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(54) **Vents for temporary shelters and coverings**

(57) A venting system for a temporary shelter 2 that includes one or more vents 8 that are positioned in the exterior shell of the temporary shelter 2. Each of the one or more vents 8 may include a membrane 16 that is moisture vapor transmissive and resistant to liquid penetration. The membrane 16 may have a moisture vapor trans-

missive rate of at least 4,000 g/m²/day. The membrane 16 may be expanded polytetrafluoroethylene. The one or more vents 8 may have a size such that there is approximately 4 m² of vent 8 surface area in the exterior shell of the temporary shelter 2 per 20 m³ of interior space within the temporary shelter 2.

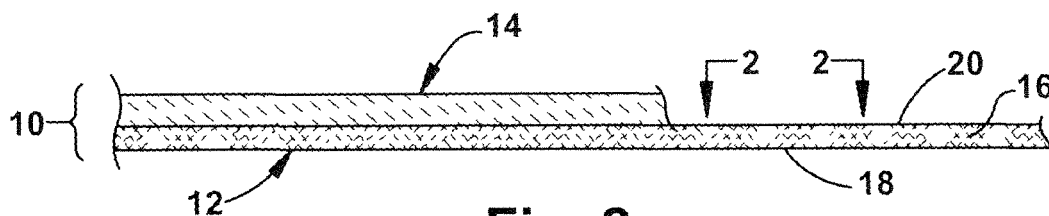


Fig. 2

Description

[0001] This present application relates generally to improved vents for temporary shelters and coverings. More specifically, but not by way of limitation, the present application relates to systems for providing breathable, water resistant membrane vents in temporary shelters or coverings to prevent humidity or heat build-up.

[0002] Temporary shelters, such as tents, temporary sheds, mobile military structures, typically are made from non-breathable fabrics or membranes. Because of the metabolic breathing process of occupants as well as other activities, such as cooking, occupation of these structures causes humidity build-up. Humidity build-up may create an uncomfortable condition for the occupants, condensation issues, damage to electrical equipment by water, and other problems. Further, coverings for electrical equipment and other types of equipment, such as weapons, automobiles or aircraft, may experience humidity or heat build-up, either from heat generation within the cover by the equipment or by exposure to the sun coupled with moisture.

[0003] Certain types of vents have been employed in temporary shelters and coverings to vent built-up humidity or heat to the atmosphere. However, conventional vents often employ mesh, which is susceptible to water penetration. More specifically, mesh and other similar vent materials allow water to enter the temporary shelter or covering, which may be uncomfortable to the occupants, lead to issues with electrical equipment housed therein or cause other problems. The problem also has been solved with the use of electric dehumidifiers. However, temporary shelters often are located in remote areas where electric service is unavailable.

[0004] Thus, there is a need for improved venting systems in temporary shelters and covering. Such improved venting systems will allow for excess water vapor to be vented to the atmosphere while preventing the penetration into the temporary structure of undesirable external conditions, such as water, dust, sand, insects, wind, microbes and the like.

[0005] According to a first aspect of the invention, the present application thus describes a venting system for a temporary shelter that includes one or more vents that are positioned in the exterior shell of the temporary shelter. Each of the one or more vents may include a membrane that is moisture vapor transmissive and resistant to liquid penetration. The membrane may have a moisture vapor transmissive rate of at least 4,000 g/m²/day.

[0006] The one or more vents may include a laminated fabric that includes the membrane and a base fabric. The base fabric may include a woven, non-woven or knit textile. The base fabric may include a flame retardant material.

[0007] In some embodiments, the membrane may be air permeable and immune to liquid penetration. At least one of the vents may be positioned in the upper part of a side of the temporary shelter. In some embodiments,

the membrane may be oleophobic. The membrane may be expanded polytetrafluoroethylene.

[0008] In some embodiments, the one or more vents may be incorporated into the temporary shelter by a waterproof zipper. In other embodiments, each of the one or more vents may be welded onto a corresponding opening in the exterior shell of the temporary shelter. In other embodiments, each of the one or more vents may be stitched directly onto a corresponding opening in the exterior shell of the temporary shelter and seam tape may be used to seal the stitch holes from water leaks. The one or more vents may have a size such that there is approximately 4 m² of vent surface area in the exterior shell of the temporary shelter per 20 m³ of interior space within the temporary shelter.

[0009] According to a second aspect of the invention, the present application further describes a structure for enclosing items, such as people or equipment, capable of generating heat or humidity. The structure may include an exterior wall and one or more vents incorporated in the exterior wall. The one or more vents may include a membrane that is moisture vapor transmissive to permit release of heat or humidity from within the structure and resistant to liquid penetration. The one or more vents may have a size such that there is approximately 4 m² of vent surface area in the exterior wall of the structure per 20 m³ of interior space within the structure.

[0010] In some embodiments, the membrane may be oleophobic. The membrane further may be air permeable and immune to liquid penetration. The membrane may be expanded polytetrafluoroethylene. The membrane may have a moisture vapor transmissive rate of at least 4,000 g/m²/day. In some embodiments, a positive air pressure may be maintained in the structure. These and other features of the present application will become apparent upon review of the following detailed description of the preferred embodiments when taken in conjunction with the drawings and the appended claims.

[0011] Various aspects and embodiments of the present invention will now be described in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of an exemplary temporary shelter with vents in accordance with exemplary embodiments of the present invention.

FIG. 2 is a schematic sectional view of a laminated fabric that includes a composite membrane which may be used in accordance with certain embodiments of the present invention.

FIG. 3 is an enlarged schematic plan view of a portion of the membrane illustrated in FIG. 2, viewed approximately along the line 2--2 in FIG. 2.

[0012] Fig. 1 illustrates a perspective view of a tent or temporary shelter 2 in which exemplary embodiments of the present application may be used. The temporary

shelter 2 may include an exterior fabric or shell 3 that is supported by two flexible, crossing rods 4 such that the temporary shelter 2 has four sides and an approximate dome shape. Those of ordinary skill in the art will recognize that the configuration of temporary shelter 2 is exemplary only and that other tent or temporary shelter configurations may be used with the invention described herein. Further, one of ordinary skill in the art will recognize that the inventive concepts described in relation to the temporary shelter 2 may be readily applied to other types of coverings, such as coverings for electrical equipment, weapons, automobiles or aircraft, that may experience heat or humidity build-up. Thus, for the sake of simplicity, exemplary embodiments will be discussed in relation to the temporary shelter 2 example, though it will be appreciated that the embodiments may be used with other types of tents, temporary shelters, and other coverings.

[0013] The temporary shelter 2 may include a door 6 for egress, which may zipper between and open and closed position. The temporary shelter 2 further may include one or more vents 8. The vents 8 may be made of a laminated fabric that includes a breathable, water-resistant or waterproof membrane. The vents 8 thus may allow water vapor to be vented to the atmosphere while being resistant or immune to water penetration, as described in more detail below. The vents 8 may be located in the exterior shell 3 of the temporary shelter 2. As shown, it may be advantageous to locate the vents 8 in the upper part (i.e., the top third) of each of the sides of the temporary shelter such that the warmer, more humid air inside the temporary shelter 2 is vented to the atmosphere. In some embodiments, as depicted in Fig. 1, the temporary shelter 2 may include rectangular vents 8 that are located in the upper part of each of its sides.

[0014] The membrane of the vent 8 may be: 1) breathable, including moisture vapor transmissive and 2) resistant or immune to liquid penetration (which, in combination, is often referred to as "waterproof breathable"). In some embodiments, the vent 8 may be air permeable. In general, "moisture vapor transmissive" is used to describe a membrane that readily permits the passage of water vapor. In some embodiments of the current application, the moisture vapor transmissive rate ("MVTR") of the membrane is at least 4,000 g/m²/day (as tested per JIS L 1099 B-2 procedures). The term "immune to liquid penetration" is used to describe a membrane that is not "wet" or "wet out" by a challenge liquid, such as water, and prevents the penetration of liquid through the membrane under varying ambient conditions.

[0015] In one embodiment, the vent 8 of the present application may include a membrane that is made from expanded polytetrafluoroethylene ("ePTFE"). In general, an ePTFE membrane is air permeable and moisture vapor transmissive, yet resistant or immune to liquid penetration at moderate pressures. Fig. 2 demonstrates a cross-section of an exemplary ePTFE laminated fabric 10, which may be used according to exemplary embod-

iments of the present application. The ePTFE laminate fabric 10 may include an ePTFE membrane 12 and a shell or base fabric 14. The ePTFE membrane 12 may include a membrane 16. The ePTFE membrane 12 is typically laminated to the base fabric 14 to create the ePTFE laminate fabric 10. The ePTFE membrane 12 and the base fabric 14 may be laminated pursuant to a thermal lamination process, adhesive lamination process, or other conventional methods. The base fabric 14 may be laminated to one side for both sides of the ePTFE membrane 12. The base fabric 14 may be a woven, nonwoven or knit textile.

[0016] As demonstrated in Fig. 3, the membrane 16 of the ePTFE membrane 12 may be porous, and preferably microporous, with a three-dimensional matrix or lattice type structure of numerous nodes 22 interconnected by numerous fibrils 24. Surfaces of the nodes 22 and fibrils 24 may define numerous interconnecting pores 26 that extend through the membrane 16 between opposite major sides 18, 20 of the membrane. ePTFE membranes are more fully described in U.S. Patents 6,228,477; 6,410,084; 6,676,993; 6,854,603; and U.S. Published Patent Application U.S. 2004/0059717, which are incorporated herein in their entirety. In some embodiments, the membrane 16 may be oleophobic. Those of ordinary skill in the art will appreciate that the description herein of the specific ePTFE membrane 12 is exemplary only and that other types of membranes may be used with the exemplary embodiments described herein. For example, such similar membranes may include microporous or non-microporous polyolefins, polyurethanes, polyesters, polyamides, polyethersulfones, cellulose acetate and the like.

[0017] As stated, the vents 8 may be made of a laminated fabric that includes a membrane. Further, according to certain embodiments, the laminated fabric may be the ePTFE laminated fabric 10 that includes an ePTFE membrane 12. The ePTFE membrane 12 may be laminated to the base fabric 14, which may be chosen for its strength (tensile and tear strength), durability, durability against ultraviolet radiation, ability to blockout light, flame retardant characteristics, softness, drapeability, and ability to seamseal. Thus, for example, the base fabric 14 may be made of polyamides, polyesters, polyolefins or other similar materials. Flame retardant fibers, such as Nomex® also may be blended into the base fabric 14. As described, the base fabric 14 may be laminated on one or both sides of the ePTFE membrane 12 pursuant to the processes described above.

[0018] The vents 8 may be integrated into the sides of the temporary shelter 2 by several means. In some embodiments, waterproof zippers may be attached to the periphery of the vent 8 and onto the corresponding opening in the exterior shell 3 of the temporary shelter 2. The vent 8 then may be zipped into place. This method of integration may allow for the easy replacement of worn or damaged vents 8. In other embodiments, the vent 8 may be stitched directly into the exterior shell 3 of the

temporary shelter 2. Seam tape or other similar material may be used to seal the stitch holes from water leaks. In other embodiments, the vents 8 may be weld onto the corresponding openings in the exterior shell 3. Any of the known processes for imparting energy for completed the weld may be used, such as ultrasonic, radio frequency, hot air gun, hot plate and the like.

[0019] The vents 8 may be sized in the temporary shelter 2 so that the vents 8 perform efficiently while also being cost effective. More specifically, the vents 8 may be sized to a minimum size at which the vents 8 maintain a comfortable humidity level within the temporary shelter 2 assuming a certain level of occupation. In this manner, the vents 8 are not sized too large, which might be wasteful from a cost perspective, or sized too small, which might not be able to maintain a comfortable humidity level within the temporary shelter 2. Given these competing criteria, it has been discovered that an efficient size for the vents 8 is approximately 4 m² of vent surface area in the exterior shell of the temporary shelter 2 per 20 m³ of interior space within the temporary shelter 2. This sizing assumes an occupancy rate of approximately one person per 10 m³ of interior space.

[0020] Accordingly, if the vent sizing ratio of approximately 4 m² of vent surface area in the exterior shell of the temporary shelter 2 per 20 m³ of interior space within the temporary shelter 2 is maintained, the relative humidity will not exceed comfortable levels. For example, it has been discovered that in a hot, dry desert environment, given the parameters and occupancy rate described above, the relative humidity will stabilize at about 60-70% if the vents 8 are included at the described vent sizing ratio (i.e., approximately 4 m² of vent surface area in the exterior shell of the temporary shelter 2 per 20 m³ of interior space within the temporary shelter 2). Note this example assumes that the inside temperature of the temporary shelter 2 is maintained at 25° C and that the outside conditions include a temperature of 45° C and 10% relative humidity. If, given the occupancy rate described above, the vents 8 were not included in this example, the relative humidity inside the temporary shelter 2 would exceed 100% in approximately one hour.

[0021] To take another example, it has been discovered that in a cold, wet environment, given the parameters and occupancy rate described above, the relative humidity will stabilize at about 40-50% if the vents 8 are included at the described vent sizing ratio (i.e., approximately 4 m² of vent surface area in the exterior shell of the temporary shelter 2 per 20 m³ of interior space within the temporary shelter 2). Note this example assumes that the inside temperature of the temporary shelter 2 is maintained at 25° C and that the outside conditions include a temperature of -10° C and 60% relative humidity. If, given the occupancy rate described above, the vents 8 were not included in this example, the relative humidity inside the temporary shelter 2 would exceed 100% in approximately one hour. Note that in some alternative embodiments the vents 8 may be sized smaller or larger than

the ratio described above. Further, in other alternative embodiments, a positive air pressure may be maintained in the temporary shelter 2 pursuant to conventional means. The positive air pressure may aid with the egress of moisture vapor through the vent 8.

[0022] From the above description of preferred embodiments of the invention, those skilled in the art will perceive improvements, changes and modifications. Such improvements, changes and modifications within the skill of the art are intended to be covered by the appended claims. Further, it should be apparent that the foregoing relates only to the described embodiments of the present application and that numerous changes and modifications may be made herein without departing from the spirit and scope of the application as defined by the following claims and the equivalents thereof.

Claims

1. A venting system for a temporary shelter (2), comprising:
 - one or more vents (8) positioned in an exterior shell of the temporary shelter (2);
 - wherein each of the vents (8) include a membrane (16) that is moisture vapor transmissive and resistant to liquid penetration.
2. The system of claim 1, wherein the membrane (16) comprises a moisture vapor transmissive rate of at least 4,000 g/m²/day.
3. The system of claim 1 or claim 2, wherein the one or more vents (8) comprise a laminated fabric that includes the membrane (16) and a base fabric (14).
4. The system of claim 3, wherein the base fabric (14) comprises a woven, non-woven or knit textile.
5. The system of any preceding claim, wherein the membrane (16) is air permeable and immune to liquid penetration.
6. The system of any preceding claim, wherein at least one of the vents (8) is positioned in the upper part of a side of the temporary shelter (2).
7. The system of any preceding claim, wherein the membrane (16) is oleophobic.
8. The system of any preceding claim, wherein the membrane (16) comprises expanded polytetrafluoroethylene.
9. The system of any preceding claim, wherein the one or more vents (8) are incorporated into the temporary

shelter (2) by a waterproof zipper.

10. The system of any preceding claim, wherein the one or more vents (8) comprise a size such that there is approximately 4 m² of vent (8) surface area in the exterior shell of the temporary shelter (2) per 20 m³ of interior space within the temporary shelter (2).

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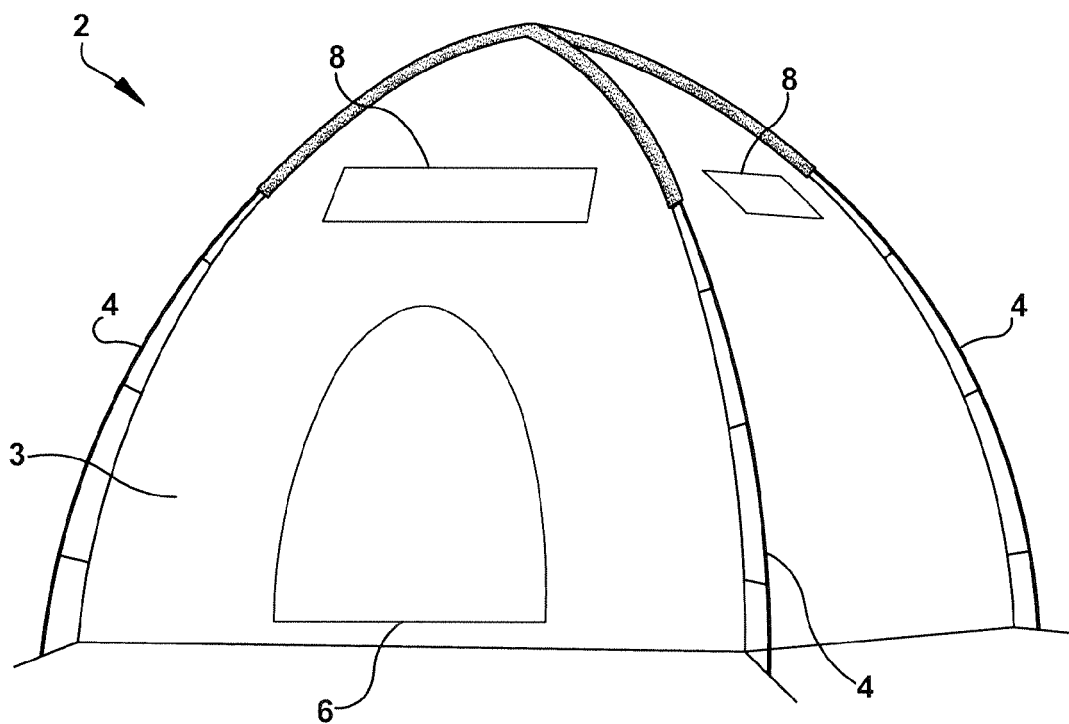


Fig. 1

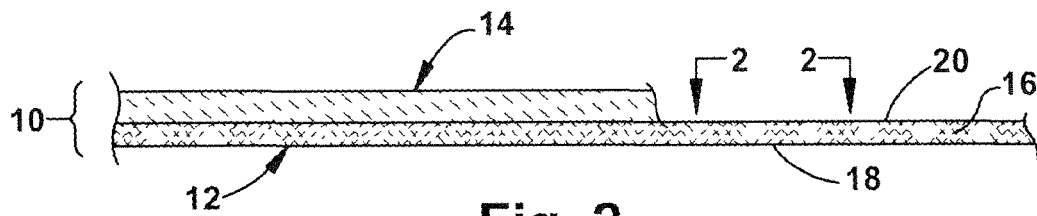


Fig. 2

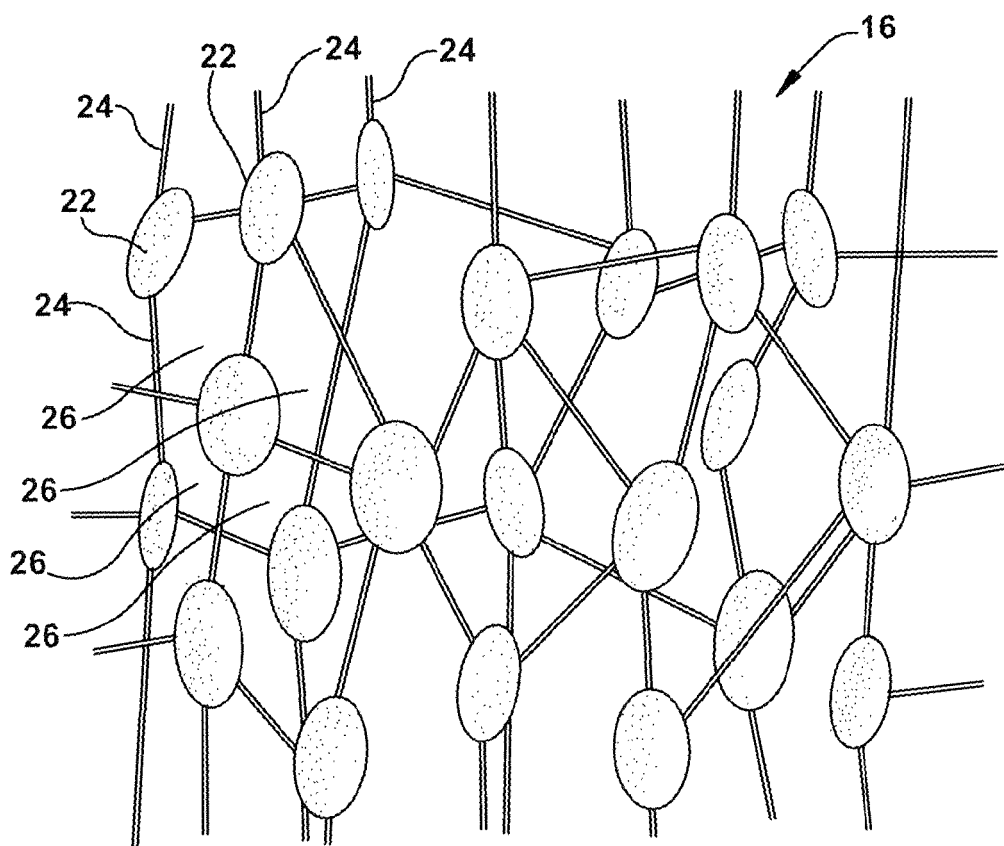


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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