

Description

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims benefit of Pakistani Patent Application No. 519/2013 filed on July 31, 2013 entitled "SOCKS", and of U.S. Patent Application No. 14/134,975 entitled "SOCKS." Priority of the foregoing applications is hereby claimed, and the contents of such applications are hereby incorporated by reference herein, for all purposes.

TECHNICAL FIELD

[0002] The innovation covers the field of legwear, more particularly the technical sock category used by athletes and people living active lifestyles.

BACKGROUND

[0003] A sock is a type of clothing used to cover a wearer's feet with the aim of providing comfort inside shoes. This comfort can be provided by way of a softer cushioned feel, by removal of sweat, and/or by providing warmth in colder environments.

[0004] Sweat is a natural way to facilitate cooling of body temperature, since evaporation of sweat is an endothermic (i.e., heat absorbing) process. During exercise, body temperature rises, and may result in excessive sweating. Sweat must be evaporated to cause endothermic cooling of a body. Since this evaporation is an integral part of sweat cooling, it may be desirable for clothing articles to have the ability to transfer moisture through them in order to promote evaporation of sweat.

[0005] As compared with other clothing articles, socks contend with more difficult conditions, since socks are tightly fitted against a wearer's skin and are typically covered with shoes having limited breathability. Such conditions result in less evaporation and prolonged wetness, which in turn result in increased friction against the wearer's skin - giving rise to blisters as well as bacteria growth, bad odor, and other disorders.

[0006] There exist specialized synthetic fiber socks which quickly spread the moisture all across the sock fabric, working on the principle of increasing the surface area of moistened fabric to increase the evaporation. This principle of increasing moistened fabric area performs reasonably well in garments where the fabric is in direct interaction with the atmosphere, but the reduced atmospheric interaction specific to the context of socks tends to limit the effectiveness of conventional moisture-spreading fabrics when applied to socks. The special cross-section design of these synthetic fibers enables the fabric made with them to hold greater amounts of moisture, but this moisture is evenly spread throughout (i.e., along the inner side as well as outer side), resulting in a condition similar to that of a natural fiber fabric, where-

in once sweating begins, a wearer's skin remain in contact with wet fabric until the fabric is completely dried after evaporation.

[0007] In view of the limited airflow inside a shoe, it would be desirable to provide a sock capable of keeping a wearer's skin isolated from wet fabric while exhibiting good wicking performance to expedite evaporation.

SUMMARY

[0008] With the constraint of low airflow in mind, socks according to various embodiments of the present invention include at least a sole portion thereof comprising a specialized layered fabric including a dual face or dual layer material (e.g., terry material) with a hydrophobic inner face (or layer) and a hydrophilic outer face (or layer). The sole portion of the sock corresponds to a sole portion of a wearer's foot having a maximum number of sweat glands and almost no airflow. The inner face (or layer) of the sock is arranged for placement in contact with skin of a wearer. With the inner face (or layer) being rich in hydrophobic fibers and the outer face (or layer) being rich in hydrophilic fibers, moisture is adsorbed from a wearer's skin by the hydrophobic fibers of the inner face (or layer) and is immediately absorbed by the absorbent outer face (or layer) where it is spread all over. This dual face or dual layer structure promotes transport of moisture to the side which is to interact with the atmosphere, thereby isolating skin from moist outer fabric. Skin covered with such a sock and additionally covered with a shoe may be maintained in a dry condition despite the constraint of reduced interaction of the sock with a surrounding atmosphere. No matter how slow the evaporation process, socks according to embodiments of the present invention promote separation of wetness from the wearer's skin, thereby avoiding problems of excessive friction, blisters and discomfort associated with use of conventional socks.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a perspective view of a sock according to one embodiment of the present invention, showing different constructions corresponding to different foot and ankle locations.

FIG. 2 is a top plan view showing the inner side of a slit-open sock according to the embodiment shown in FIG. 1.

FIG. 3 is a bottom plan view showing the outer side of a slit-open sock according to the embodiment shown in FIGS. 1-2.

FIG. 4A is a perspective schematic view showing a dual face terry material proximate to skin of a wearer,

with an (upward-facing) inner face including loops (or pile) of hydrophobic yarn arranged to adsorb droplets of sweat for transport away from the skin.

FIG. 4B is a perspective view of the dual face terry material of FIG. 4A with an (upward-facing) outer face including hydrophilic yarn, and showing absorption of sweat by the outer face following transport of sweat to the outer face by the hydrophobic inner layer.

FIG. 5 is a table providing results of tests for vertical wicking and absorbency of a dual face terry material that may be used to fabricate at least a portion of a sock according to embodiments to the present invention.

FIG. 6 is a schematic stitch diagram for a dual face terry material of at least a portion of a sock according to embodiments of the present invention.

DETAILED DESCRIPTION

[0010] As noted previously, a sock according to the present invention may include a dual face or dual layer material (e.g., terry material) at at least a sole portion thereof, with the inner face or layer including a hydrophobic yarn, the outer face or layer including a hydrophilic yarn, and the inner face or layer being arranged for placement in contact with skin of a wearer. This construction essentially provides low absorbency fibers along the inner face (or layer) and high absorbency fibers along the outer face (or layer). Such construction is designed to transport moisture away from skin of a wearer via absorption using the hydrophobic yarn of the inner face or layer, and to spread moisture within the outer face via absorption using the hydrophilic yarn of the outer face or layer, to permit evaporation of sweat from the outer face or layer to a surrounding environment.

[0011] Examples of hydrophobic yarns that may be used in constructing portions of a sock as described herein include, but are not limited to, polypropylene, polyester, acrylic, and blends of the foregoing materials. As will be recognized by one skilled in the art, other hydrophobic materials or combinations of materials may be used. Examples of hydrophilic yarns that may be used in constructing portions of a sock as described herein include, but are not limited to, wool, cotton, viscose, and blends of the foregoing materials. As will be recognized by one skilled in the art, other hydrophilic materials or combinations of materials may be used.

[0012] In certain embodiments, a sock as described herein includes plaiting of stretch hydrophobic yarn. Such plaiting may be provided in the dual face or dual layer material arranged in at least the sole portion of the sock. Such plaiting may be tailored to specific zones of a sock provide desired level of stretch characteristics.

[0013] In certain embodiments, an inner face or inner

layer of the dual face or dual layer material consists of 100% hydrophobic yarn. Such yarn may keep a wearer's skin dry and isolated while providing cushioning.

[0014] In certain embodiments, an outer face or outer layer of the dual face or dual layer material (or an outer face or outer layer of the entire sock) comprises hydrophilic yarn to transport sweat from the inner face or inner layer to the outer face or outer layer. Sweat is absorbed by the outer face or outer layer and spread around such face or layer by absorption to promote evaporation. In certain embodiments, the outer layer or outer face of the entire sock (not just the sole portion) comprises hydrophilic material to maximize evaporation of sweat to an ambient environment.

[0015] In certain embodiments, an inner side or inner layer of the dual face or dual layer material has minimal to no affinity for moisture or sweat. Such inner side or inner layer may have an absorbency test value of at least 30 seconds according to AATCC Test Method 79. Such test method measures a propensity of fabric to take up water, whereby a fabric sample is placed in an embroidery hoop with all creases removed, a burette dispenses a drop of water onto the surface of the fabric from a distance of 9.5 mm below the burette, and time is recorded until the water drop is complete absorbed into the fabric.

[0016] In certain embodiments, an outer face or outer layer of the dual face or dual layer material has great affinity for moisture or sweat. Such outer side or outer layer may have any absorbency test value of 5 seconds or less.

[0017] In certain embodiments, an outer face or outer layer of the dual face or dual layer material (which covers the entirety of the sole portion, and in certain embodiments preferably covers the entire outer perimeter of a sock) exhibits excellent spread of moisture, with the outer face or outer layer being arranged to interact with an ambient atmosphere. Such outer face or outer layer may exhibit vertical wicking of at least 10 centimeters in 30 minutes. Vertical wicking tests (e.g., AATCC Test Method 197 or Consumer Testing Lab method CTL-FW-1 06) generally involve placement of suspension of vertically aligned fabric specimen with a cut edge in a container of liquid, (e.g., distilled water) and recordation of height of liquid the is absorbed for a specified time. Such tests are used to evaluate the ability of fabric to transport liquid along and/or through the fabric.

[0018] In certain embodiments, a sock as disclosed herein may have separate colors on inner and outer sides (or faces) thereof. In certain embodiments, an inner face (or layer) may include a first color, an outer face (or layer) may include a second color, and the first color differs from the second color. In certain embodiments, the provision of separate colors along inner and outer sides (or faces) of a sock may exclude heel and toe areas of the sock.

[0019] In certain embodiments, a sock may include a mesh or mesh channeled material portion arranged to be positioned along a top portion of a wearer's foot where

conditions of less sweat and greater airflow may be experienced. Such mesh or mesh channeled material portion may include hydrophilic main yarn and stretch hydrophobic plaiting yarn.

[0020] In certain embodiments, a sock may include a plain knit fabric portion arranged to be positioned along a wearer's ankle. Such plain knit fabric portion may include hydrophilic main yarn and stretch hydrophobic plaiting yarn.

[0021] In certain embodiments, a sock may include reverse plaited terry fabric portions arranged to be positioned along a wearer's heel and along a wearer's toes, and intended to provide increased (e.g. maximum) cushioning. Such reverse plaited terry fabric portions may include hydrophilic and/or hydrophobic main yarn and stretch hydrophobic plaiting yarn.

[0022] In certain embodiments, a sock may include simulated rib fabric portion arranged to be positioned at a top portion of the sock (e.g., above an ankle portion) for maximum grip along a wearer's leg. The simulated rib fabric portion may include hydrophilic main yarn, stretch hydrophobic plaiting, and laid-in elastic yarn.

[0023] In certain embodiments, at least a sole portion of a sock may include two thread terry fabric construction with dual faces or layers, having a hydrophobic inner pile, stretch hydrophobic plaiting, and hydrophilic main yarn in the outer layer or face.

[0024] In certain embodiments, at least a sole portion of a sock may include an inner pile (e.g., embodying an inner face or layer) comprising hydrophobic yarn, with stretch plaiting in the middle, and with an outer face or outer layer comprising hydrophobic yarn.

[0025] In certain embodiments, a hydrophobic inner face or inner layer portion is arranged to press against and contact a hydrophilic outer face or outer layer portion under application of elastic pressure and/or body weight of a wearer. Such contact causes adsorbed moisture on the hydrophobic inner face or inner layer portion to be absorbed by the hydrophilic outer face or outer layer, into which the moisture is rapidly spread to promote evaporation.

[0026] While the present invention will be described with reference to a few specific embodiments, the description is illustrative of the invention and is not to be construed as limiting the invention.

[0027] FIG. 1 is a perspective view of a sock according to one embodiment of the present invention, showing different constructions corresponding to different foot and ankle locations depending on functional requirements at those places. Mesh channels 5 are arranged to be positioned at a top portion of a wearer's foot where there is lesser sweat and greater airflow. The mesh channels 5 include hydrophilic main yarn and stretch hydrophobic plaiting yarn. A plain knit fabric portion 2 arranged to be positioned along a wearer's ankle includes standard plain knit fabric with hydrophilic main yarn and stretch hydrophobic plaiting yarn. Reverse plaited terry fabric is provided at heel and toe portions 3 for maximum cushioning,

with hydrophilic main yarn and stretch hydrophobic plaiting. A simulated rib fabric portion 1 arranged to be positioned at a top portion of the sock (e.g., above an ankle portion) to receive a wearer's leg and provide maximum grip, with such portion 1 including hydrophilic main yarn, stretch hydrophobic plaiting, and laid-in elastic yarn. A sole portion 4 includes two thread terry fabric construction with dual faces, having a hydrophobic inner pile, stretch hydrophobic plaiting, and hydrophilic main yarn.

[0028] FIG. 2 is a top plan view showing the inner side of a slit-open sock according to the embodiment shown in FIG. 1. Provided at the top of the sock and arranged to be positioned around a wearer's leg is an inner surface 6 of false rib fabric for maximum grip, with hydrophilic main yarn, stretch hydrophobic plaiting, and laid-in hydrophobic elastic yarn. Arranged to be positioned around a wearer's ankle and/or leg is an inner surface 7 of standard plain knit fabric including stretch hydrophobic plaiting yarn with hydrophilic main yarn on an outer side thereof. Reverse plaiting terry fabric is provided along inner heel surface 8 and inner toe surface 9, with thick terry pile for maximum cushioning including hydrophilic and or hydrophobic main yarn with stretch hydrophobic plaiting. Arranged to be positioned at a top portion of a wearer's foot is an inner surface of mesh fabric 10 at a location having lesser sweat and greater airflow, with such fabric including stretch hydrophobic plaiting yarn with hydrophilic main yarn on an outer side. Arranged to be positioned along a sole portion of a wearer's foot is an inner surface of a two thread terry fabric 11 with dual face construction, having an inner pile (or inner face) made with hydrophobic yarns, with stretch hydrophobic plaiting in the middle, and with hydrophilic main yarn on an outer side or outer face.

[0029] FIG. 3 is a bottom plan view showing the outer side of a slit-open sock according to the embodiment shown in FIGS. 1-2. Provided at the top of the sock and arranged to be positioned around a wearer's leg is an outer surface 12 of simulated rib fabric for maximum grip, with hydrophilic main yarn, stretch hydrophobic plaiting, and laid-in hydrophobic elastic yarn. Arranged to be positioned around a wearer's ankle and/or leg is an inner surface 13' of standard plain knit fabric including hydrophilic main yarn with stretch hydrophobic plaiting yarn. Reverse plaiting terry fabric is provided along inner heel surface 14 and inner toe surface 15, exhibiting plain stitch, with hydrophilic main yarn and stretch hydrophobic plaiting. Arranged to be positioned at a top portion of a wearer's foot is an outer surface of mesh fabric 16 at a location having lesser sweat and greater airflow, with such fabric including hydrophilic main yarn with stretch hydrophobic plaiting yarn on an inner side. Arranged to be positioned along a sole portion of a wearer's foot is an inner surface of a two thread terry fabric 17 including dual face construction, exhibiting plain stitch with hydrophilic main yarn on an outer side, with stretch hydrophobic plaiting in the middle, and with hydrophobic yarn pile on an inner side.

[0030] FIGS. 4A-4B illustrate the functioning of the dual face or dual layer terry fabric as described herein. Sweat vapor¹⁷ is exuded by a wearer's skin 18 and momentarily adsorbs to inner terry pile 19 made of hydrophobic yarns. Under elastic pressure and body weight the two layers of fabric (i.e., the hydrophobic inner layer 19 and the hydrophilic outer layer 20), are pressed against each other. Adsorbed moisture on the inner side 19 of the terry fabric is absorbed up by the outer hydrophilic layer 20 the moisture it is spread rapidly for evaporation.

[0031] FIG. 5 is a table providing results of tests for vertical wicking and absorbency of a dual face terry material (fabric) that may be used to fabricate at least a portion of a sock according to embodiments to the present invention.. An inner face portion of the material exhibited an absorbency test value of greater than 30 seconds upon testing according to AATCC Test Method 79. An outer face portion exhibited an absorbency test value of 1.8 seconds upon testing according to AATCC Test Method 79. The results clearly show that this fabric has no affinity for moisture on the inner side, while the outer layer is highly absorbent. With respect to vertical wicking, the vertical wicking of the outer layer is also excellent, showing that moisture is rapidly spread for quick evaporation. The foregoing results are also indicative of the fact that the layer next to a wearer's skin remains dry.

[0032] FIG. 6 is a schematic stitch diagram for a dual face terry material (fabric) of at least a portion of a sock according to embodiments of the present invention. Such figure illustrates knit stitch hydrophilic main yarn 21, knit stitch, plaited stretch hydrophobic yarn 22, and float stitch terry hydrophobic yarn 23 arranged in an exemplary construction.

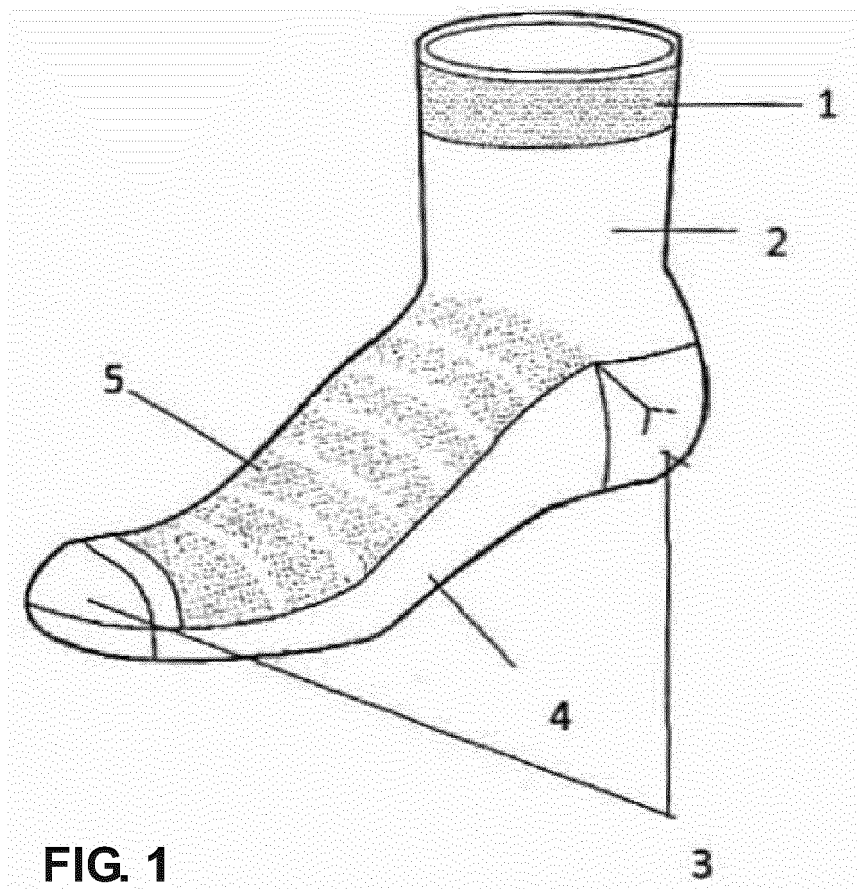
[0033] While the invention has been described herein in reference to specific aspects, features and illustrative embodiments of the invention, it will be appreciated that the utility of the invention is not thus limited, but rather extends to and encompasses numerous other variations, modifications and alternative embodiments, as will suggest themselves to those of ordinary skill in the field of the present invention, based on the disclosure herein. Various combinations and sub-combinations of the structures described herein are contemplated and will be apparent to a skilled person having knowledge of this disclosure. Any of the various features and elements as disclosed herein may be combined with one or more other disclosed features and elements unless indicated to the contrary herein. Correspondingly, the invention as hereinafter claimed is intended to be broadly construed and interpreted, as including all such variations, modifications and alternative embodiments, within its scope and including equivalents of the claims.

Claims

1. A sock comprising a sole of dual face terry material including an inner face and an outer face, wherein

the inner face comprises hydrophobic yarn, the outer face comprises hydrophilic yarn, and the inner face is arranged for placement in contact with skin of a wearer.

2. The sock according to claim 1, further comprising plaiting of stretch hydrophobic yarn.
3. The sock according to any one of claims 1 or 2, wherein the inner face consists of 100% hydrophobic yarn.
4. The sock according to any one of claims 1 to 3, wherein the outer face consists of 100% hydrophilic yarn.
5. The sock according to any one of claims 1 to 4, wherein the inner face comprises an absorbency test value of at least 30 seconds according to AATCC Test Method 79.
6. The sock according to any one of claims 1 to 5, wherein the outer face comprises an absorbency test value of no more than 5 seconds according to AATCC Test Method 79.
7. The sock according to any one of claims 1 to 6, wherein the outer face comprises a vertical wicking test value of at least 10 cm in 30 minutes.
8. The sock according to any one of claims 1 to 7, wherein the inner face comprises a first color, the outer face comprises a second color, and the first color differs from the second color.
9. The sock according to any one of claims 1 to 8, wherein the sole comprises a dual layer material, wherein the dual layer material includes an inner layer comprising the inner face, and wherein the dual layer material includes an outer layer comprising the outer face.
10. The sock according to claim 9, wherein the dual layer material comprises terry material.



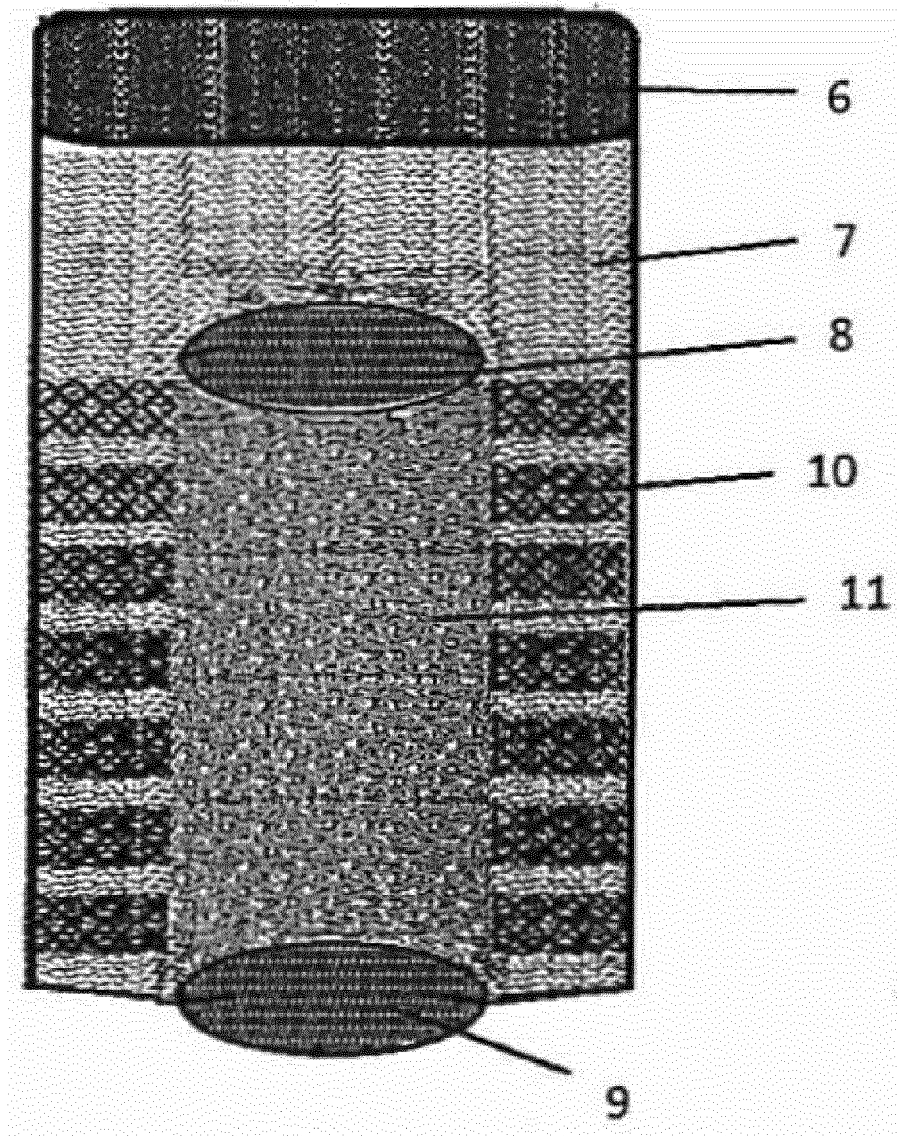


FIG. 2

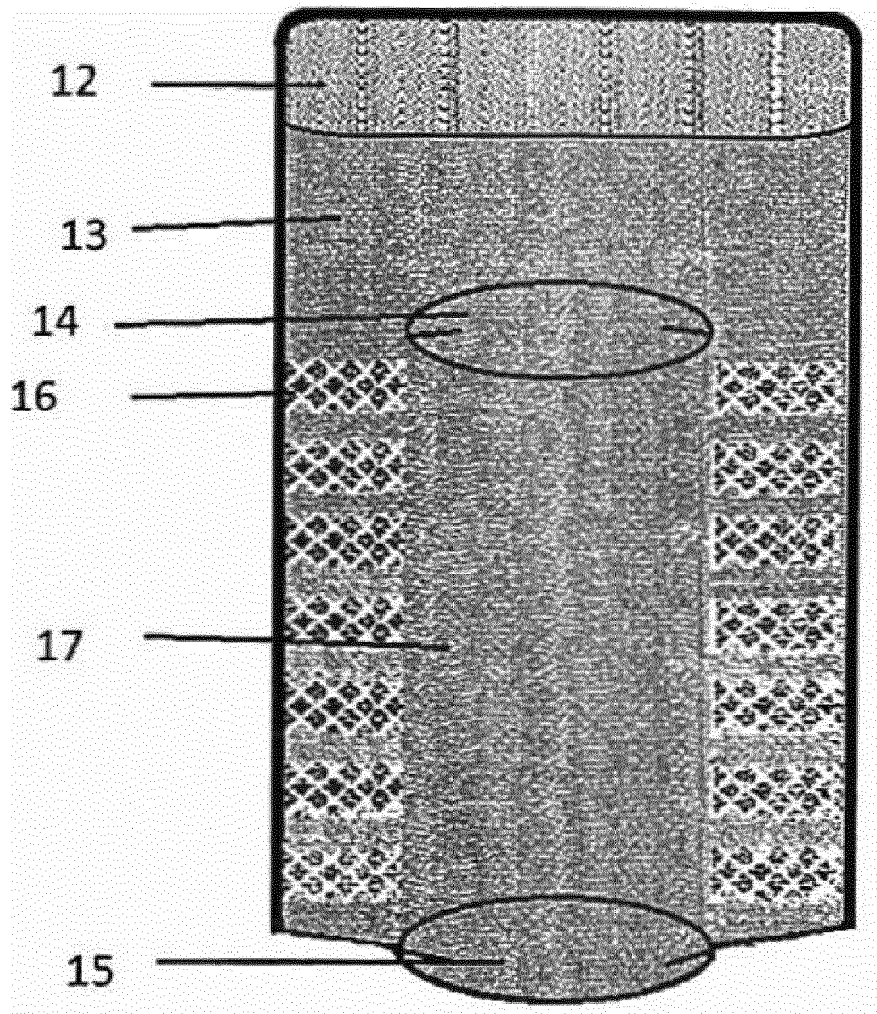


FIG. 3

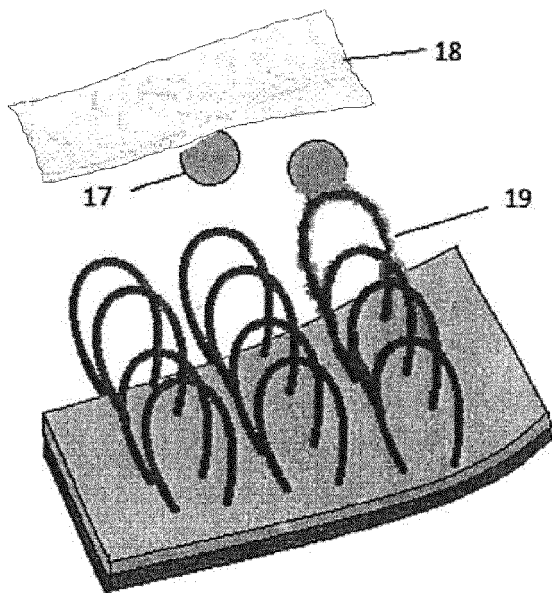


FIG. 4A

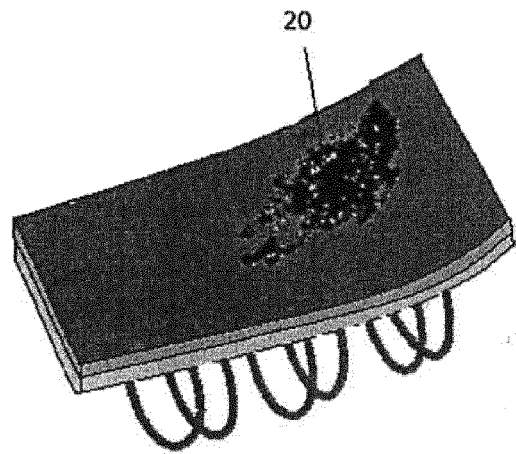


FIG. 4B

Absorbency (AATCC-79)	
Outer Side	1.8 sec
Inner Side	>30 sec
Vertical Wicking (CTL-FW-106)	
Length Wicking, 5 Min	.08 cm
Length Wicking, 30 Min	13 cm

FIG. 5

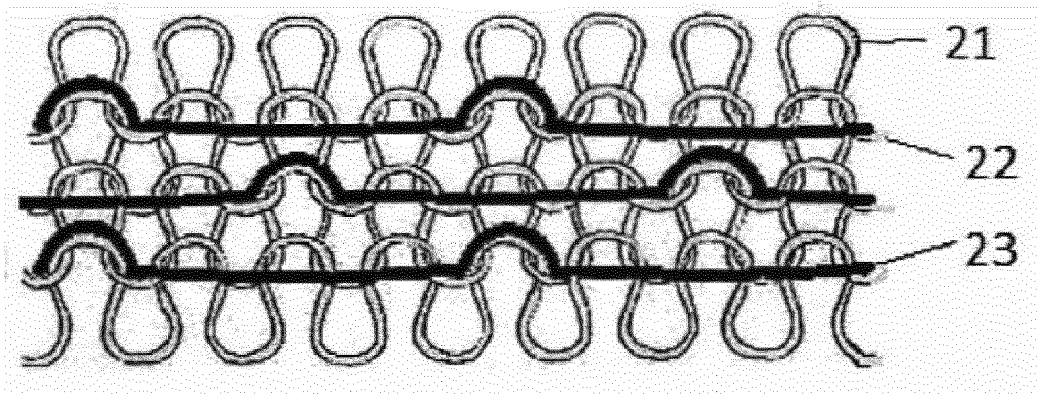


FIG. 6



EUROPEAN SEARCH REPORT

 Application Number
 EP 14 16 0305

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 5 319 807 A (BRIER DANIEL L [US]) 14 June 1994 (1994-06-14) * column 6, line 10 - line 35; figures 1-3 *	1-4,8-10	INV. A41B11/00 A41B11/02
X	US 4 615 188 A (HURSH DAVID F [US] ET AL) 7 October 1986 (1986-10-07) * figures 2,3 * * column 2, line 39 - line 41 * * column 2, line 43 - line 44 * * column 3, line 18 - line 22 *	1-4,8-10	
A	US 5 708 985 A (OGDEN J MICHAEL [US]) 20 January 1998 (1998-01-20) * column 5, line 15 *	2	
			TECHNICAL FIELDS SEARCHED (IPC)
			A41B A41D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 December 2014	Examiner van Voorst, Frank
CATEGORY OF CITED DOCUMENTS		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	
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			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 16 0305

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-12-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5319807 A	14-06-1994	AU 6317794 A	01-12-1994
		CA 2123770 A1	26-11-1994
		JP H073502 A	06-01-1995
		US 5319807 A	14-06-1994
		US 5353524 A	11-10-1994

US 4615188 A	07-10-1986	NONE	

US 5708985 A	20-01-1998	AU 5174398 A	03-06-1998
		CA 2271316 A1	22-05-1998
		EP 0938269 A1	01-09-1999
		US 5708985 A	20-01-1998
		WO 9820758 A1	22-05-1998

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- PK 5192013 [0001]
- US 134975 A [0001]