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(54) **PROTECTIVE GARMENT WITH THERMAL LINER HAVING VARYING MOISTURE ATTRACTION**

SCHUTZKLEIDUNG MIT ISOLATIONSFUTTER MIT UNTERSCHIEDLICHER FEUCHTIGKEITSABSORBIERUNG

VÊTEMENT DE PROTECTION DOTÉ D UNE DOUBLURE THERMIQUE PRÉSENTANT UNE ATTRACTION DE L'HUMIDITÉ VARIABLE

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Description

[0001] This application relates to protective garments, and more particularly, to protective garments with a thermal barrier having varying moisture attraction, such as certain hydrophobic and/or hydrophilic qualities.

BACKGROUND

[0002] Protective or hazardous duty garments are used in a variety of industries and settings to protect the wearer from hazardous conditions such as heat, smoke, cold, sharp objects, chemicals, liquids, fumes and the like. Such protective or hazardous duty garments are often used in adverse conditions. In addition, the wearers of such garments are typically placed under physical strain by carrying heavy gear and equipment. Wearers seek to avoid fatigue to remain mentally sharp and physically ready to carry out tasks.

[0003] Wearers of protective garments are often exposed to liquids, such as water or other liquids used during firefighting activities, or water in the form of perspiration. For example, an active and fully geared firefighter can perspire at a rate of 1200 to 1800 grams per hour as his or her body strives to maintain metabolic balance. Water or moisture (including any predominantly aqueous liquid) can alter the performance of the protective garment, such as by reducing the thermal insulation of the garment, and/or reducing ability of water vapor to pass outwardly through the selectively permeable moisture barrier of the garment. Moreover, if the moisture is left on the wearer's skin and not permitted to evaporate, the wearer may experience physical discomfort. US2007/136923 describes a garment with a heat resistant pad having a sealant thereon.

SUMMARY

[0004] The invention provides a protective garment as set out in the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Fig. 1 is a front perspective view of one embodiment of the garment of the present invention, shown in the form of a coat with certain layers cut away for illustrative purposes;

[0006] Fig. 2 is a side, exploded cross-sectional view of the garment of Fig. 1; and

[0007] Fig. 3 is a front perspective view of the garment of the present invention, shown in the form of a pair of trousers with certain layers cut away for illustrative purposes.

DETAILED DESCRIPTION

[0008] Fig. 1 illustrates a protective or hazardous duty garment 10 in the form of a firefighter's coat, generally

designated 10. The garment 10 includes a body portion 12 having a left front panel 14, right front panel 16 and a back panel 18. The left front panel 14 and right front panel 16 may be releasably attachable by a fastener 20, such as a zipper, snaps, clasps, clips, hook-and-loop fastening material (i.e., VELCRO® fastening material) combinations of these components or the like. The body portion 12 may define a torso cavity 22 that is shaped to receive a wearer's torso therein. The garment 10 may include a pair of arms or sleeves 24 coupled to and extending generally outwardly from the body portion 12 and shaped to receive a wearer's arms therein.

[0009] As shown in Fig. 3, the garment 10 may also take the form of a pair of trousers, including a pair of legs 27 shaped to receive a wearer's legs therein. Moreover, the garment 10 can also take various other forms, such as coveralls, jumpsuits, vests, etc. Each of these garments 10 may have the layers/materials described below (i.e. shown in Fig. 2 and in the cut-away portions of Figs. 1 and 3) to provide the accompanying benefits.

[0010] The garment 10 may include various layers through its thickness to provide heat, moisture and abrasion resistant qualities to the garment 10 so that the garment 10 can be used as a protective, hazardous duty, and/or firefighter garment. For example, in one embodiment the garment 10 may include an outer shell 26, a moisture barrier 28 located inside of and adjacent to the outer shell 26, and a thermal liner or barrier 30 located inside of and adjacent to the moisture barrier 28. Thus, in the illustrated configuration, the moisture barrier 28 is positioned between the outer shell 26 and the thermal barrier 30.

[0011] The outer shell 26 may be made of or include a variety of materials that are woven, knitted, or otherwise formed of high tenacity, flame resistant fibers. For example, the outer shell 26 may be made of a flame, tear, heat and abrasion resistant material such as a compact weave of aramid fibers and/or polybenzamidazole fibers. Commercially available aramid materials include NOMEX® and KEVLAR® fibers (both trademarks of E.I. DuPont de Nemours & Co., Inc. of Wilmington, Delaware), and commercially available polybenzamidazole fibers include PBI® fibers (a trademark of PBI Performance Fabrics of Charlotte, North Carolina). Thus, the outer shell 26 may be an aramid material, a blend of aramid materials, a polybenzamidazole material, a blend of aramid and polybenzamidazole materials, or other appropriate materials, such as BASOFIL® textile cloth sold by Basofil Fibers, LLC of Enka, North Carolina, or PYLON® textile materials sold by Toyo Boseki Babushiki Kaisha of Osaka, Japan. The material of the outer shell 26 may have a weight of, for example, between about 169-338 gr/m² (5-10 oz/yd².)

[0012] The outer shell 26 may exhibit some resistance to the absorption of water/moisture, since absorption of water/moisture increases the weight of the garment 10, alters the thermal conductivity of the garment 10, and decreases the effectiveness of the moisture barrier 28,

as will be described in greater detail below. If desired, the outer shell 26 may be coated with a durable, water repellent finish (i.e. a polymer finish, such as perfluorohydrocarbon, such as TEFLON® finish sold by E. I. Du Pont de Nemours and Company of Wilmington, Delaware). However, the outer shell 26 need not necessarily be so treated to resist the absorption of water.

[0013] The moisture barrier 28 and thermal barrier 30 may be generally coextensive with the outer shell 26, or spaced slightly inwardly from the outer edges of the outer shell 26 (i.e., spaced slightly inwardly from the outer ends of the sleeves 24, the collar 34 and from the upper and lower edge of the coat/trousers, etc.) to provide moisture and thermal protection throughout the garment 10.

[0014] The moisture barrier 28 may include a semi-permeable membrane layer 28a and a substrate 28b. The membrane layer 28a may be generally moisture vapor permeable but generally impermeable to liquid moisture. The membrane layer 28a may be made of or include expanded polytetrafluoroethylene ("PTFE") such as GORE-TEX®, CROSSTECH® or CHEMPAK® materials (all of which are trademarks of W.L. Gore & Associates, Inc. of Newark, Delaware), polyurethane-based materials, neoprene-based materials, cross-linked polymers, polyamid, or other materials. The membrane layer 28a may have microscopic openings that permit moisture vapor (such as water vapor) to pass therethrough, but block liquids (such as liquid water) from passing therethrough. The membrane layer 28a may be made of a microporous material that is either hydrophilic, hydrophobic, or somewhere in between. The membrane layer 28a may also be monolithic and may allow moisture vapor transmission therethrough by molecular diffusion. The membrane layer 28a may also be a combination of microporous and monolithic materials (known as a bicomponent moisture barrier), in which the microporous or monolithic materials are layered or intertwined.

[0015] The membrane layer 28a may be bonded or adhered to the substrate 28b of a flame and heat resistant material to provide structure and protection to the membrane layer 28a. The substrate 28b may be or include aramid fibers similar to the aramid fibers of the outer shell 26, but may be thinner and lighter in weight, and allow moisture vapor to freely pass therethrough. The substrate 28b may be woven, non-woven, spunlace or other materials.

[0016] In the illustrated embodiment, the membrane layer 28a is located between the outer shell 26 and the substrate 28b. However, the orientation of the moisture barrier 28 may be reversed such that the substrate 28b is located between the outer shell 26 and the membrane layer 28a. Moreover, in the illustrated embodiment, the substrate layer 28b is located on only one side of the membrane layer 28a. However, a substrate layer 28b may be located on both sides of the membrane layer 28a, if desired, to improve durability or other performance parameters of the moisture barrier 28.

[0017] The moisture barrier 28 helps to prevent exter-

nal moisture/water (i.e., that has breached the outer shell 26) from reaching the thermal barrier 30. If the thermal barrier 30 retains sufficient external moisture/water, the thermal barrier 30 becomes significantly more thermally conductive, which allows the external heat to be more easily transferred to the wearer. A moisture-laden thermal barrier 30 also adds significant weight, thus increasing fatigue of the wearer. Accordingly it is desired to limit the absorption of external moisture by the thermal barrier 30. In addition, by providing a "breathable" moisture barrier 28, vapor and dry heat can pass from the torso cavity 22, through the moisture barrier 28, and out of the garment 10.

[0018] However, when either side of the moisture barrier 28 becomes sufficiently exposed to moisture, the moisture barrier 28 may no longer allow vapor to pass therethrough. More particularly, when a continuous sheet of water/moisture (i.e. formed by capillary or attractive forces of the water, or by sheer volume of the water/moisture) coats one or both sides of the moisture barrier 28, the moisture barrier 28 may be considered to be "wetted out," and the microscopic openings of the membrane layer 28a may be sealed or blocked (or the moisture barrier 28 otherwise adversely effected) such that water/moisture vapor cannot pass through the moisture barrier 28. When the thermal barrier 30 is wet or saturated with water/moisture, the thermal barrier 30 may contribute to wetting out of the moisture barrier 28 (i.e. by direct physical contact and/or capillary action between the thermal barrier 30 and moisture barrier 28, or by causing the air adjacent to the moisture barrier 28 to become saturated such that moisture condenses on the moisture barrier 28, etc.)

[0019] Accordingly, the thermal barrier 30 may be configured to reduce wetting out of the moisture barrier 28. In one embodiment, the thermal barrier 30 includes three layers: a first, or outer, or dry layer 30a, a second, or middle, or reservoir layer 30b, and a third or inner, or face cloth layer 30c. The dry layer 30a may be positioned adjacent to the moisture barrier 28 (i.e. positioned between the moisture barrier 28 and the reservoir layer 30b) and can be made of knitted, non-woven or woven materials and may resist absorption of water/moisture.

[0020] For example, the dry layer 30a may be relatively thick (i.e. between about 0,4mm-1,2mm. (1/64"-3/16")) layer of batting, or felt or needled non-woven bulk or batting material 30a. The material of the dry layer 30a can include aramid fiber batting (such as NOMEX® batting), an aramid blend of non-woven material, an aramid spunlace material, an aramid needlepunch material, an aramid non-woven material, an aramid blend needlepunch material, an aramid blend batting material, meta-aramid materials, para-aramid materials, KERMEL® thermostable organic polymeric material sold by Kermel SAS of Colmar, France, TWARON® synthetic fibers sold by Teijin Aramid B.V. Ltd. of Arnhem, Netherlands, KEVLAR® material, foam (either open cell or closed cell), or combinations of these materials which may be imparted with

flame and heat resistant properties.

[0021] The dry layer 30a may be made of materials, or treated, such that the dry layer 30a is hydrophobic or generally hydrophobic and is configured to resist the absorption of water/moisture. The dry layer 30a may be made of inherently hydrophobic or generally hydrophobic materials, or made of materials which are treated to be hydrophobic or generally hydrophobic. A material/treatment may be considered to be hydrophobic, generally hydrophobic, water-repellant, or nonhydrophilic, when the material/treatment has a contact angle with water/moisture of greater than about 90°. In this case, the attractive or adhesive forces within a drop of water are stronger than the attractive or adhesive forces between the water and the material/treatment. This aversion of water to the hydrophobic material/treatment causes the drop of water to form into a somewhat spherical or closed shape, rather than spread out and be absorbed into or attracted to the hydrophobic material/treatment. If desired, the hydrophobic material/treatment may have a contact angle of less than 150° such that the materials/treatment are not superhydrophobic, although the material/treatment may be superhydrophobic in some cases.

[0022] A layer/liner, such as layer 30a, may also, or instead, be considered to be hydrophobic or generally hydrophobic if the layer/liner can gain and retain no more than 100% (or 50% in another embodiment) of its weight in moisture. In this manner it should be clear that a layer/liner need not entirely consist of hydrophobic materials to be considered hydrophobic as a whole, and a hydrophobic layer/liner could in fact include some "neutral" or even some hydrophilic materials and still be considered hydrophobic or generally hydrophobic. The same principles apply, of course, to a hydrophilic layer/liner.

[0023] If the dry layer 30a is made with a material that is not inherently hydrophobic or generally hydrophobic (such as an aramid spunlace or aramid nonwoven material) the dry layer 30a may be treated with a durable water-repellant finish, such as, in one embodiment, perfluorohydrocarbon. The durable water-repellant finish should be sufficiently durable that it can withstand at least five launderings (according to appropriate NFPA standards, EN standards, or the like) without substantial diminution in its water repellency (i.e. in one case, such that the water repellant finish loses no more than 10% of its ability to prevent water absorption).

[0024] The reservoir layer 30b may be positioned between the dry layer 30a and the face cloth layer 30c, and may be made of materials, or treated, such that the reservoir layer 30b is hydrophilic or generally hydrophilic, and thus configured to retain water/moisture in the layer 30b. In this case, materials of the reservoir layer 30b may have a contact angle of greater than 90° such that the attractive or adhesion forces within a drop of water/moisture are weaker than those between the water/moisture and the hydrophilic (or non-water repellent or non-hydrophobic) materials. Alternately, or in addition, the layer 30b may be considered to be hydrophilic or generally

hydrophilic if the layer/liner can gain and retain at least twice its weight in moisture.

[0025] The reservoir layer 30b can be made of any of the materials described above for the dry layer 30a, but may also include cotton, acrylic, or viscose. In some cases, the thermal barrier 30 may lack any significant polymer filler material, such as a superabsorbent polymer, including a cross-linked polyacrylamide. In one embodiment, the reservoir layer 30b includes 50%, or at least about 25%, by weight of absorbent hydrophilic material or fibers, such as Lenzing FR viscose. These materials are absorbent and include interstices to help store and retain moisture. The balance of the reservoir layer 30b can consist of adsorbent hydrophilic material with flame and heat resistant properties, such as KYNOL™ material sold by Gun Ei Chemical of Japan, meta aramid, aramid, or para aramid materials such as NOMEX®, KERMEL®, TWARON®, KEVLAR® or TEIJINCONEX® sold by Teijin Techno Products Limited of Osaka, Japan. These adsorbent materials help to wick up moisture such that it can be absorbed by the absorbent materials of the reservoir layer. The adsorbent and absorbent materials of the reservoir layer 30b may be blended together to form a generally homogeneous mixture.

[0026] The inner layer 30c can be the innermost layer of the garment (i.e. positioned immediately adjacent to a wearer or the wearer's clothing), or positioned adjacent to an inner liner (not shown). The inner liner 30c can be a weave of light weight aramid material, and may be made of any of the materials described above for the reservoir layer 30b, dry layer 30a, or substrate 28b of the moisture barrier 28. The inner layer 30c may be made of or include some hydrophilic or generally hydrophilic material (or material treated to be hydrophilic) to wick moisture away from the wearer. Thus the inner layer 30c may be hydrophilic or generally hydrophilic, but may be less hydrophilic than the reservoir layer 30b since too much wicking of moisture may cause the inner layer 30c to become saturated.

[0027] The inner layer 30c may form the innermost layer of the garment 10, and therefore is desired to present a comfortable surface to the wearer, and protects the moisture barrier 28 and other layers 30a, 30b of the thermal barrier 30 from abrasion and wear. If desired, at least the layers 30b and 30c may be directly joined together to form an integral liner/layer of the garment which improves ease of repair and replacement, and/or help to retain moisture in the reservoir layer 30b. Alternately, or in addition, all three layers 30a, 30b, 30c may be joined together to form an integral liner/layer 30. The layers 30a, 30b, 30c can be joined together by various means, such as quilting, stitching, adhesives, combinations of these techniques or otherwise, although the layers 30a, 30b, 30c may remain separate if desired. In some cases, the thermal barrier 30 may be joined to the moisture barrier 28 to form an integral inner liner component.

[0028] Rather than each layer 30a, 30b, 30c being strictly identified as hydrophobic/ hydrophilic, each layer

30a, 30b, 30c may be more hydrophobic/hydrophilic than other layers and still operate in the desired manner. For example, the thermal layer 30 may include a reservoir layer 30b that is more hydrophilic than the dry layer 30a and/or the inner layer 30c, and an inner layer 30c that is more hydrophilic than the dry layer 30a. Conversely, the dry layer 30a may be more hydrophobic than the inner layer 30c, which in turn may be more hydrophobic than the reservoir layer 30b. In this manner, moisture presented to the thermal barrier 30 from inside the garment 10 (i.e. in the form of perspiration) is transported through the inner layer 30c and is held within the reservoir layer 30b until conditions of interior pressure and/or exterior dryness allow moisture (in the form of water vapor) to pass further outward through the dry layer 30a and the breathable moisture barrier 28.

[0029] By maintaining a relatively hydrophobic dry layer 30a facing the moisture barrier 28, wetting out of the inner surface of the moisture barrier 28 is prevented or reduced. In particular, because the dry layer 30a generally repels, and does not retain, water/moisture, a relatively dry surface is presented to the inner surface of the moisture barrier 28 to prevent wetting out of the moisture barrier 28. In addition, the dry layer 30a allows moisture vapor/water vapor to pass therethrough. Accordingly, moisture/water stored in the reservoir 30b can pass through the dry layer 30a and moisture barrier 28 in vapor form, and exit the garment 10 to increase comfort and thermal insulation of the garment 10. If desired, no layers of the garment or other materials, particularly hydrophilic materials or layers, are positioned between the dry layer 30a and the moisture barrier 28 so that the dry layer 30a can provide a dry facing surface as desired.

[0030] In addition, as noted above the inner layer 30c may be hydrophilic or generally hydrophilic to help draw moisture away from the wearer. Because the reservoir layer 30b is more hydrophilic than the inner layer 30c, moisture is drawn or wicked from the inner layer 30c into the reservoir 30b, wherein the water/moisture is stored until it can be vented through the moisture barrier 28.

[0031] Although the moisture barrier 28 is shown as being located between the outer shell 26 and the thermal barrier 30, the positions of the moisture barrier 28 and thermal barrier 30 may be reversed such that the thermal barrier 30 is located between the outer shell 26 and the moisture barrier 28. In this case, the orientation of the thermal barrier 30 would be reversed so that the dry layer 30a is the inner-most layer, facing the moisture barrier 28 to prevent wetting out of the moisture barrier 28. Moreover it should be understood that the garment 10 may include various arrangements of liners, barriers and materials, as desired, in which the various layers described herein are included, omitted, and/or rearranged.

[0032] The thermal barrier 30, as a whole, may trap air and possess sufficient loft to provide thermal resistance to the garment 10 to allow the garment to properly function as a firefighting garment. In one embodiment, the thermal barrier 30 (and/or the garment 10 as a whole)

may have a thermal protection performance ("TPP") of at least about twenty or at least about ten, and/or the garment 10 as a whole may have a TPP of at least about thirty-five.

[0033] Each layer of the garment 10, and the garment 10 as a whole, may meet the National Fire Protection Association ("N.F.P.A.") 1971 standards for protective firefighting garments ("Protective Clothing for Structural Firefighting") (or equivalent standards set by European Committee for Standardization (also known as Comité Européen de Normalisation ("CEN")). The NFPA standards specify various minimum requirements for heat and flame resistance and tear strength. For example, in order to meet the NFPA standards, the outer shell 26, moisture barrier 28 and thermal barrier 30 collectively, and individually, must be able to resist igniting, burning, melting, dripping and/or separation when exposed to a temperature of 260°C (500° F) for at least five minutes in a forced air oven. Furthermore, in order to meet the NFPA standards, all combined layers of the garment 10 must provide a thermal protective performance rating of at least thirty-five.

[0034] NFPA standards also require that the outer shell 26, moisture barrier 28, and thermal barrier 30 collectively, and individually, be sufficiently flame resistant to meet the flame test specified therein. Apparatus and procedures for determining flame resistance are in accordance with NFPA 1971, NFPA 1975 and ASTM D 6413, *Standard Test Method for Flame Resistance of Textiles (Vertical Test)*, which is incorporated by reference herein. For example, each layer 26, 38, 30, and the garment 10 as a whole, should have a char length of not more than 102mm. (four inches) or under NFPA 1975 standards a char length of not more than 152mm (six inches) and shall not melt or drip, when tested in the manner specified in the flame resistance test.

[0035] Although the invention is shown and described with respect to certain embodiments, it should be clear that modifications will occur to those skilled in the art upon reading and understanding the specification,

Claims

1. A protective garment (10) comprising:
 - an outer shell (26);
 - thermal barrier (30); and
 - a moisture barrier (28) positioned between said outer shell (16) and said thermal barrier (30), said thermal barrier (30) including an outer layer (30a), an inner layer (30c), an intermediate layer (30b) is positioned between said outer (30a) and inner (30c) layers, wherein said outer layer (30a) is positioned adjacent to said moisture barrier (28), and wherein (4) moisture is more attracted to said intermediate layer (30b) than to said outer layer (30a) due to the nature of the materials

of the intermediate layer (30b) and/or the outer layer (30a) and/or a treatment applied thereto.

2. The garment of claim 1 wherein said thermal barrier (30) and said outer shell (26) resist igniting, burning, melting, dripping or separation when exposed to a temperature of 260° (500°F) for at least five minutes. 5
3. The garment of claim 1 wherein said outer layer (30a) is hydrophobic and said intermediate layer (30b) is hydrophilic. 10
4. The garment of claim 1 wherein said inner layer (30c) is hydrophilic. 15
5. The garment of claim 1 wherein said outer layer (30a) faces said moisture barrier (28) with no layers therebetween so that said thermal barrier (30) presents a relatively dry surface to said moisture barrier (28). 20
6. The garment of claim 1 wherein moisture is more attracted to said intermediate layer (30b) than to said inner layer (30c).
7. The garment of claim 1 wherein moisture is more attracted to said inner layer (30c) than to said outer layer (30a). 25
8. The garment of claim 1 wherein said inner layer (30c) is an inner face cloth forming the innermost surface of said garment (10) and is configured to face a wearer when said garment (10) is worn. 30
9. The garment of claim 1 wherein said inner layer (30c), said intermediate layer (30b) and said outer layer (30a) are directly coupled together form a discrete layer of said garment (10). 35
10. The garment of claim 1 wherein said moisture barrier (28) is liquid impermeable and moisture vapor permeable. 40
11. The garment of claim 1 wherein said garment (10) is a coat and said thermal barrier (30) is formed in the shape of a coat, or wherein said garment (10) is a pair of trousers and said thermal barrier (30) is formed in the shape of a pair of trousers. 45
12. The garment of claim 1 wherein said intermediate layer (30b) includes at least 25% absorbent material, and wherein the remainder of said intermediate layer (30b) is made of adsorbent material. 50

Patentansprüche 55

1. Schutzkleidungsstück (10) umfassend:

ein äußeres Obermaterial (26);
eine Wärmebarriere (30) und
eine Feuchtigkeitsbarriere (28), die zwischen dem äußeren Obermaterial (16) und der Wärmebarriere (30) positioniert ist, wobei die Wärmebarriere (30) eine äußere Schicht (30a), eine innere Schicht (30c), eine Zwischenschicht (30b), die zwischen den äußeren (30a) und inneren (30c) Schichten positioniert ist, umfasst, wobei die äußere Schicht (30a) an der Feuchtigkeitsbarriere (28) anliegend positioniert ist und wobei Feuchtigkeit stärker an die Zwischenschicht (30b) als an die äußere Schicht (30a) auf Grund der Art der Materialien der Zwischenschicht (30b) und/oder der äußeren Schicht (30a) angezogen wird, und/oder eine Behandlung, die darauf aufgebracht wird.

2. Kleidungsstück nach Anspruch 1, wobei die Wärmebarriere (30) und das äußere Obermaterial (26) dem Feuerfangen, Brennen, Schmelzen, Tropfenbilden oder Auftrennen widerstehen, wenn sie einer Temperatur von 260 °C (500 °F) mindestens fünf Minuten lang ausgesetzt werden.
3. Kleidungsstück nach Anspruch 1, wobei die äußere Schicht (30a) hydrophob und die Zwischenschicht (30b) hydrophil ist.
4. Kleidungsstück nach Anspruch 1, wobei die innere Schicht (30c) hydrophil ist.
5. Kleidungsstück nach Anspruch 1, wobei die äußere Schicht (30a) der Feuchtigkeitsbarriere (28) ohne Schichten dazwischen zugewandt ist, so dass die Wärmebarriere (30) eine relativ trockene Oberfläche der Feuchtigkeitsbarriere (28) zu präsentiert.
6. Kleidungsstück nach Anspruch 1, wobei Feuchtigkeit stärker an die Zwischenschicht (30b) als an die innere Schicht (30c) angezogen wird.
7. Kleidungsstück nach Anspruch 1, wobei Feuchtigkeit stärker an die innere Schicht (30c) als an die äußere Schicht (30a) angezogen wird.
8. Kleidungsstück nach Anspruch 1, wobei die innere Schicht (30c) ein innerer Oberstoff ist, der die innerste Fläche des Kleidungsstücks (10) bildet und so konfiguriert ist, dass er einem Träger zugewandt ist, wenn das Kleidungsstück (10) getragen wird.
9. Kleidungsstück nach Anspruch 1, wobei die innere Schicht (30c), die Zwischenschicht (30b) und die äußere Schicht (30a) direkt aneinander gekoppelt sind, um eine einzelne Schicht des Kleidungsstücks (10) zu bilden.

10. Kleidungsstück nach Anspruch 1, wobei die Feuchtigkeitsbarriere (28) flüssigkeitsundurchlässig und feuchtigkeitsdampfdurchlässig ist.
11. Kleidungsstück nach Anspruch 1, wobei das Kleidungsstück (10) ein Mantel ist und die Wärmebarriere (30) in Gestalt eines Mantels gebildet ist, oder wobei das Kleidungsstück (10) eine Hose ist und die Wärmebarriere (30) in Gestalt einer Hose gebildet ist.
12. Kleidungsstück nach Anspruch 1, wobei die Zwischenschicht (30b) mindestens 25 % absorptionsfähiges Material umfasst und wobei der Rest der Zwischenschicht (30b) aus absorptionsfähigem Material hergestellt ist.

Revendications

1. Vêtement protecteur (10) comprenant :
- une enveloppe externe (26) ;
 - une barrière thermique (30) ; et
 - une barrière à l'humidité (28) positionnée entre ladite enveloppe externe (16) et ladite barrière thermique (30), ladite barrière thermique (30) incluant une enveloppe externe (30a), une couche interne (30c), une couche intermédiaire (30b) qui est positionnée entre lesdites couches externe (30a) et interne (30c), dans lequel ladite couche externe (30a) est positionnée de manière adjacente à ladite barrière à l'humidité (28) et dans lequel l'humidité est plus attirée vers ladite couche intermédiaire (30b) que vers ladite couche externe (30a) dû à la nature des matériaux de la couche intermédiaire (30b) et/ou de la couche externe (30a) et/ou du traitement appliqué dessus.
2. Vêtement selon la revendication 1, dans lequel ladite barrière thermique (30) et ladite enveloppe externe (26) résistent à l'ignition, à la combustion, à la fusion, à l'exsudation ou à la séparation lorsqu'elles sont exposées à une température de 260° C (500° F) durant au moins cinq minutes.
3. Vêtement selon la revendication 1, dans lequel ladite couche externe (30a) est hydrophobe et ladite couche intermédiaire (30b) est hydrophile.
4. Vêtement selon la revendication 1, dans lequel ladite couche interne (30c) est hydrophile.
5. Vêtement selon la revendication 1, dans lequel ladite couche externe (30a) fait face à ladite barrière à l'humidité (28) sans couche entre elles de sorte que ladite barrière thermique (30) présente une surface
- relativement sèche à ladite barrière à l'humidité (28).
6. Vêtement selon la revendication 1, dans lequel l'humidité est plus attirée vers ladite couche intermédiaire (30b) que ladite couche interne (30c).
7. Vêtement selon la revendication 1, dans lequel l'humidité est plus attirée vers ladite couche interne (30c) que ladite couche externe (30a).
8. Vêtement selon la revendication 1, dans lequel ladite couche interne (30c) est un tissu à face interne formant la surface la plus interne dudit vêtement (10) et est configuré pour faire face au porteur lorsque ledit vêtement (10) est porté.
9. Vêtement selon la revendication 1, dans lequel ladite couche interne (30c), ladite couche intermédiaire (30b) et ladite couche externe (30a) sont directement couplées ensemble pour former une couche discrète dudit vêtement (10).
10. Vêtement selon la revendication 1, dans lequel ladite barrière à l'humidité (28) est imperméable aux liquides et perméable à la vapeur humide.
11. Vêtement selon la revendication 1, dans lequel ledit vêtement (10) est un manteau et ladite barrière thermique (30) est formée pour prendre la forme d'un manteau, ou dans lequel ledit vêtement (10) est une paire de pantalons et ladite barrière thermique (30) est mise en forme de paire de pantalons.
12. Vêtement selon la revendication 1, dans lequel ladite couche intermédiaire (30b) inclut au moins 25 % de matériau absorbant, et dans lequel le reste de ladite couche intermédiaire (30b) est constitué d'un matériau adsorbant.

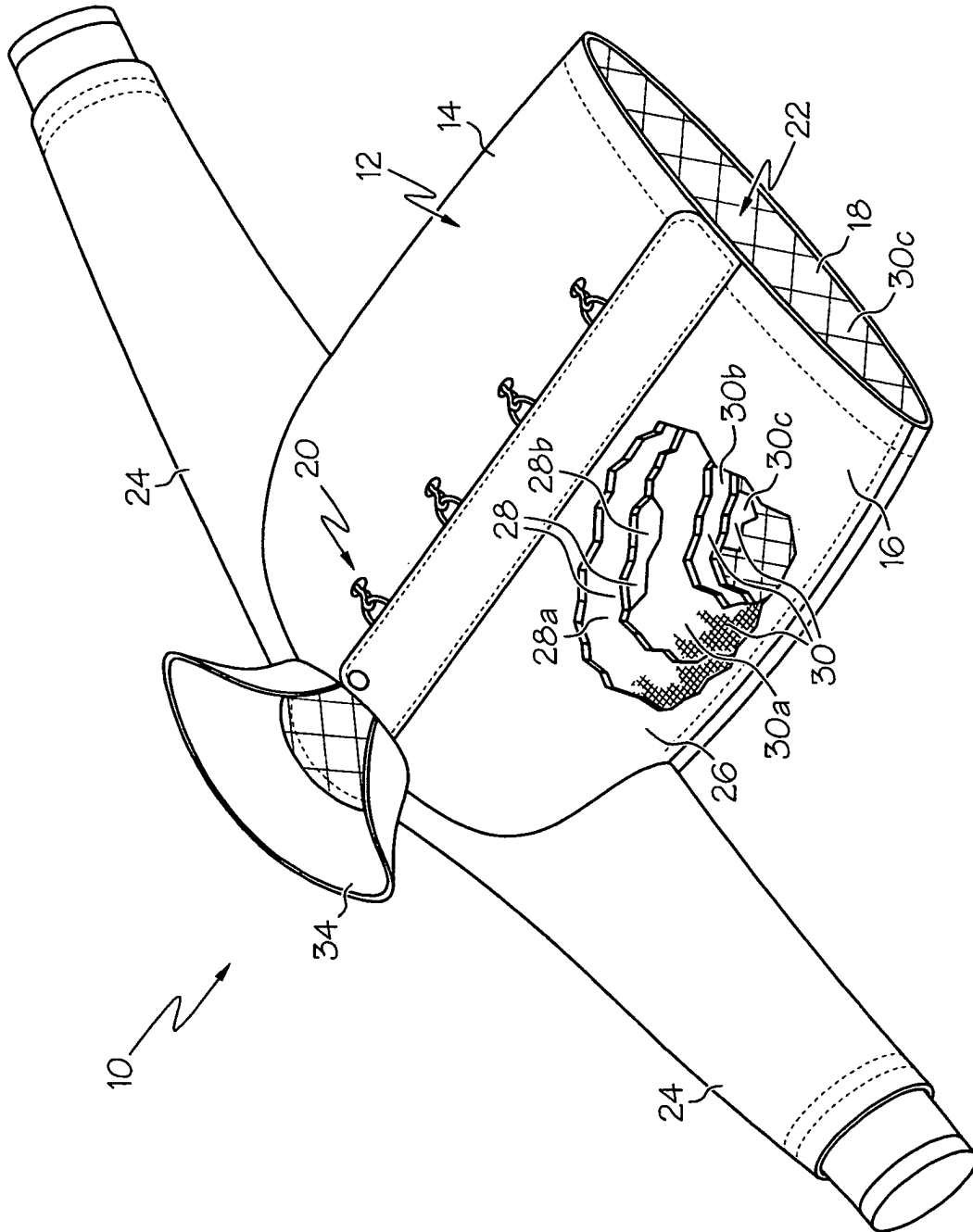


FIG. 1

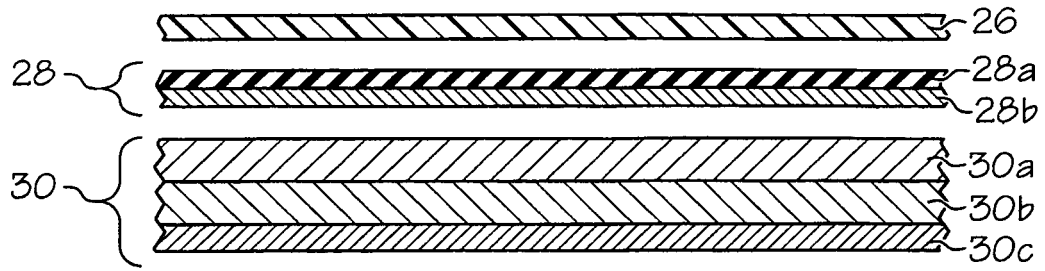


FIG. 2

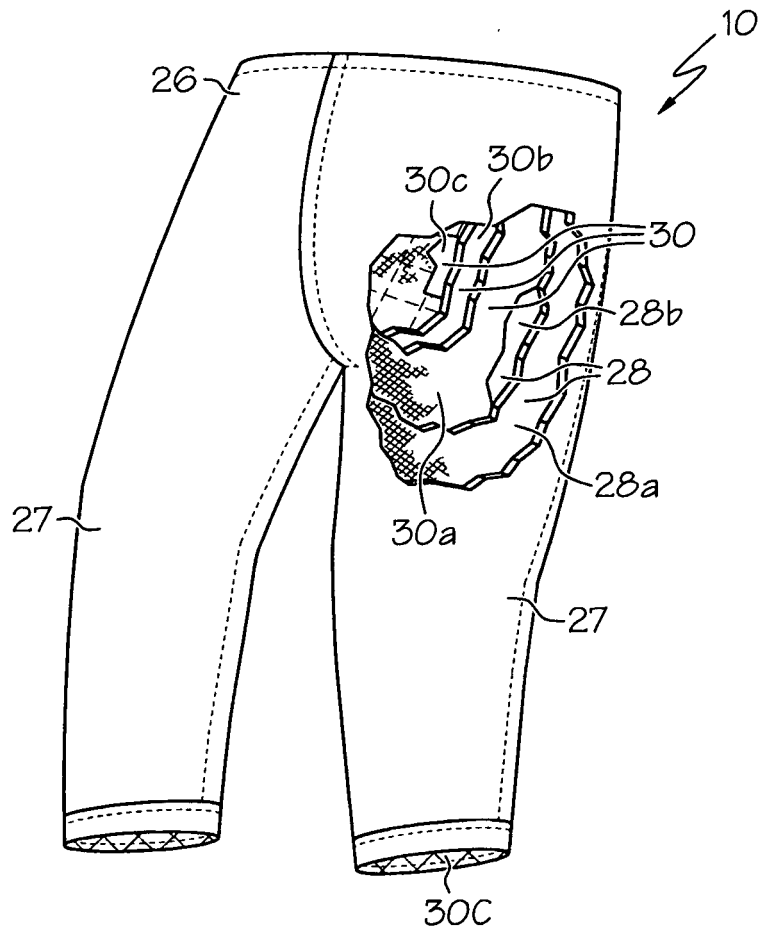


FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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