A waterproof, breathable shoe is disclosed, having a shaped polymeric upper to accommodate the wear's foot, as well as layers to provide other properties to the shoe. At least five layers make up the shoe upper: (1) an innermost woven fabric; (2) an air permeable rubber layer; (3) an air permeable waterproof, four-way stretch membrane layer; (4) a structured air mesh layer; and (5) an outer woven fabric.
WATERPROOF, BREATHABLE SHOE

FIELD OF INVENTION

[0001] This invention relates to footwear (boots or shoes) that has an upper capable of resisting the passage of moisture while at the same time permitting the passage of air through the upper.

BACKGROUND OF THE INVENTION

[0002] Waterproof, breathable outer garments have been extremely popular for winter wear because they are more comfortable for wearers. Traditional outer weather gear was impervious to moisture, which kept the wearer dry during storms. However, for winter sports, it was desirable to allow moisture from the wearer’s body to exit through the garment to provide comfort during participation in sports. Such garments were relatively light weight and foldable for storage. Typically, such garments would have a layer of breathable fabric and a layer of water resistant material.

[0003] Boots and shoes, unlike garments, must encompass the foot and maintain the shape whether or not in use. Boots and shoes do not collapse like jackets do. There is a need for a shape-retaining layer to provide structural integrity to boots and shoes.

[0004] U.S. Patent Application 2006/0242862 A1, published Nov. 2, 2006, (Chelani), relates to a “Winter Sport/Snow Boot” that is foldable to allow the boot to collapse and be fastened at fasteners 14 and 16 for “holding the boot in a folded, closed position” (Abstract), similar to a folded garment. Such a folded boot does not have the structural integrity for retaining the shape of a boot or shoe in normal use. Chelani has a catalog of different combinations of layers that might be used in a collapsible boot, including paragraph 26, which describes a “possible use” of a layer of “waterproof, breathable, and stretchable material” coupled to “a perforated neoprene layer.” This speculation as to possible combinations for a foldable boot that was never shown to have been made or patented is not an anticipation of a boot-shaped structure that has five layers laminated together.

SUMMARY OF THE INVENTION

[0005] The present invention is a comfortable upper for boots and shoes comprising a plurality of layers that allow moisture in the foot to escape to the atmosphere while at the same time preventing water from outside the boot or shoe to enter and soak the foot. The outermost layer is fabric providing a smooth permeable surface for easy cleaning. Woven nylon is the preferred fabric for both the outermost layer and the innermost layer, comfortable for a bare foot or a socked foot.

[0006] Next to the outermost layer is the structurally important synthetic rubber layer that keeps the foot warm and maintains the shape of the boot or shoe to conform to the wearer’s foot. The third or center layer is an air permeable thermoplastic waterproof material similar to that used in waterproof, breathable outer garments, except that it must be four-way stretch material, as contrasted to the two-way stretch material used in outer garments. The fourth layer is a structured air mesh layer for cushioning the foot in the boot. The innermost layer is a fabric layer similar to the outermost layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a partially exploded cross-sectional view of the layers in the boot or shoe upper.

[0008] FIG. 2 is an isometric view of a shoe or boot according to the invention with a slice through the layers of the upper to reveal the laminated layers.

[0009] FIG. 3 is a plan view of a segment of the second rubber layer of the upper illustrating a pattern of perforations to allow the passage of air through the layer.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] As shown in FIG. 1, the preferred embodiment is a five-layer composite of products that in combination are waterproof and breathable. The term “shoe” is used here generically to include boots and other foot coverings worn in moist environments. The composite of an outermost layer 12 of a strong yet soft protective layer for the shoe upper. My preferred outer layer is nylon jersey fabric, which is air permeable and tough against abrasion, yet soft to the touch.

[0011] The next layer below layer 12 is a rubber or synthetinc rubber layer 13 which provides warmth and structural integrity for the shoe. This layer is shaped on a last to accommodate a human foot inside. Suitable materials for layer 13 are neoprene, chloroprene and similar impermeable membranes known to those skilled in the art. My preferred material for heat retention in layer 13 is a styrene butadiene rubber product sold under the name “Seamate” made by Nam Liong Enterprises Co., Ltd., of Taiwan.

[0012] It is important to the invention that layer 13 be permeable for the passage of air from inside the shoe to the outside of the shoe. Normally, a rubber membrane to 4 millimeters in thickness would be impermeable to the passage of air or water. In order to provide air permeability for layer 13, holes may be made in the layer 13.

[0013] Leather, a common outer material for shoes, is not suitable as the outer layer because it is normally not air permeable. If the protective properties of leather are desired, then a sixth layer outside the layer 12 may be added so long as perforations or open spaces are included to allow the escape of air from inside the shoe. The shoe in FIG. 2 is isometric view, partially enlarged, of a preferred embodiment of the invention. This example has a partial covering 18 of leather or leather substitute over the outermost layer of the laminate to provide strength for the metal fasteners 21, 22, 23, 24, 26, 27, 28, 29, 31 and 32 for retaining shoe laces 25 in place and for wear resistance. Gaps in the leather outer 18 at 33, 34, 36, and 37 between the fasteners for shoe lace holders allow for air to escape from layer 1. Perforations (not numbered) in the leather 18 also facilitate the passage of air. An impermeable rubber covering for the lower portion 38 of the upper allows the user to stand in water to a depth of approximately four centimeters without seepage through layer 12. Heel piece 39 and toe piece 41 provide additional protection to those areas. The shoe structure of FIG. 2 is merely illustrative of additional features that may be added and those additional features form no part of the present invention.
FIG. 3 is a plan view of layer 13 having a pattern of holes or perforations to permit passage of air through the layer 13. Any pattern may be used, the only requirement being that the strength and structural integrity of the rubber not be compromised. My preferred embodiment is a pattern as in FIG. 3 with holes between 1 and 2 mm in diameter, spaced apart between 6 and 8 mm.

Returning to the layers of FIG. 1, the middle or third layer 14 is a waterproof, air permeable membrane of the type widely used in outer garments. A crucial difference is that the three-dimensional structure of shoes requires the ability to stretch four ways: up, down, left and right. Outer garments need not be able to stretch four ways; two-way stretch is sufficient. My preferred material for layer 14 is a polyurethane product called “Miracle-Tex” made by Mao Jie Shoe and Materials Co., Ltd., Dong Guan City, China. It has been tested using ASTM test E96-2000 with the back facing water in the inverted water method at 23°C, relative humidity 50±2%, and air speed 0.02 meters per minute to have 7796 grams per square meter of membrane per 24 hours. Of course, other air permeable, four-way stretch waterproof membranes may be used for layer 14, and the Miracle-Tex is merely the best mode contemplated at the time of filing this application.

Backed the waterproof membrane 14 is layer 16, a structured air mesh, which provides comfort for the wearer’s foot and allows free passage of air. My preferred embodiment of layer 16 is a structured air mesh from Yi Heng Textile Co., Dong Guan City, China. The innermost layer of the laminate is layer 17, a soft, strong fabric as in layer 12. My preferred layer 17 is a nylon jersey fabric.

Collectively, the layers 12, 13, 14, 16 and 17 of the preferred embodiments were tested using ASTM test D737-2004; Texttest FX 3300 Air Permeability Test III. The laminate passed more than 11 cubic feet per minute.

The sole and covering 38, as well as heel pieces 34 and toe piece 41 are completely impervious to water to permit the wearer to stand or walk through water to a depth of about 4 centimeters, the laminate of the upper is air permeable in layer 14 to allow moisture laden air inside the shoe to escape, while at the same time preventing liquid water from entering the interior of the shoe. Layer 16 allows free passage of air, while layer 13 limits the amount of air passing through in order to retain body heat for the comfort of the wearer in cold weather. The combination of layers allows body heat to provide warmth and comfort and the escape of perspiration as vapor, while still being waterproof.

1. A shoe having a sole, an insole and an upper, said upper comprising a plurality of laminated layers, the innermost layer of woven fabric, the next layer of stretchable and deformable material for cushioning pressure on the wearer’s foot, the middle layer of a waterproof, four-way stretch, air-permeable membrane, the next layer of synthetic rubber perforated to allow the passage of air, and an outermost layer of woven fabric.

2. A shoe as in claim 1, wherein the innermost and outermost layers are woven nylon jersey fabric.

3. A shoe as in claim 1, wherein the stretchable and deformable layer is structured air mesh.

4. A shoe as in claim 1, wherein the perforations of the rubber layer are between 1 and 2 mm in diameter and are spaced apart between 6 and 8 mm.

5. A shoe as in claim 1, wherein an impermeable membrane is wrapped around the entire periphery of the lower portion of the shoe to prohibit the flow of either water or air into the shoe when standing in a depth of water less than 3 centimeters.