 (27.07.2011) description, embodiment 2 and figures 1-3	1-7
X	CN 201588054 U (ZHU, Jianrong) 22 September 2010 (22.09.2010) description, embodiments, and figures 1-3	1-7
A	JP 2006249595 A (TEIJIN FIBERS LTD.) 21 September 2006 (21.09.2006) the whole document	1-7
A	US 2003021944 A1 (MILLIKEN & CO et al.) 30 January 2003 (30.01.2003) the whole document	1-7
A	CN 101270530 A (TORAY FIBER RESEARCH INSTITUTE (CHINA) CO., LTD.) 24 September 2008 (24.09.2008) the whole document	1-7

☐ 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
05 June 2017	28 June 2017
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer TAN, Yuan Telephone No. (86-10) 62085489

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2017/077787

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 102134776 A	27 July 2011	None	
CN 201588054 U	22 September 2010	None	
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		US 2004102119 A1	27 May 2004
		WO 02053362 A1	11 July 2002
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Form PCT/ISA /210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 204281985 U **[0003] [0005]**
- JP 2011226026 A **[0004]**