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(54) Title: A FABRIC SIMULATING THE PLANT STRUCTURE FOR MOISTURE MANAGEMENT

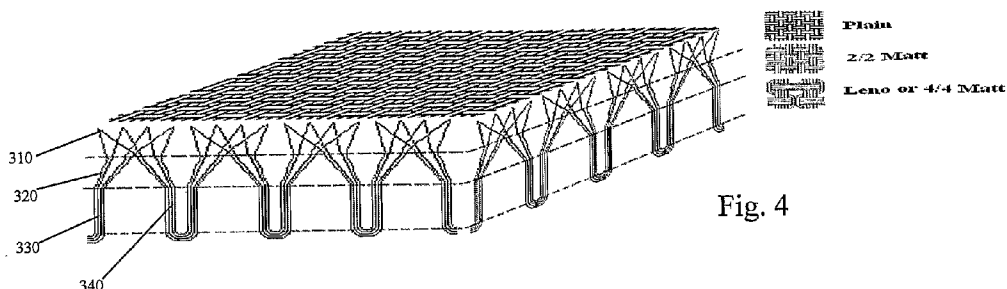


Fig. 4

(57) Abstract: A fabric having moisture management function, which has a structure simulating plant structure and comprises at least two layers as follows: a bottom layer, which is of a leno or matt structure simulating main stem of plant, in which a number of yarns are grouped together to form a plurality of fabric units; said bottom layer can be adapted to be in contact with human skin; a top layer, which is of a plain weave structure, in which the yarns of said fabric unit further split in the top layer to form such a plain weave structure, simulating the branching in plant structure; wherein, in said fabric, water can be transported from the bottom layer to the middle layer and further to the top layer where it evaporates due to the improved capillarity of the yarns so as to provide better moisture management function.

A Fabric Simulating the Plant Structure for Moisture Management

FIELD OF THE INVENTION

The present invention relates to articles and fabrics, in particular, fabrics having a textile construction simulating structures of plants, and which possess excellent moisture management function, as well as methods of making fabrics and articles, and methods of using articles and fabrics.

BACKGROUND OF THE INVENTION

With the improvement in living standards, our requirements for clothing are not only on the basic warm-keeping function of the clothing but also on the wearing comfort. Although conventional clothes made of pure cotton tend to have better sweat absorption properties, they tend to retain the sweat in the fabric layer next to the skin, giving wearer an uncomfortable feeling of wet and cold after exercise. It thus becomes an objective of the field to develop a type of fabric which possesses excellent moisture management function.

U.S. Patent No. 5,217,782 discloses a multi-layer fabric having moisture management function which comprises a thicker inner layer composed of hydrophobic fiber having good water permeability; a thinner middle hydrophilic layer and a thicker outer hydrophilic layer. Due to the hydrophobic nature of the inner layer, water can be transported to outer layer very quickly without having to stay in the inner layer and thereby brings a better feeling to wearers. This invention has a disadvantage in that, unless the garment is tightly fitted to the body and sweat is transmitted through the inner hydrophobic layer, the sweat will stay on or drip down along the skin surface, as the hydrophobic inner layer does not absorb

liquid sweat,

U.S. Patent No. 6,432,504 discloses a composite fabric having moisture management function. It transports water on skin to outer layer through the capillary action and this composite fabric comprises an inner hydrophilic layer formed of a thicker fiber and an outer hydrophilic layer formed of a thinner fiber. However, by having fibers of different fineness in the inner and outer layer, the liquid transport function of this fabric is very much limited.

Although the fabrics disclosed in the above-mentioned two patent documents possess certain level of moisture management function, their liquid water transport property is very much limited.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a fabric having excellent water transport properties for moisture management, so as to keep the wearer cool and dry. Also provided are related methods of making, methods of using, articles, and articles derived therefrom.

In one embodiment, the present invention provides a fabric having moisture management function, which has a structure simulating plant structure and comprises at least two layers as follows: (i) a bottom layer, which may be of a leno or matt structure simulating main stem of plant, in which a number of yarns are grouped together to form a plurality of fabric units; wherein said bottom layer can be adapted to be in contact with human skin; (ii) a top layer, which may be of a plain weave structure, in which the yarns of said fabric units in the bottom layer split in the top layer to form such a plain weave structure. Each group of multiple yarns from the bottom layer is split into single yarns in the top layer, which simulates the

branching in the structure of plant.

In another embodiment, the present invention provides a fabric having three layers: (i) a bottom layer, which may be of a leno or matt structure simulating main stem of plant, in which a number of yarns are grouped together to form a plurality of fabric units; wherein said bottom layer can be adapted to be in contact with human skin; (ii) a middle layer, which may be of a matt, huckaback or honeycomb structure simulating branches of plant, in which the yarns of said fabric unit split initially in the middle layer to form such a matt, huckaback or honeycomb structure; (iii) a top layer, which may be of a plain weave structure, in which the yarns of said fabric unit further split in the top layer to form such a plain weave structure. The splitting of groups of yarns into smaller groups of yarns in the middle layer and into single yarns in the top layer simulates the branching in the structure of the plant.; wherein, in said fabric, water can be transported from the bottom layer to the top layer or from the bottom layer to the middle layer and further to the top layer where it evaporates faster due to the spread of liquid water on the top surface so as to provide better moisture management function.

In the fabric having the structure according to the present invention, because of its emulation of such plant structures in its textile construction, water can be effectively transported so as to greatly improve water transport property of the fabric.

The present invention will be further described according to its preferred embodiment with reference to attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic structural view of a two-layer fabric according to

the first embodiment of the invention;

Fig. 2 is to schematically show the interchanging of warp and weft of the fabric according to the first embodiment of the invention;

Fig. 3 is to schematically show the weave design of the fabric according to the first embodiment of the invention;

Fig. 4 is a schematic structural view of a three-layer fabric according to the second embodiment of the invention;

Fig. 5 is to schematically show interchanging of weft of the fabric according to the second embodiment of the invention;

Fig. 6 is to schematically show the weave design of the fabric according to the second embodiment of the invention;

Fig. 7(a) is a graph showing the absorption behavior of the fabric having two-layer Plant Structure (Cotton Weft);

Fig. 7(b) is a graph showing the absorption behavior of the fabric having the two-layer Plant Structure (Coolmax Weft);

Fig. 8 is a graph showing the absorption behavior of the fabric having the three-layer Plant Structure.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Plants are nature's creation for covering the earth; they not only possess the most important process for sustaining life on earth, i.e. the photosynthesis, but also provide necessary protection over the earth and have excellent water transport properties. Through this special structure of plants, underground water can be transported against the gravity from the roots all the way up to leaves of plants. Studies have shown that the excellent water transport properties of plants attribute to the special

structural features that exist in plants. The greater ratio of surface area to volume in the leaves than that in the stems of plants forms a special tree-shaped network, which favors water transport. The tree-shaped networks also exist in many other natural flow systems in nature such as river basins, human lungs, blood vessels and the like. This fact also proves that this tree-shaped network has the advantage in water transport of this tree-shaped network.

The present invention utilizes emulation of such plant structure in a textile construction, i.e. to form a substantially tree-shaped network in textile construction so as to achieve an excellent water transport property. The unique material has excellent water transport and thermal properties. Such material will be ideal for clothing as it would facilitate the transport of sweat and water from skin so as to keep the wearer dry and comfortable. It also has other applications, such as carpet, a manmade grass, geotextiles (i.e. a fabric used for civil construction) and etc. for its benefits in keeping the under-covered area dry.

Fig. 1 is a schematic structural view of a two-layer fabric according to the first embodiment of the invention.

As shown in Fig. 1, the fabric according to the first embodiment of the present invention is a woven fabric having two layers; the bottom layer 220 in contact with skin is a matt structure, in which two yarns are grouped together to form a plurality of stem-like fabric units 240, which are respectively arranged in rows. The fabric unit 240, i.e. the "two-yarn stems" split into single yarns in the top layer 210, which is a plain weave structure. The splitting simulates the branching in the structure of the plant, which creates a greater surface area to volume ratio.

A method for preparing the two-layers fabric according to the first embodiment of the present invention is as follows:

In the two layers fabric as shown in Fig. 2, both warp and weft yarns in the bottom and top layer interchanges. As the two yarn groups move from the bottom layer to the top layer, they split into single yarns.

The weave designs of the two layers fabric is depicted in Fig. 3. The weave design is well within the limit of dobby loom with 16 heald shafts.

As shown in Fig. 4, the fabric according to the second embodiment of the present invention is a woven fabric having three layers; the bottom layer 330 in contact with skin is a 4×4 matt structure, in which four or more yarns are grouped together to form a plurality of stem-like fabric units 340, which are respectively arranged in rows. The fabric unit 340, i.e. the "four-yarn stem" split into "two-yarn branches" in the middle layer 320 locating above the bottom layer 330, which then form a 2×2 matt structure simulating the branching in the structure of plant. The top layer 310 locating above the middle layer 320 is a plain weave structure, in which said yarns separate at the top layer 310 so as to obtain a greater surface area to volume ratio.

A method for producing the three layers fabric according to the first embodiment of the present invention is as follows:

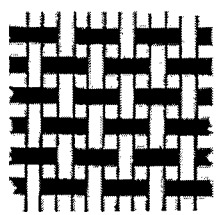
In the three layers fabric, as shown in Fig.5, the weft yarns interchanged from the bottom layer to the middle layer and finally to the top layer, thereafter return from the top layer to the bottom layer.

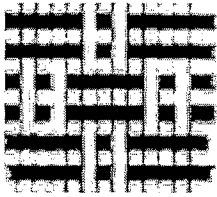
The weave designs of the three layers fabric is depicted in Fig. 6. The weave design is well within the limit of dobby loom with 24 heald shafts. The three layers fabric depicted by Fig. 4 only has interchanging stitches in the weft. It is also possible to produce the three layer fabric with interchanging stitches in both warp and weft direction for the three layer fabrics, but for that a jacquard weaving machine is required to weave the fabric, as designs will exceed the capacity of a normal dobby loom. For both

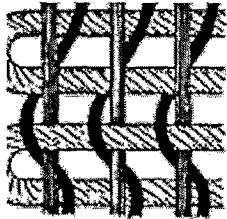
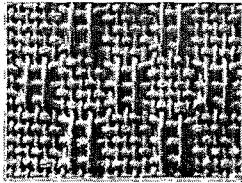
the two-layer and three-layer fabrics, the upper surface of the top layer may be further finished to create hairiness and/or loops to simulate the leaf of a plant. Moreover, the roots may be simulated by having a finish of brushing pile on the lower surface of the bottom layer to enhance water transport property.

Physical and chemical treatment may be also applied to a fiber, yarn and fabric. For example, hydrophilic treatments including oxygen plasma or oxidation may be applied to the bottom surface to enhance water absorption. Compared with existing moisture management fabrics, the treated fabric facilitates liquid water transport (or wicking) by the combination of different fibers and yarns. The new clothing material has the advantage of enhancing wicking due to improved capillarity and the cohesion-tension mechanism owing to its tree-shaped network. The large spaces between the "stems" in the bottom layer of the fabric will also facilitate air convection or ventilation next to the skin.

The "plain, matt, leno, huckaback and honeycomb" weave structures, mentioned above are technical terms defined as follows:

Weave type	Description	Diagram
Plain	A style of weave, in which the weft and warp yarns intertwine alternately, to produce a checkerboard effect. In this weave, each yarn gives maximum amount of support to the adjacent yarn, and in proportion to the quantity of materials employed.	

Matt	A variation of the plain weave in which two or more warp and filling yarns are woven side by side to resemble a plaited basket.	
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Weave type	Description	Diagram
Leno	A weave in which the warp yarns are arranged in pairs with one twisted around the other between picks of filling yarn as in marquissette. This type of weave gives firmness and strength to an open-weave fabric and prevents slippage and displacement of warp and filling yarns.	
Huck-a-back	Huckaback is a combination of plain and floated weave. It gives an absorbent fabric because of floated weave and a firm structure due to presence of plain.	
Honeycomb	A fabric in which the warp and weft threads float to form a honeycomb shape with ridges and hollows to produce a cellular cloth.	

WORKING EXAMPLE

Using polyester warp and various types of weft yarns (viz. cotton, Coolmax, Thermolite), four two-layer fabrics and fifteen three-layer fabrics were produced. Detailed parameters of the fabrics are shown in Table-1. Detailed results of the MMT test for all the fabrics are shown in the Table-2.

Table 1: Particulars of Different Fabric Samples

S. no.	Fabric Design and construction	Warp Yarn	Weft Yarn	Weight kg/mt ²	Thickness (x10 ⁻³ mt)	EPcm	PPcm
Two Layer Structure							
1	Plant structure(F-Plain, B- 2/2 Matt)	11.11 Tex polyester	7.38 Tex 100% Cotton	168.7	0.562	64	86
2	Two layer interchanged plain	11.11 Tex polyester	7.38 Tex Cotton Yarn	157.7	0.568	64	85
3	Plant structure(F-Plain, B- 2/2 Matt)	11.11 Tex polyester	19.76tex/100% coolmax	226.5	0.669	65	64
4	Two layer interchanged plain	11.11 Tex polyester	19.76tex/100% coolmax	225.6	0.701	65	65
Three Layer Structure							
1	Plant structure (F-Plain, M- 2/2 Matt, B-4/4 Matt)	11.11 Tex polyester	28tex/2 100% cotton	348.08	1.81	62	63
2	Three layer interchanged plain	11.11 Tex polyester	28tex/2 100% cotton	341.46	1.67	59	61
3	Three layer interchanged Matt	11.11 Tex polyester	28tex/2 100% cotton	356.18	1.84	63	66
4	Three layer Plain Matt Matt(tree)	11.11 Tex polyester	28tex/2 100% cotton	349.48	1.79	61	64
5	Three layer Plain	11.11 Tex polyester	28tex/2 100% cotton	321.78	1.48	58	54
6	Plant structure (F-Plain, M- 2/2 Matt, B-4/4 Matt)	11.11 Tex polyester	37.96tex/2 Thermolite	359.47	1.49	65	63
7	Three layer interchanged plain	11.11 Tex polyester	37.96tex/2 Thermolite	340.57	1.29	63	61
8	Three layer interchanged Matt	11.11 Tex polyester	37.96tex/2 Thermolite	375.98	1.59	65	68
9	Three layer Plain Matt Matt(tree)	11.11 Tex polyester	37.96tex/2 Thermolite	360.17	1.63	65	61
10	Three layer Plain	11.11 Tex polyester	37.96tex/2 Thermolite	329.06	1.09	59	55
11	Plant structure (F-Plain, M- 2/2 Matt, B-4/4 Matt)	11.11 Tex polyester	39.52tex/2 100% coolmax	368.03	1.79	64	65
12	Three layer interchanged plain	11.11 Tex polyester	39.52tex/2 100% coolmax	360.04	1.21	63	61
13	Three layer interchanged Matt	11.11 Tex polyester	39.52tex/2 100% coolmax	376.14	1.88	64	66
14	Three layer Plain Matt Matt(tree)	11.11 Tex polyester	39.52tex/2 100% coolmax	366.97	1.85	65	61
15	Three layer Plain	11.11 Tex polyester	39.52tex/2 100% coolmax	323.60	1.11	57	53

F- Face, M- Middle, B- Back.

Table 2: MMT Test results of different 3-layers fabric samples

Sample No.	Wetting Time		Abs rate%		Max wet Radius		Spreading speed		One way transport
	inside	outside	Inside	Outside	Inside	Outside	inside	outside	
Two Layer Fabric									
Cotton									
1	2.12	2.19	58.24	62.94	30	30	2.53	2.64	148.85
2	2.1	2.1	69.6	68.0	30.0	30.0	2.5	2.5	44.9
Coolmax									
3	2.2	2.2	44.3	55.3	23.0	26.0	2.1	2.2	272.9
4	2.2	2.3	42.6	51.8	30.0	30.0	2.1	2.1	129.7
Three Layer Fabric									
Cotton									
1	2.75	2.88	43.65	45.46	21.00	27.00	1.60	1.66	186.48
2	2.83	2.88	43.17	45.32	25.00	25.00	1.35	1.33	141.15
3	2.75	2.91	43.57	45.33	20.00	20.00	1.13	1.11	93.49
4	2.86	2.93	46.43	46.02	20.00	25.00	1.22	1.30	165.58
5	3.19	3.14	43.46	45.37	27.00	26.00	1.53	1.50	160.30
Thermolite									
6	2.69	2.63	39.74	54.26	21.00	27.00	1.55	1.79	276.39
7	3.03	3.03	43.57	51.43	24.00	26.00	1.49	1.51	210.77
8	3.56	3.41	39.02	50.16	24.00	27.00	1.44	1.47	205.09
9	2.84	2.91	43.17	50.60	22.00	25.00	1.47	1.49	272.53
10	2.90	2.96	55.77	58.26	24.00	25.00	1.55	1.46	171.43
Coolmax									
11	2.53	2.68	57.67	62.91	26.00	30.00	1.97	2.00	230.13
12	2.72	2.72	69.35	59.32	22.00	25.00	1.41	1.45	198.60
13	2.97	2.74	42.64	58.80	20.00	20.00	1.30	1.23	155.28
14	2.55	2.98	62.32	58.04	23.00	25.00	1.34	1.27	200.05
15	3.07	3.20	52.66	56.54	24.00	21.00	1.27	1.23	170.16

From Table 2, we can also see that the two-layer fabrics and three-layer fabrics have much better (up to 3 times) one way water transport properties than fabrics of other structures in similar weights. The faster initial water absorption and much improved one way water transport properties of the plant structured fabrics are very advantageous to thermal comfort in terms of keeping the wearer dry and cool when sweating.

All fabrics were tested using a Transplanar Water Transport Tester (TWTT) (Patent pending) and Moisture Management tester (MMT). During the testing by TWTT, the fabric specimen was in contact with a water surface of constant water level. The amount of water absorbed or transmitted through the fabric was measured in real time. Results are illustrated in Fig. 7(a&b) and Fig. 8. As it can be seen from Fig. 7(a), 7(b) and 8, the plant structured two-layer and three-layer fabrics have significantly faster initial water absorption rate and total water absorption than fabrics of other constructions made of the same types of yarns and in similar weight, respectively.

What is claimed is:

1. A fabric having moisture management function, which has a structure simulating plant structure and comprises at least two layers as follows:

a bottom layer in which a number of yarns are grouped together to form a plurality of fabric units so as to form a structure simulating main stem of plant;

a top layer in which the yarns of said fabric unit further split in the top layer so as to form a structure simulating the branching of plant structure;

wherein, in said fabric, water is transported from the bottom layer to the top layer where it evaporates due to the improved capillarity of the yarns so as to provide better moisture management function.

2. The fabric having moisture management function according to claim 1, said fabric further comprises a middle layer in which the yarns of said fabric unit split initially in the middle layer so as to form a structure simulating the branching of plant structure, wherein, in said fabric, water is transported from the bottom layer to the middle layer and further to the top layer where it evaporates due to the improved capillarity of the yarns so as to provide better moisture management function.

3. The fabric having moisture management function according to claim 1, said structure simulating plant structure is a woven structure.

4. The fabric having moisture management function according to claim 1, said structure simulating plant structure is a knitted structure.

5. The fabric having moisture management function according to claim 1, said bottom layer comprises a leno structure.

6. The fabric having moisture management function according to

claim 1, said bottom layer comprises a matt structure.

7. The fabric having moisture management function according to claim 1, said top layer comprises a plain weave structure.

8. The fabric having moisture management function according to claim 2, wherein the middle layer comprises a hopsack structure.

9. The fabric having moisture management function according to claim 2, wherein the middle layer comprises a huckaback structure.

10. The fabric having moisture management function according to claim 2, wherein the middle layer comprises a honeycomb structure.

11. The fabric having moisture management function according to claim 1, wherein said top layer is further finished to create hairiness and/or loops to further simulate leaves of plant so as to provide better water transport effect.

12. The fabric having moisture management function according to claim 1, wherein said bottom layer is further finished to brush pile to simulate roots of plant so as to absorb water more effectively.

13. The fabric having moisture management function according to claim 1, wherein hydrophilic treatment is applied to the bottom layer so as to enhance water absorption capacity.

14. The fabric having moisture management function according to claim 13, wherein said hydrophilic treatment includes oxygen plasma and oxidation treatment.

15. The fabric having moisture management function according to claim 1, wherein the bottom layer is adapted to be in contact with human skin.

16. An article comprising at least two layers:

a bottom layer in which a number of yarns are grouped together to form a plurality of fabric units so as to form a structure simulating main stem of plant;

a top layer in which the yarns of said fabric unit further split in the top layer so as to form a structure simulating the branching of plant structure;

wherein, in said fabric, water is transported from the bottom layer to the top layer where it evaporates due to the improved capillarity of the yarns so as to provide better moisture management function.

17. An article comprising at least three layers:

a bottom layer in which a number of yarns are grouped together to form a plurality of fabric units so as to form a structure simulating main stem of plant;

a middle layer in which the yarns of said fabric unit split initially in the middle layer so as to form a structure simulating the branching of plant structure;

a top layer in which the yarns of said fabric unit further split in the top layer so as to form a structure simulating the branching of plant structure;

wherein, in said fabric, water is transported from the bottom layer to the middle layer and further to the top layer where it evaporates due to the improved capillarity of the yarns so as to provide better moisture management function.

18. The article according to claim 16, wherein the article is a carpet, a manmade grass, or a geotextile.

19. The article according to claim 17, wherein the article is a carpet, a manmade grass, or a geotextile.

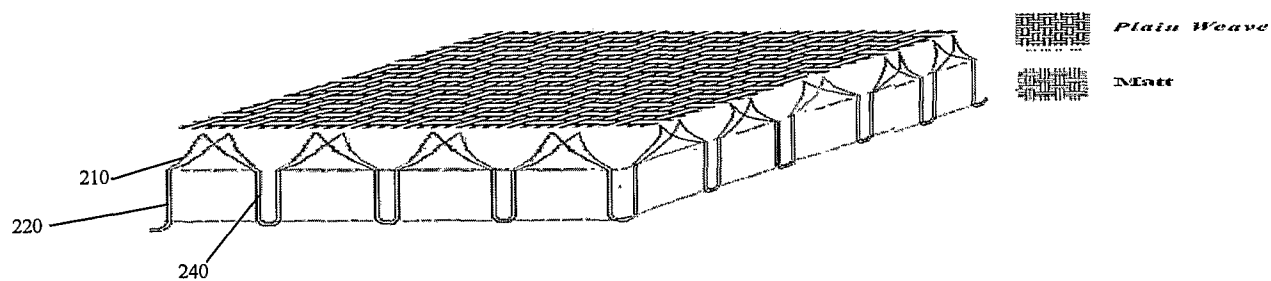


Fig. 1

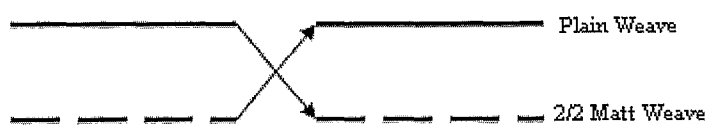


Fig. 2

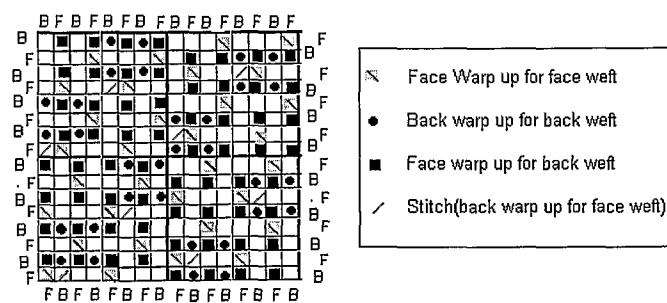


Fig. 3

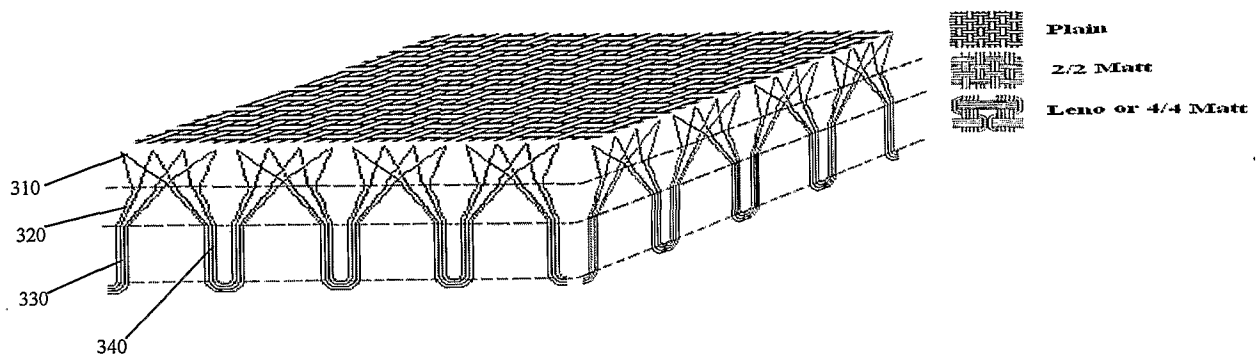


Fig. 4

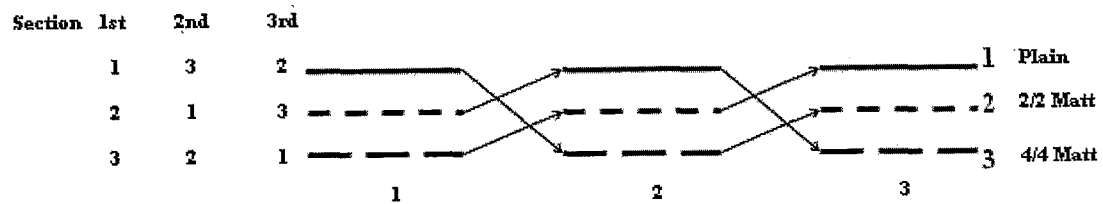
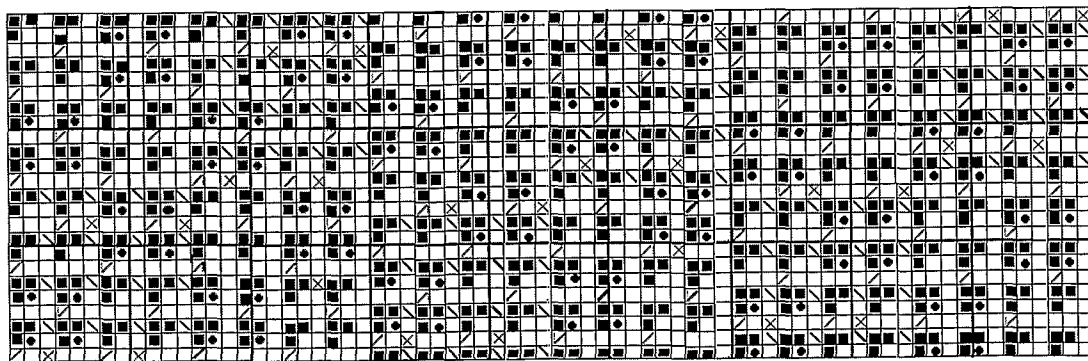


Fig. 5



- / Face warp up for face weft
- Middle warp up for middle weft
- \ Back warp up for back weft
- Face warp up for middle and back weft
- × Stitch(back warp up for face weft)

Fig. 6

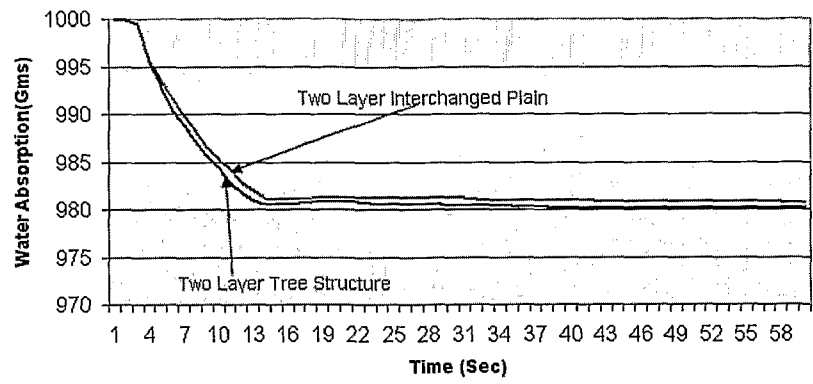


Fig. 7(a)

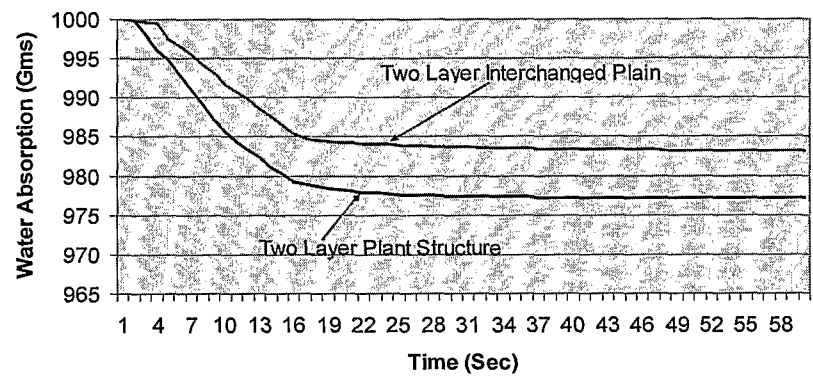


Fig. 7(b)

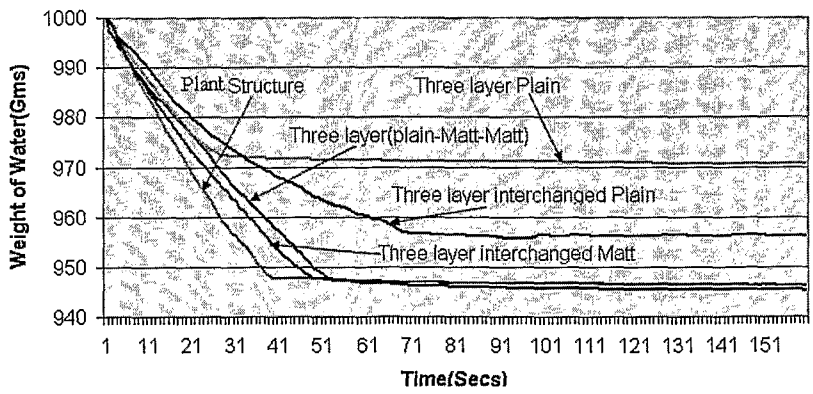


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2007/001210

A. CLASSIFICATION OF SUBJECT MATTER D03D 25/00 (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) IPC: D03D11/00, D03D15/00, D03D 25/00, D06M11/-, D06M15/-, D06M23/- 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) WPI, EPODOC, PAJ, CNPAT, CNKI, CA: moisture w manag+, moisture w transfer+, moisture w transport+, hydrophilic+, hydrophobic+, absorb+, repellen+, layer?																	
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>CN1760419A(THE HONG KONG POLYTECHNIC UNIVERSITY et al.), 19 Apr. 2006(19.04.2006), claims 1-5, page 3 lines 1-5</td> <td>1-19</td> </tr> <tr> <td>A</td> <td>CN1580384A(GUANG DONG EXQUEL TEXTILES CO LTD), 16 Feb. 2005(16.02.2005), the whole document</td> <td>1-19</td> </tr> <tr> <td>A</td> <td>US2005188470A1(Li Yi et al.), 01 Sep. 2005(01.09.2005), the whole document</td> <td>1-19</td> </tr> <tr> <td>A</td> <td>US2005075027A1(Marc D. Etchells et al.), 07 Apr. 2005(07.04.2005), the whole document</td> <td>1-19</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	CN1760419A(THE HONG KONG POLYTECHNIC UNIVERSITY et al.), 19 Apr. 2006(19.04.2006), claims 1-5, page 3 lines 1-5	1-19	A	CN1580384A(GUANG DONG EXQUEL TEXTILES CO LTD), 16 Feb. 2005(16.02.2005), the whole document	1-19	A	US2005188470A1(Li Yi et al.), 01 Sep. 2005(01.09.2005), the whole document	1-19	A	US2005075027A1(Marc D. Etchells et al.), 07 Apr. 2005(07.04.2005), the whole document	1-19
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.																	
<table border="0"> <tr> <td> * Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier application or patent but published on or after the international filing date “L” document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed </td> <td> “T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family </td> </tr> </table>			* Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier application or patent but published on or after the international filing date “L” document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family													
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Date of the actual completion of the international search 03 Jan. 2008(03.01.2008)		Date of mailing of the international search report 24 Jan. 2008 (24.01.2008)															
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451		Authorized officer Song, Lin Telephone No. (86-10)62084562															

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN1760419A	19.04.2006	NONE	
CN1580384A	16.02.2005	WO2005113884A	01.12.2005
		US2006148356A	06.07.2006
		GB2432167A	16.05.2007
		CN1973081A	30.05.2007
		DE112005000904T	30.08.2007
US2005188470A1	01.09.2005	NONE	
US2005075027A1	07.04.2005	NONE	