Title: ATHLETIC GEAR PROVIDING ENHANCED MOISTURE MANAGEMENT

Abstract: Athletic gear, such as an athletic garment and/or protective athletic equipment, providing enhanced moisture management to a wearer (e.g., a hockey, lacrosse, football, or other sports player). For example, the athletic gear may have a quick-drying capability to increase a rate of evaporation of moisture.
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ATHLETIC GEAR PROVIDING ENHANCED MOISTURE MANAGEMENT

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from U.S. Patent Application 61/865,416 filed on August 13, 2013 and hereby incorporated by reference herein.

FIELD

The invention relates to athletic gear and, more particularly, to athletic garments and protective athletic equipment worn by individuals engaged in sports such as hockey, football and lacrosse.

BACKGROUND

Individuals engaging in various sports, such as hockey, football, and lacrosse, typically wear protective athletic equipment (e.g., shoulder pads, elbow pads, gloves, helmets, etc.) to protect themselves against impacts with other people and/or objects (e.g., pucks, sticks, playing surfaces, boards, etc.), often over and/or under athletic garments (e.g., baselayer shirts, pants and socks worn under the protective athletic equipment, team jerseys worn over the protective athletic equipment, etc.).

For example, a hockey player typically wears a baselayer shirt, baselayer pants and socks under shoulder pads, elbow pads, protective pants, and leg pads, a team jersey over the shoulder pads and elbow pads, as well as protective gloves and a helmet, and possibly other gear (e.g., a jockstrap, a jock short, etc.). The player's protective athletic equipment increases sweating and humidity and reduces air circulation about the player's body. The player's "micro-climate" therefore tends to be relatively highly humid with limited ventilation. While the
player’s baselayer shirt and pants may be made of moisture-wicking fabric that moves sweat towards their outer surfaces, the protective athletic equipment considerably impedes air circulation at the baselayer shirt and pants' outer surfaces and, therefore, tends to keep moisture within the player's micro-climate.

Similar issues often arise in other sports, such as football and lacrosse, in which players wear protective athletic equipment.

For these and other reasons, there is a need for improvements in athletic gear worn by individuals engaged in sports involving protective athletic equipment.

**SUMMARY**

According to an aspect of the invention, there is provided an athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer. The athletic garment comprises: a surface to contact the protective athletic equipment; and a material comprising active elements to manage moisture as the wearer sweats.

According to another aspect of the invention, there is provided an athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer. The athletic garment comprises: a surface to contact the protective athletic equipment; and a material comprising active elements to facilitate drying of the material as the wearer sweats.

According to another aspect of the invention, there is provided an athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer. The athletic garment comprises: a surface to contact the protective athletic equipment; and a material to manage moisture as the wearer sweats. The material comprises: a base substance; and active elements connected to the base substance.
According to another aspect of the invention, there is provided an athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer. The athletic garment comprises: a surface to contact the protective athletic equipment; and a material to manage moisture as the wearer sweats. A drying rate of the material is at least 2.1 ml/hr according to AATCC Test Method 201.

According to another aspect of the invention, there is provided an athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer. The athletic garment comprises: a surface to contact the protective athletic equipment; and a material to manage moisture as the wearer sweats. A drying rate of the material is at least 15 ml/hr according to AATCC Test Method 200.

According to another aspect of the invention, there is provided an athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer. The athletic garment comprises: a surface to contact the protective athletic equipment; and a material comprising active elements to manage moisture as the wearer sweats. A surface area of the active elements is at least 200 m² per gram of the active elements.
equipment worn by the wearer. The athletic garment comprises: a surface to contact the protective athletic equipment; and a material to manage moisture as the wearer sweats. The material is responsive to heat generated by the wearer's body to vaporize liquid moisture in contact with the material.

According to another aspect of the invention, there is provided an athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer. The athletic garment comprises: a surface to contact the protective athletic equipment; and a material comprising active elements to provide a cooling effect perceivable by the wearer as the wearer sweats.

According to another aspect of the invention, there is provided an article of protective athletic equipment to be worn by a wearer. The article of protective athletic equipment comprises: an inner surface for facing towards the wearer; an outer surface for facing away from the wearer; and a material comprising active elements to manage moisture as the wearer sweats.

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According to another aspect of the invention, there is provided an article of protective athletic equipment to be worn by a wearer. The article of protective athletic equipment comprises: an inner surface for facing towards the wearer; an outer surface for facing away from the wearer; and a material to manage moisture as the wearer sweats. A surface area of the material is at least 300 cm² per square centimeter of the material.

According to another aspect of the invention, there is provided an article of protective athletic equipment to be worn by a wearer. The article of protective athletic equipment comprises: an inner surface for facing towards the wearer; an outer surface for facing away from the wearer; and a material comprising active elements to manage moisture as the wearer sweats. A surface area of the active elements is at least 200 m² per gram of the active elements.

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According to another aspect of the invention, there is provided athletic gear to be worn by a wearer. The athletic gear comprises: an article of protective athletic equipment; and an athletic garment to be worn under or over the article of protective athletic equipment. A given one of the article of protective athletic equipment and the athletic garment comprises a material comprising active elements to manage moisture as the wearer sweats.

According to another aspect of the invention, there is provided athletic gear to be worn by a wearer. The athletic gear comprises: an article of protective athletic equipment; and an athletic garment to be worn under or over the article of protective athletic equipment. A given one of the article of protective athletic equipment and the athletic garment comprises a material comprising active elements to facilitate drying of the material as the wearer sweats.

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the wearer sweats. The material comprises: a base substance; and active elements connected to the base substance.

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According to another aspect of the invention, there is provided athletic gear to be worn by a wearer. The athletic gear comprises: an article of protective athletic equipment; and an athletic garment to be worn under or over the article of protective athletic equipment. A given one of the article of protective athletic
equipment and the athletic garment comprises a material comprising active elements to manage moisture as the wearer sweats. A surface area of the active elements is at least 200 m$^2$ per gram of the active elements.

According to another aspect of the invention, there is provided athletic gear to be worn by a wearer. The athletic gear comprises: an article of protective athletic equipment; and an athletic garment to be worn under or over the article of protective athletic equipment. A given one of the article of protective athletic equipment and the athletic garment comprises a material to manage moisture as the wearer sweats. The material is responsive to heat generated by the wearer's body to vaporize liquid moisture in contact with the material.

According to another aspect of the invention, there is provided athletic gear to be worn by a wearer. The athletic gear comprises: an article of protective athletic equipment; and an athletic garment to be worn under or over the article of protective athletic equipment. The article of protective athletic equipment comprises a vent. The athletic gear comprises: an article of protective athletic equipment; and an athletic garment to be worn under or over the article of protective athletic equipment. The athletic garment comprises a vent. The vent of the article of protective athletic equipment and the vent of the athletic garment overlap when the athletic gear is worn by the wearer.

According to another aspect of the invention, there is provided a skate to be worn by a wearer. The skate comprises: an inner surface for facing towards the wearer; an outer surface for facing away from the wearer; and a material comprising active elements to manage moisture as the wearer sweats.

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According to another aspect of the invention, there is provided a skate to be worn by a wearer. The skate comprises: an inner surface for facing towards the wearer; an outer surface for facing away from the wearer; and a material to manage moisture as the wearer sweats. The material comprises: a base substance; and active elements connected to the base substance.

According to another aspect of the invention, there is provided a skate to be worn by a wearer. The skate comprises: an inner surface for facing towards the wearer; an outer surface for facing away from the wearer; and a material to manage moisture as the wearer sweats. A drying rate of the material is at least 2.1 ml/hr according to AATCC Test Method 201.

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According to another aspect of the invention, there is provided a skate to be worn by a wearer. The skate comprises: an inner surface for facing towards the wearer; an outer surface for facing away from the wearer; and a material comprising active elements to manage moisture as the wearer sweats. A surface area of the active elements is at least 200 m² per gram of the active elements.
According to another aspect of the invention, there is provided a skate to be worn by a wearer. The skate comprises: an inner surface for facing towards the wearer; an outer surface for facing away from the wearer; and a material to manage moisture as the wearer sweats. The material is responsive to heat generated by the wearer's body to vaporize liquid moisture in contact with the material.

According to another aspect of the invention, there is provided a skate to be worn by a wearer. The skate comprises: an inner surface for facing towards the wearer; an outer surface for facing away from the wearer; and a material comprising active elements to provide a cooling effect perceivable by the wearer as the wearer sweats.

These and other aspects of the invention will now become apparent to those of ordinary skill in the art upon review of the following description of embodiments of the invention in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of embodiments of the invention is provided below, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows an example of athletic gear wearable by a user in accordance with an embodiment of the invention, in which the athletic gear comprises an athletic garment configured to be worn under or over protective athletic equipment;

Figures 2 and 3 show front and rear views of the athletic garment;

Figures 4 and 5 show front and rear views of shoulder pads of the protective athletic equipment;
Figures 6 and 7 show side and rear views of an elbow pad of the protective athletic equipment;

Figures 8 and 9 illustrate portions of a material making up at least part of the athletic garment;

Figure 10 illustrates a cross-sectional view of an active element of the material of Figures 8 and 9;

Figure 11 shows a cross-sectional view of a protector of the athletic garment;

Figures 12 and 13 show front and rear views of a variant of the athletic garment in accordance with another embodiment of the invention;

Figure 14 shows a front view of another variant of the athletic garment in accordance with another embodiment of the invention;

Figures 15 and 16 illustrate portions of a material making up at least part of the athletic garment of Figure 14;

Figures 17 and 18 illustrate portions of a variant of the material making up at least part of the athletic garment in accordance with another embodiment of the invention;

Figures 19 and 20 show front and rear views of another variant of the athletic garment in accordance with another embodiment of the invention;

Figure 21 illustrates a portion of a material making up at least part of the athletic garment of Figures 19 and 20;
Figure 22 illustrates a cross-sectional view of a portion of a front of the shoulder pads;

Figures 23 and 24 illustrate portions of a material making up at least part of the front of the shoulder pads;

Figure 25 illustrates a cross-sectional view of an active element of the material of Figures 23 and 24;

Figures 26 to 29 illustrate cross-sectional views of portions of other parts of the shoulder pads;

Figures 30 and 31 show front and rear views of a variant of the shoulder pads in accordance with another embodiment of the invention;

Figure 32 shows a front view of another variant of the shoulder pads in accordance with another embodiment of the invention;

Figures 33 and 34 illustrate portions of a material making up at least part of the shoulder pads of Figure 32;

Figures 35 and 36 illustrate portions of a variant of the material making up at least part of the shoulder pads in accordance with another embodiment of the invention;

Figure 37 illustrates a portion of a material making up at least part of a variant of the shoulder pads in accordance with another embodiment of the invention;

Figure 38 illustrates a cross-sectional view of a portion of the elbow pad;
Figures 39 and 40 show views of an example of a protective glove in accordance with another embodiment of the invention;

Figure 41 shows an example of protective pants in accordance with another embodiment of the invention;

Figures 42 and 43 show views of an example of a leg pad in accordance with another embodiment of the invention;

Figures 44 and 45 show views of an example of a helmet in accordance with another embodiment of the invention;

Figure 46 shows an example of a neck guard in accordance with another embodiment of the invention;

Figures 47 and 48 show a perspective view and an exploded view of an example of a skate in accordance with another embodiment of the invention;

Figures 49 and 50 show front and rear views of another variant of the athletic garment in accordance with another embodiment of the invention;

Figures 51 and 52 show front and rear views of another variant of the shoulder pads in accordance with another embodiment of the invention;

Figure 53 illustrates another variant of the athletic gear in accordance with another embodiment of the invention;

Figures 54 and 55 illustrate another variant of the shoulder pads in accordance with another embodiment of the invention; and
Figures 56 and 57 show front and back views of regions of an upper body of the user.

It is to be expressly understood that the description and drawings are only for the purpose of illustrating certain embodiments of the invention and are an aid for understanding. They are not intended to be a definition of the limits of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

Figures 1 to 7 show an example of athletic gear 11 wearable by a wearer when engaging in a sport (e.g., hockey, lacrosse, football, etc.) in accordance with an embodiment of the invention. The athletic gear 11 comprises protective athletic equipment 12 and an athletic garment 10 that is configured to be worn by the wearer under or over the protective athletic equipment 12. In this embodiment, the athletic garment 10 is an undergarment configured to be worn by the wearer under the protective athletic equipment 12. More particularly, in this embodiment, the undergarment 10 is a baselayer garment configured to be worn in contact with the wearer’s body. In this example, the baselayer garment 10 is a baselayer shirt. The protective athletic equipment 12 is wearable by the wearer to provide impact protection, i.e., to protect the wearer’s body against impacts with another person and/or an object (e.g., a puck, a ball, a stick, a playing surface, a board, a post, or any other object involved in the sport) as the wearer engages in the sport. In this example, the protective athletic equipment 12 includes a plurality of articles of protective athletic equipment (i.e., protective athletic devices), namely shoulder pads 13 for protecting a chest, an upper back, and shoulders of the wearer and elbow pads 15i, 152 for protecting elbows and adjacent parts of the wearer’s arms. Specifically, in this embodiment, the wearer is a hockey player playing hockey such that the shoulder pads 13 are hockey shoulder pads, the elbow pads 15i, 152 are hockey elbow pads, and the baselayer shirt 10 is a hockey baselayer shirt.
As further discussed below, in this embodiment, the athletic gear 11 provides enhanced moisture management to deal with sweat produced by the player's body. Notably, in this embodiment, the athletic gear 11 has a quick-drying capability to increase a rate of evaporation of moisture within a "micro-climate" of the player. This is particularly useful in view of the protective athletic equipment 12 worn by the player that increases sweating and humidity and reduces air circulation about the player's upper body. In other words, the quick-drying capability of the athletic gear 11 helps to deal with the player's micro-climate that is affected by the protective athletic equipment 12.

1. Athletic garment

The shirt 10 comprises an inner surface 17 for facing towards the player and an outer surface 19 for facing away from the player. In this embodiment in which the shirt 10 is a baselayer shirt to be worn under the protective athletic equipment 12, the inner surface 17 is configured to contact the player's body and the outer surface 19 is configured to contact the protective athletic equipment 12.

The shirt 10 comprises a torso portion 14 including a front 16, a back 18, a top opening 20 for passing a neck and head of the player, and a lower opening 22 for fitting around a lower torso region (e.g., a waist and hips) of the player. In this embodiment, the shirt 10 also comprises a pair of sleeves 24i, 242 for receiving arms of the player. In this example, the sleeves 24i, 242 are long sleeves extending to wrists of the player. The sleeves 24i, 242 may be short sleeves (e.g., the shirt 10 may be a T-shirt) in other examples. In other embodiments, the shirt 10 may be sleeveless.

The shirt 10 comprises a material 30 making up at least part of the shirt 10. That is, the shirt 10 is at least partly (i.e., partly or entirely) made of the material 30. In this embodiment, the shirt 10 is at least mainly (i.e., mainly or entirely) made of...
the material 30. More particularly, in this embodiment, the material 30 makes up at least part of the torso portion 14 and each of the sleeves 24i, 242.

In this embodiment, with additional reference to Figure 8, the material 30 is a fabric. The fabric 30 is a thin pliable textile material comprising a fibrous base substance 29 including fibers 3\textsuperscript{1-31} \text{F} arranged in a network by weaving, knitting, interlacing, felting or otherwise crossing them. The fibers 3\textsuperscript{1-31} \text{F} may include any suitable natural or synthetic fibers (e.g., polyester, nylon, spandex (elastane), or other fibers, or blends of these fibers). In this embodiment, the fabric 30 includes yarns 32\textsuperscript{1-32} \text{Y} that comprise respective ones of the fibers 3\textsuperscript{1-31} \text{F}. More particularly, in this embodiment, the fabric 30 is a woven or knit fabric.

In this example of implementation, the shirt 10 is a compression shirt, i.e., a form-fitting shirt that has a compression fit when worn by the player. This may help to keep muscles warm to reduce muscle strain and fatigue, wick sweat away from the player's body, and prevent or reduce chafing and rashes. To that end, the fibers 3\textsuperscript{1-31} \text{F} of the fabric 30 may include spandex (elastane) fibers or other stretchable fibers having suitable elasticity. The shirt 10 may not be a compression shirt in other examples of implementation.

For example, in this embodiment, the fibers 3\textsuperscript{1-31} \text{F} of the fabric 30 include polyester and spandex fibers. For instance, the fabric 30 may comprise at least 75% polyester fibers and at least 10% spandex fibers (e.g., the fabric 30 may comprise 87% 75D/72F or 75D/48F textured polyester and 13% 40 denier spandex, may be a single jersey construction weighing 155 g/m\textsuperscript{2}, and may have wicking finish applied to it). The fabric 30 may have any other suitable composition in other embodiments.

The fabric 30 is configured taking into account an interface between the shirt 10 and the protective athletic equipment 12 worn by the player. Notably, the fabric 30 has mechanical properties to resist tearing or other excessive damage due to
friction or other contact between the shirt 10 and the protective athletic equipment 12. For example, in some embodiments, the fabric 30 may have an abrasion resistance of at least 10000 rubs according to ASTM 4966 - Option 1. As another example, in some embodiments, the fabric 30 may have a bursting strength of at least 40 psi if the fabric 30 weighs 3.4 oz./yd.² or less, or at least 55 psi if the fabric 30 weighs 3.5 oz./yd.² or more, according to ASTM D3788. As another example, in some embodiments, the fabric 30 may have a snagging resistance of at least 3 according to ASTM D3939 (Mace Snap). These properties of the fabric 30 may have any other suitable values in other embodiments.

In this embodiment, the fabric 30 is a quick-drying material, i.e., a material exhibiting a drying rate which is relatively high, to quickly evaporate moisture as the player sweats. For example, in some embodiments, the drying rate of the fabric 30 may be at least 2.1 ml/hr, in some cases at least 2.3 ml/hr, in some cases at least 2.5 ml/hr, and in some cases even more, according to AATCC Test Method 201 of the American Association of Textile Chemists and Colorists (AATCC). Alternatively or additionally, in some embodiments, the drying rate of the fabric 30 may be at least 15 ml/hr, in some cases at least 20 ml/hr, in some cases at least 25 ml/hr, and in some cases even more, according to AATCC Test Method 200 of the AATCC. The drying rate of the fabric 30 may have any other suitable value in other embodiments.

More particularly, in this embodiment, to facilitate moisture evaporation, the fabric 30 is configured to (1) spread moisture over a large surface area and (2) harness heat generated by the player's body to vaporize liquid moisture.

For example, in some embodiments, a surface area of the fabric 30 may be at least 300 cm² per square centimeter of fabric, in some cases at least 400 cm² per square centimeter of fabric, in some cases at least 500 cm² per square centimeter of fabric, in some cases at least 600 cm² per square centimeter of
fabric, and in some cases even more. Alternatively or additionally, in some embodiments, a surface area of a constituent of the fabric 30 may be at least 200 m² per gram of the constituent, in some cases at least 400 m² per gram of the constituent, in some cases at least 600 m² per gram of the constituent, in some cases at least 800 m² per gram of the constituent, in some cases at least 1000 m² per gram of the constituent and in some cases even more. The surface area of the constituent of the fabric 30 may have any other suitable value in other embodiments.

To harness heat generated by the player’s body to vaporize moisture, a constituent of the fabric 30 captures this heat to raise its temperature and cause vaporization of liquid moisture in contact with it. For example, in some embodiments, a specific heat capacity of a constituent of the fabric 30 (i.e., an amount of heat required to increase the temperature of a unit mass of the constituent of the fabric 30 by one degree) may be relatively low. For instance, in some embodiments, the specific heat capacity of the constituent of the fabric 30 may be less than polyester’s specific heat capacity and less than spandex’s specific heat capacity. The specific heat capacity of the constituent of the fabric 30 may have any other suitable value in other embodiments. Additionally or alternatively, in some embodiments, a molar absorptivity at an infrared wavelength of a constituent of the fabric 30 (i.e., a measurement of how strongly a chemical species of the constituent of the fabric 30 absorbs electromagnetic radiation at the infrared wavelength) may be relatively high. For instance, in some embodiments, the molar absorptivity at an infrared wavelength of the constituent of the fabric 30 may be greater than polyester’s molar absorptivity at that infrared wavelength and greater than spandex’s molar absorptivity at that infrared wavelength. The molar absorptivity at the infrared wavelength of the constituent of the fabric 30 may have any other suitable value in other embodiments.
Also, in some embodiments, a constituent of the fabric 30 may be configured to manifest an exothermic reaction releasing heat to accelerate the drying process. That is, a constituent of the fabric 30 may be configured to exothermically react (i.e., produce heat when reacting) with liquid moisture. The exothermic reaction may be chemical and/or physical. For example, in some embodiments, the exothermic reaction manifested by the constituent of the fabric 30 may be adsorption of liquid moisture by the constituent of the fabric 30, such that heat is released when the liquid moisture is adsorbed by the constituent of the fabric 30.

With additional reference to Figure 9, in this embodiment, the fabric 30 comprises active elements 40I-40P to manage moisture as the player sweats, including to enhance evaporation of liquid moisture in the fabric 30. The active elements 40I-40P are "active" in that they have a property allowing them to induce a chemical and/or physical reaction in response to a stimulus at their surface. In this example, this reaction induced by the active elements 40I-40P helps accelerate the drying process of the fabric 30. The fabric 30 thus dries faster than if the active elements 40I-40P were omitted but the fabric 30 was otherwise identical (i.e., dries faster than a comparative fabric identical to the fabric 30 but without the active elements 40I-40P).

In this example of implementation, the active elements 40I-40P are connected to the fibers 33ι-33κ of the fibrous base substance 29. In other examples of implementation, the fibers 33ι-33κ of the fabric 30 may themselves be the active elements 40I-40P that enhance the drying process of the fabric 30 on their own, without having distinct active elements connected to the fibers 33ι-33κ.

More particularly, in this embodiment, the active elements 40I-40P are active particles distributed within the fabric 30. In this example, the active particles 40I-40P have an adsorptive property that causes them to adsorb liquid moisture as the player sweats. This reaction, i.e., adsorption, caused by the active particles 40I-40P helps evaporating the liquid moisture.
With additional reference to Figure 10, in this embodiment, each of the active particles 40₁-40ₚ is a microporous particle that includes a multitude of pores 42₁-42ₜ (e.g., several thousands of pores) which can trap the liquid moisture.

Because of their pores 42₁-42ₜ, the active particles 40₁-40ₚ have a surface area which is very large, thereby vastly spreading the liquid moisture to aid evaporating it. For example, in some embodiments, the surface area of the active particles 40₁-40ₚ may be such that the surface area of the fabric 30 is at least 300 cm² per square centimeter of fabric, in some cases at least 400 cm² per square centimeter of fabric, in some cases at least 500 cm² per square centimeter of fabric, in some cases at least 600 cm² per square centimeter of fabric, and in some cases even more. Alternatively or additionally, in some embodiments, the surface area of the active particles 40₁-40ₚ may be at least 200 m² per gram of active particle, in some cases at least 400 m² per gram of active particle, in some cases at least 600 m² per gram of active particle, in some cases at least 800 m² per gram of active particle, in some cases at least 1000 m² per gram of active particle and in some cases even more. The surface area of the active particles 40₁-40ₚ may have any other suitable value in other embodiments.

Also, in this embodiment, the active particles 40₁-40ₚ use heat generated by the player's body to vaporize moisture. For example, in some embodiments, a specific heat capacity of the active particles 40₁-40ₚ may be relatively low. For instance, in some embodiments, the specific heat capacity of the active particles 40₁-40ₚ may be less than a specific heat capacity of the fibrous base substance 29 of the fabric 30. Thus, in this example, the specific heat capacity of the active particles 40₁-40ₚ may be less than polyester's specific heat capacity and less than spandex's specific heat capacity. The specific heat capacity of the active particles 40₁-40ₚ may have any other suitable value in other embodiments. Additionally or alternatively, in some embodiments, a molar absorptivity at an
infrared wavelength of the active particles 40I-40P may be relatively high. For instance, in some embodiments, the molar absorptivity at an infrared wavelength of the active particles 40I-40P may be greater than a molar absorptivity at that infrared wavelength of the fibrous base substance 29 of the fabric 30. For instance, in some embodiments, the molar absorptivity at an infrared wavelength of the active particles 40I-40P may be greater than polyester’s molar absorptivity at that infrared wavelength and greater than spandex’s molar absorptivity at that infrared wavelength. The molar absorptivity at the infrared wavelength of the active particles 40I-40P may have any other suitable value in other embodiments.

Furthermore, the adsorption of liquid moisture by the active particles 40I-40P is an exothermic reaction releasing heat that helps to accelerate the drying process.

The active particles 40I-40P may be implemented in any suitable way. In this embodiment, the active particles 40I-40P comprise activated carbon. The activated carbon may be produced in various known ways. For instance, the activated carbon may be produced from carbonaceous materials such as wood, nutshell, coconut husk, coir, peat, lignite, coal, or other carbonaceous substances using known processes (e.g., physical reactivation using hot gases which involves carbonization and/or oxidation, or chemical activation using chemicals on raw material prior to carbonization), or synthetically using known processes (e.g., pyrolysis of polystyrene beads). In other embodiments, the active particles 40I-40P may comprise activated alumina (aluminum oxide), silica gel, soda ash, aluminum trihydrate, baking soda, cinoxate (p-methoxy-2-ethoxyethyl ester cinnamic acid), zinc oxide, zeolites, titanium dioxide, or any other suitable material.

The active particles 40I-40P may be incorporated into the fabric 30 using any suitable process. For example, in some embodiments, the active particles 40I-40P may be joined to the fibrous base substance 29 of the fabric 30 using: an air
dispersion process in which the active particles are entrained in a gaseous carrier onto the fibrous base substance 29 of the fabric 30 where they are fixed; a padding process in which the fibrous base substance 29 of the fabric 30 is passed through a bath of the active particles; a liquid suspension or mixture of a binder and the active particles applied to the fibrous base substance 29 of the fabric 30; or a xerographic process using electrostatic or magnetic attraction to transfer a toner formulation including the active particles towards the fibrous base substance 29 of the fabric 30. In some cases, a protective substance may be provided onto the active particles 40i-40p to protect these active particles during manufacturing of the fabric 30 and subsequently removed. Examples of such processes are described in U.S. Patent 6,998,155, U.S. Patent Application Publication 2008/0121141 and U.S. Patent 7,247,374, which are incorporated by reference herein.

Examples of materials that can be used for the fabric 30 including the active particles 40i-40p may be commercially obtained from Cocona Inc., Boulder, Colorado.

In addition to its quick-drying fabric 30 which enhances moisture management, in this embodiment, the shirt 10 has functional features to interact with the protective athletic equipment 12, protect the player, and/or otherwise enhance the player's comfort and performance.

For instance, in this embodiment, the shirt 10 comprises grippers 44i-443 for engaging and gripping the protective athletic equipment 12 to help hold it in place. In this example, the grippers 44i, 442 are located on the sleeves 24i, 242 to engage the elbow pads 15i, 152, while the gripper 443 is located on the torso portion 14 to engage the shoulder pads 13.

The grippers 44i-443 can grip the protective athletic equipment 12 in any suitable way to help hold it in place. In this embodiment, each of the grippers 44i-443 is a
frictional gripper that helps to hold the protective athletic equipment 12 in place by friction. That is, a frictional force exerted by a gripper 44_x on an underside of the protective athletic equipment 12 is greater than a frictional force exerted by the fabric 30 on the underside of the protective athletic equipment 12 (i.e., a coefficient of friction between the gripper 44_x and the underside of the protective athletic equipment 12 is greater than a coefficient of friction between the fabric 30 and the underside of the protective athletic equipment 12).

The grippers 44i-443 may comprise any suitable material to exert sufficient friction. For example, in this embodiment, each of the grippers 44i-443 comprises a tackifying material 43 such as a thermoplastic elastomer (e.g., Santoprene™), polyurethane (thermoplastic or thermoset), polyvinyl chloride (e.g., Plastisol), silicone, or any other suitable material providing tackiness. More particularly, in this example, each of the grippers 44i-443 includes frictional gripping members 45_1-45_n which are made of the tackifying material 43.

Any other suitable material providing a high coefficient of friction may be used in other embodiments. For instance, in some embodiments, each of the grippers 44i-443 may comprise hooks or loops of a hook-and-loop fastener (e.g., Velcro™) to engage the underside of the protective athletic equipment 12. In some cases, the underside of the protective athletic equipment 12 may include complementary loops or hooks of the hook-and-loop fastener to engage the hooks or loops of the grippers 44i-443. In other cases, the underside of the protective athletic equipment 12 may not include complementary loops or hooks, in which case the grippers 44i-443 may have hooks that anchor themselves in a material (e.g., fabric) on the underside of the protective athletic equipment 12.

The grippers 44i-443 may be provided in the shirt 10 in any suitable way. For instance, in this embodiment, the grippers 44i-443 may be printed (e.g., screen-printed) onto the fabric 30. In other embodiments, the grippers 44i-443 may be
adhesively bonded to the fabric 30, stitched to the fabric 30, or provided using any other suitable process.

In this embodiment, the shirt 10 comprises a protector 48 for protecting a body part of the player. In this example, the protector 48 comprises a neck guard at a collar 39 of the shirt 10 to protect the player's neck against cuts from and possibly other impacts with skates, hockey sticks, pucks, or other objects.

More particularly, in this embodiment, with additional reference to Figure 11, the neck guard 48 comprises a cut-resistant material 50 to provide resistance against cuts from a skate's blade. In this example, the cut-resistant material 50 is a cut-resistant fabric. More specifically, in this example, the cut-resistant fabric 50 is a para-aramid fabric (e.g., Kevlar™). The cut-resistant material 50 may be implemented in any other suitable way in other examples (e.g., using high performance polyethylene (HPPE), fiberglass, etc.).

Also, in this embodiment, the neck guard 48 comprises padding 51 to provide padded protection and comfort to the player. The pad 51 may comprise foam, such as ethylene vinyl acetate (EVA) foam, expanded polypropylene (EPP) foam, expanded polyethylene (EPE) foam (e.g., low-density polyethylene (LDPE) foam), vinyl nitrile (VN) foam, polyurethane foam, or any other suitable foam, and/or may comprise any other shock-absorbing material (e.g., a gel).

Furthermore, in this embodiment, the neck guard 48 comprises an outer covering 52 disposed over the cut-resistant material 50 and the padding 51 and forming an external surface of the neck guard 48. In this example, the outer covering 52 is a fabric. More particularly, in this example, the fabric 52 is a quick-drying fabric as described above in respect of the fabric 30.

The neck guard 48 is configured to receive the player's neck when the player puts on the shirt 10 and to be removed from the player's neck when the player
takes off the shirt 10. In this embodiment, the neck guard 48 is openable to receive and be removed from the player's neck. More particularly, in this example, the neck guard 48 includes a closure 53 that is selectively openable and closable to allow the player's neck to be received by and removed from the neck guard 48. In this case, the closure 53 includes a fastener (e.g., a hook-and-loop fastener, a button, etc.) to keep it closed, and cooperates with a zipper 27 extending in the back of the shirt 10. In other examples, the neck guard 48 may be stretchable to permit it to be stretched over the player's head and then closed by contracting around the player's neck when the player puts on the shirt 10.

Although it comprises a neck guard in this embodiment, the protector 48 may be provided to protect another body part of the player in other embodiments (e.g., a pad secured to the fabric 30 to protect a chest, back, shoulder, elbow, or other body part of the player).

While the shirt 10 is constructed in a particular way in this embodiment, the shirt 10 may be constructed in various other ways in other embodiments.

For example, in some embodiments, as shown in Figures 12 and 13, the drying rate of the shirt 10 may differ over a plurality of areas 60₁-60₇ of the shirt 10. That is, the drying rate of a given one of the areas 60₁-60₇ of the shirt 10 may be different from (i.e., greater or lesser than) the drying rate of another one of the areas 60₁-60₇ of the shirt 10. For instance, the drying rate of a first one of the areas 60₁-60₇ of the shirt 10 that is disposed to (i) be covered by the protective athletic equipment 12 and/or (ii) overlie a first region of the player's body which is expected to generate more sweat may be greater than the drying rate of a second one of the areas 60₁-60₇ of the shirt 10 that is disposed to (i) not be covered by the protective athletic equipment 12 and/or (ii) overlie a second region of the player's body which is expected to generate less sweat.
For instance, in this embodiment, the area 601 of the shirt 10 is an area of the torso portion 14 of the shirt 10 that is disposed to overlie a front region of the player's torso and be covered the shoulder pads 13, the area 602 of the shirt 10 is an area of the torso portion 14 of the shirt 10 that is disposed to overlie a back region of the player's torso and be covered the shoulder pads 13, the areas 603, 604 of the shirt 10 are areas of the torso portion 14 of the shirt 10 that are disposed to overlie lateral regions of the player's torso and not be covered by the shoulder pads 13, the areas 60s, 60e of the shirt 10 are areas of the sleeves 24i, 242 of the shirt 10 that are disposed to overlie elbow regions of the player's arms and be covered by the elbow pads 15i, 152, and the areas 607, 60s of the shirt 10 are areas of the sleeves 24i, 242 of the shirt 10 that are disposed to overlie upper arm regions of the player's arms and not be covered by the elbow pads 15i, 152.

As an example, the drying rate of the areas 601, 602, 603, 604 of the shirt 10, which overly regions of the player's torso that may generate more sweat, may be greater than the drying rate of the areas 60s, 60e, 607, 60s of the shirt 10, which overly regions of the player's arms that may generate less sweat. As another example, the drying rate of the areas 601, 602 of the shirt 10, which overly regions of the player's torso that are beneath the shoulder pads 13, may be greater than the drying rate of the areas 603, 604 of the shirt 10, which overly regions of the player's torso that are not beneath the shoulder pads 13. As yet another example, the drying rate of the area 602 of the shirt 10, which overlies the back region of the player's torso that may generate more sweat, may be greater than the drying rate of the area 601 of the shirt 10, which overlies the front region of the player's torso that may generate less sweat, even though both of the areas 601, 602 of the shirt 10 are covered by the shoulder pads 13. As yet another example, the drying rate of the areas 60s, 60e of the shirt 10, which overly regions of the player's arms that are covered by the elbow pads 15i, 152, may be greater than the drying rate of the areas 607, 60s of the shirt 10, which overly regions of the player's arms that are not covered by the elbow pads 15i, 152.
For example, in some embodiments, a ratio of (i) the drying rate of a given area \( 60i \) of the shirt \( 10 \) over (ii) the drying rate of another area \( 60j \) the shirt \( 10 \) may be at least 1.1, in some cases at least 1.2, in some cases at least 1.3, in some cases at least 1.4, in some cases at least 1.5, and in some cases even more (e.g., 2 or more). The difference between the drying rate of the area \( 60i \) of the shirt \( 10 \) and the drying rate of the area \( 60j \) of the shirt \( 10 \) may take on any other suitable value in other embodiments.

The variation of the drying rate over the areas \( 60i -60 \) of the shirt \( 10 \) can be implemented in any suitable manner. In this embodiment, this may be achieved by varying a concentration or loading of the active particles \( 40i -40 \, P \) of the fabric \( 30 \) over the areas \( 60i -60 \) of the shirt \( 10 \). The concentration or loading of the active particles \( 40i -40 \, P \) of the fabric \( 30 \) in a given area \( 60i \) of the shirt \( 10 \) may be greater than the concentration or loading of the active particles \( 40i -40 \, P \) of the fabric \( 30 \) in another area \( 60j \) of the shirt \( 10 \) such that the drying rate of the area \( 60i \) of the shirt is greater than the drying rate of the area \( 60j \) of the shirt \( 10 \). The concentration or loading of the active particles \( 40i -40 \, P \) of the fabric \( 30 \) in a particular area \( 60x \) of the shirt \( 10 \) can be measured as a weight percent of the active particles \( 40i -40 \, P \) in the area \( 60x \) of the shirt \( 10 \), i.e., a weight of the active particles \( 40i -40 \, P \) in the area \( 60x \) of the shirt \( 10 \) divided by a total weight of the area \( 60x \) of the shirt \( 10 \) and multiplied by one hundred. For example, in some embodiments, a ratio of (i) the concentration or loading of the active particles \( 40i -40 \, P \) of the fabric \( 30 \) in the given area \( 60i \) of the shirt \( 10 \) over (ii) the concentration or loading of the active particles \( 40i -40 \, P \) of the fabric \( 30 \) in the other area \( 60j \) of the shirt \( 10 \) may be at least 1.1, in some cases at least 1.2, in some cases at least 1.5, in some cases at least 2, in some cases at least 4, and in some cases even more (e.g., 8 or more). In some examples of implementation, an area \( 60x \) of the shirt \( 10 \) may be free of active particles, i.e., there is no active particle in the area \( 60x \) of the shirt \( 10 \), such that the concentration or loading of the active particles \( 40i -40 \, P \) of the fabric \( 30 \) in the area \( 60x \) of the shirt \( 10 \) is
substantially zero. The variation of the drying rate over the areas 60₁-60ₐ of the shirt 10 can be implemented in other ways in other embodiments (e.g., by varying a yarn size or fabric weight in different areas).

To further enhance moisture management, in some embodiments, with additional reference to Figures 14 to 16, in addition to its fabric 30 which is a quick-drying material, the shirt 10 may comprise a cooling material 65 providing a cooling effect perceivable by the player. As the quick-drying material 30 works to accelerate moisture evaporation to help dry the shirt 10, the cooling material 65 may help the player feel cooler.

In this embodiment, the cooling material 65 is a fabric. The cooling fabric 65 comprises a fibrous base substance 37 including fibers 33₁-33ₐ, which may include any suitable natural or synthetic fibers (e.g., polyester, nylon, spandex (elastane), or other fibers, or blends of these fibers). In this example, the cooling fabric 65 is a woven or knit fabric.

The cooling effect provided by the cooling fabric 65 may be implemented in any suitable way. In this embodiment, the cooling fabric 65 comprises active elements 70₁-70ᵥ to generate the cooling effect. More particularly, in this embodiment, the active elements 70₁-70ᵥ are connected to the fibrous base substance 37. For example, in some embodiments, the cooling fabric 65 may be configured to cool down when absorbing moisture as the player sweats, i.e., a moisture-activated cooling fabric. For instance, the active elements 70₁-70ᵥ may be swellable elements configured to swell when absorbing moisture to create the cooling effect. Examples of materials that can be used for the cooling fabric 65 that is moisture-activated are fabrics including Nexar™ polymers which may be commercially obtained from Kraton Performance Polymers Inc., Houston, Texas. As another example, in some embodiments, the cooling fabric 65 may be configured to cool down when absorbing heat from the player's body, i.e., a heat-activated cooling fabric. For instance, the active elements 70₁-70ᵥ may be phase-
change material (PCM) elements (e.g., microencapsulated PCM elements) configured to change phase when absorbing heat to create the cooling effect. Examples of materials that can be used for the cooling fabric 65 that is heat-activated are fabrics including Thermocules™ PCM elements which may be commercially obtained from Outlast Technologies LLC, Boulder, Colorado. In other embodiments, the fibers 33I-33R of the cooling fabric 65 may themselves be the active elements 70i-70v that generate the cooling effect on their own, without having distinct active elements connected to the fibers 33I-33R of the fibrous base substance 37. For instance, the fibers 33I-33R of the cooling fabric 65 may be configured to cool down when absorbing and trapping moisture inside them as the player sweats. Examples of materials that can be used for this purpose may be commercially obtained from CoolCore, Portsmouth, New Hampshire. Other examples of materials that can be used for the cooling fabric 65 may include IceFil by Ventex, Luxicool, Cool Jade, Advansa's Thermo Cool, and HeiQ's Adaptive.

The quick-drying fabric 30 and the cooling fabric 65 may be arranged in any suitable manner in the shirt 10. For example, in this embodiment, a quantity of the quick-drying fabric 30 in the shirt 10 is greater than a quantity of the cooling fabric 65 in the shirt 10. More particularly, in this embodiment, the quick-drying fabric 30 is present in a bulk of the shirt 10, while the cooling fabric 65 is present only in a limited area of the shirt 10 where the cooling effect may be better perceived by the player. Thus, in this embodiment, the cooling fabric 65 is present in a quick-cooling spot of the player's body, i.e., a spot of the player's body that is more efficient at cooling. The quick-cooling spot includes a pulse point, i.e., an area where the player's pulse can be felt since blood vessels are closer to his/her skin's surface, meaning that blood and body temperature can be more easily cooled. In this example, the cooling fabric 65 is disposed in the collar 39 of the shirt 10 since the cooling effect at the player's neck may be well perceived by the player. In cases where the shirt 10 includes the neck guard 48 as discussed previously, the outer covering 52 of the neck guard 48 may
comprise the cooling fabric 65. In other examples, the cooling fabric 65 may be disposed in other quick-cooling spots of the player's body (e.g., a crook of the elbow, a wrist, a forehead, an inner thigh, a bend of the knee, or an ankle).

In some embodiments, the fabric 30, which makes up at least part of the torso portion 14 and the sleeves 24I, 242 of the shirt 10, may be a quick-drying and cooling fabric. That is, the fabric 30 may be configured such that (1) its drying rate is relatively high and (2) it provides a cooling effect perceivable by the player. For example, in some embodiments, as shown in Figures 17 and 18, the fabric 30 may comprise (1) the active elements 40I-40P for quick-drying and (2) the active elements 70I-70v for the cooling effect connected to the fibrous base substance 29. This may be done by applying the active elements 40I-40P and the active elements 70I-70v to the fibrous base substance 29 in a common process or sequential processes using known techniques (e.g., from companies mentioned above) to provide these elements in fabrics.

In some embodiments, as shown in Figures 49 and 50, the shirt 10 may comprise vents 66I-66A for ventilation. Facilitating air circulation may further enhance the quick-drying capability of the shirt 10. Each of the vents 66I-66A allows a greater air flow than parts of the shirt 10 outside of the vents 66I-66A.

More particularly, in this embodiment, each of the vents 66I-66A comprises a mesh material 63 (i.e., a material having an open texture) for ventilation. In this example, the vents 66I-66A are respectively located in underarm, back, neck, lateral sides, and arm areas of the shirt 10. The vents 66I-66A may be disposed in any other suitable manner in other examples. The vents 66I-66A may be implemented in various other ways in other embodiments (e.g., openings).

In some embodiments, the shirt 10 may comprise an indicator 71 to indicate a current quick-drying effectiveness of the quick-drying fabric 30. This "quick-drying effectiveness indicator" 71 may be useful in cases where the effectiveness of the
fabric 30 at quickly-drying itself can decrease (e.g., after the shirt 10 has been repeatedly used or has been washed with a detergent) in order to allow the player to know when the shirt 10 may no longer work as desired.

While in embodiments considered above it is a fabric making up a bulk of the shirt 10, the quick-drying material 30 may be another type of material making up one or more smaller parts of the shirt 10 in other embodiments. For example, in some embodiments, as shown in Figures 19 to 21, the quick-drying material 30 may be foam making up parts 69₁-69₆ of the shirt 10 (e.g., pads secured to a fabric 21 making up a bulk of the shirt 10). For instance, the quick-drying foam 30 may comprise a cellular (i.e., foamed) base substance 67 (e.g., EVA, EPP, EPE, VN, PU or any other suitable cellular substance) and active elements 68₁-68₆, such as the active particles 40₁-40₆ discussed above, connected to the cellular base substance 67 to enhance evaporation of liquid moisture in the foam 30. As another example, in some embodiments, the quick-drying material 30 may be a membrane.

In some embodiments, the quick-drying material 30 may be anti-microbial. For instance, in some embodiments in which it is a fabric, the quick-drying material 30 may be treated (e.g., via a pad bath or exhaust process) or may have yarn-based anti-microbial or anti-odor technology.

Although in this embodiment the baselayer garment 10 is an undershirt, the baselayer garment 10 may be any other baselayer garment in other embodiments. For example, in some embodiments, the baselayer garment 10 may be underpants (e.g., shorts or a cup supporter) configured to be worn under protective pants (e.g., protective shorts), a sock configured to be worn under a shin guard, a compression sleeve (e.g., arm or shin sleeve) configured to be worn under an arm pad (e.g., an elbow pad) or a leg pad, or a head cap configured to be worn under a helmet.
While in this embodiment the athletic garment 10 is configured to be worn under the protective athletic equipment 12, the athletic garment 10 may be configured to be worn over the protective athletic equipment 12 in other embodiments. For example, in some embodiments, the athletic garment 10 may be a jersey (e.g., a team jersey) configured to be worn over the protective athletic equipment 12.

2. Protective athletic equipment

The shoulder pads 13 protect various regions of the player's upper body. As shown in Figures 56 and 57, the player's thorax has a front side FS and a back side BS. The front side FS of the player's thorax, which can also be referred to as a "chest" or "ventral" side, comprises left and right pectoral regions LPR, RPR overlying left and right pectoral muscles of the player and a sternum region SR overlying a sternum of the player. The back side BS of the player's thorax, which can also be referred to as a "dorsal" side, comprises a thoracic spinal region TSR overlying thoracic vertebrae of the player, left and right trapezius regions LTR, RTR overlying left and right trapezius muscles of the player, and left and right latissimus dorsi regions LLR, RLR overlying left and right latissimus dorsi muscles of the player. Each of the player's shoulders has a clavicle region CR, a scapular region BR, an acromioclavicular joint region ACR, and a deltoid region DR respectively overlying a clavicle, a scapula, an acromioclavicular joint, and a deltoid muscle of that shoulder.

The shoulder pads 13 comprise an inner surface 23 for facing towards the player and an outer surface 25 for facing away from the player. In this embodiment in which the shoulder pads 13 are to be worn over the shirt 10, the inner surface 23 of the shoulder pads 13 is configured to contact the outer surface 19 of the shirt 10.

The shoulder pads 13 comprise a front 54, a back 55, left and right shoulder arches 56i, 562, and left and right shoulder protectors 57i, 572. The front 54, the
back 55, and the shoulder arches 56i, 562 define a neck opening 58 for receiving
the player's neck. In this embodiment, the shoulder pads 13 also comprise left
and right upper arm protectors 59i, 592.

The front 54 of the shoulder pads 13 is configured to cover at least part of the
front side FS of the player's thorax. In this embodiment, the front 54 of the
shoulder pads 13 comprises left and right pectoral portions 72i, 722 for covering
the left and right pectoral regions LPR, RPR of the player, a sternum portion 73
for covering the sternum region SR of the player, and a top edge 74 delimiting
the neck opening 58.

In this embodiment, with additional reference to Figure 22, the front 54 of the
shoulder pads 13 comprises protective padding 75 disposed between an inner
liner 76 and an outer covering 77. The protective padding 75 provides padded
protection to the left and right pectoral regions LPR, RPR and the sternum region
SR of the player. The protective padding 75 comprises a shock-absorbing
material 47. For instance, in some examples of implementation, the shock-
absorbing material 47 may comprise foam, such as ethylene vinyl acetate (EVA)
foam, expanded polypropylene (EPP) foam, expanded polyethylene (EPE) foam
(e.g., low-density polyethylene (LDPE) foam), vinyl nitrile (VN) foam, or any other
suitable foam, or any other shock-absorbing substance other than foam (e.g., a
gel).

The outer covering 77 of the front 54 of the shoulder pads 13 faces away from
the player's body. The outer covering 77 comprises a material 78 making up at
least part of the outer covering 77. That is, the outer covering 77 is at least partly
(i.e., partly or entirely) made of the material 78. For instance, in some
embodiments, the material 78 may be a flexible material (e.g., a woven fabric, a
polyurethane or other elastomeric layer, etc.). In other embodiments, the material
78 may be a rigid material (e.g., polycarbonate, high-density polyethylene
(HDPE), polypropylene, etc.) that forms a rigid shell.
The inner liner 76 of the front 54 of the shoulder pads 13 faces the player's body. More particularly, in this embodiment, the inner liner 76 faces and engages the shirt 10. The inner liner 76 comprises a material 80 making up at least part of the inner liner 76. That is, the inner liner 76 is at least partly (i.e., partly or entirely) made of the material 80. In this embodiment, the inner liner 76 is at least mainly (i.e., mainly or entirely) made of the material 80.

In this embodiment, with additional reference to Figures 23 and 24, the material 80 of the inner liner 76 of the front 54 of the shoulder pads 13 is a fabric. The fabric 80 is a thin pliable material comprising a fibrous base substance 81 including fibers 82₁-82ᵣ arranged in a network by weaving, felting, knitting, interlacing, or otherwise crossing them. The fibers 82₁-82ᵣ may include any suitable natural or synthetic fibers (e.g., polyester, nylon, spandex (elastane), or other fibers, or blends of these fibers). In this embodiment, the fabric 80 includes yarns 83₁-8₃ᵣ that comprise respective ones of the fibers 82₁-8₂ᵣ. More particularly, in this embodiment, the fabric 80 is a woven or knit fabric.

For example, in this embodiment, the fibers 82₁-8₂ᵣ of the fabric 80 of the inner liner 76 include polyester fibers. For instance, the fabric 80 may comprise different types of polyester fibers (e.g., the fabric 80 may comprise 51% 75D/48F textured polyester and 49% 50D/72F polyester and weigh 120 g/m²). The fabric 80 may have any other suitable composition in other embodiments.

The fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 is configured taking into account movements of the player. In this example, the fabric 80 is also configured taking into account an interface between the shirt 10 and the shoulder pads 13. For instance, in this embodiment, the fabric 80 has mechanical properties to resist tearing or other excessive damage due to movements of the player and/or friction or other contact between the shirt 10 and the shoulder pads 13.
In this embodiment, the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 is a quick-drying material, i.e., a material exhibiting a drying rate which is relatively high, to quickly evaporate moisture as the player sweats.

In this example, at least some liquid moisture evaporated by the fabric 80 may have been transported to the inner liner 76 by the shirt 10 which wicked this liquid moisture away from the wearer's body. For example, in some embodiments, the drying rate of the fabric 80 may be at least 2.1 ml/hr, in some cases at least 2.3, in some cases at least 2.5, and in some cases even more, according to AATCC Test Method 201 of the American Association of Textile Chemists and Colorists (AATCC). Alternatively or additionally, in some embodiments, the drying rate of the fabric 80 may be at least 15 ml/hr, in some cases at least 20 ml/hr, in some cases at least 25 ml/hr, and in some cases even more, according to AATCC Test Method 200 of the AATCC. The drying rate of the fabric 80 may have any other suitable value in other embodiments.

More particularly, in this embodiment, to facilitate moisture evaporation, the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 is configured to (1) spread moisture over a large surface area and (2) harness heat generated by the player's body to vaporize liquid moisture.

For example, in some embodiments, a surface area of the fabric 80 may be at least 300 cm² per square centimeter of fabric, in some cases at least 400 cm² per square centimeter of fabric, in some cases at least 500 cm² per square centimeter of fabric, in some cases at least 600 cm² per square centimeter of fabric, and in some cases even more. Alternatively or additionally, in some embodiments, a surface area of a constituent of the fabric 80 may be at least 200 m² per gram of the constituent, in some cases at least 400 m² per gram of the constituent, in some cases at least 600 m² per gram of the constituent, in some cases at least 800 m² per gram of the constituent, in some cases at least 1000 m² per gram of the constituent and in some cases even more. The surface area...
of the constituent of the fabric 80 may have any other suitable value in other embodiments.

To harness heat generated by the player's body to vaporize moisture, a constituent of the fabric 80 captures this heat to raise its temperature and cause vaporization of liquid moisture in contact with it. For example, in some embodiments, a specific heat capacity of a constituent of the fabric 80 (i.e., an amount of heat required to increase the temperature of a unit mass of the constituent of the fabric 80 by one degree) may be relatively low. For instance, in some embodiments, the specific heat capacity of the constituent of the fabric 80 may be less than polyester's specific heat capacity. The specific heat capacity of the constituent of the fabric 80 may have any other suitable value in other embodiments. Additionally or alternatively, in some embodiments, a molar absorptivity at an infrared wavelength of a constituent of the fabric 80 (i.e., a measurement of how strongly a chemical species of the constituent of the fabric 80 absorbs electromagnetic radiation at the infrared wavelength) may be relatively high. For instance, in some embodiments, the molar absorptivity at an infrared wavelength of the constituent of the fabric 80 may be greater than polyester's molar absorptivity at that infrared wavelength. The molar absorptivity at the infrared wavelength of the constituent of the fabric 80 may have any other suitable value in other embodiments.

Also, in some embodiments, a constituent of the fabric 80 may be configured to manifest an exothermic reaction releasing heat to accelerate the drying process. That is, a constituent of the fabric 80 may be configured to exothermically react (i.e., produce heat when reacting) with liquid moisture. The exothermic reaction may be chemical and/or physical. For example, in some embodiments, the exothermic reaction manifested by the constituent of the fabric 80 may be adsorption of liquid moisture by the constituent of the fabric 80, such that heat is released when the liquid moisture is adsorbed by the constituent of the fabric 80.
In this embodiment, the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 comprises active elements 84I-84E to manage moisture as the player sweats, including to enhance evaporation of liquid moisture in the fabric 80. The active elements 84I-84E are "active" in that they have a property allowing them to induce a chemical and/or physical reaction in response to a stimulus at their surface. In this example, this reaction induced by the active elements 84I-84E helps accelerate the drying process of the fabric 80. The fabric 80 thus dries faster than if the active elements 84I-84E were omitted but the fabric 80 was otherwise identical (i.e., dries faster than a comparative fabric identical to the fabric 80 but without the active elements 84I-84E).

In this example of implementation, the active elements 84I-84E are connected to the fibers 82I-82R of the fibrous base substance 81. In other examples of implementation, the fibers 82I-82R of the fabric 80 may themselves be the active elements 84I-84E that enhance the drying process of the fabric 80 on their own, without having distinct active elements connected to the fibers 82I-82R.

More particularly, in this embodiment, the active elements 84I-84E are active particles distributed within the fabric 80. In this example, the active particles 84I-84E have an adsorptive property that causes them to adsorb liquid moisture as the player sweats. This reaction, i.e., adsorption, caused by the active particles 84I-84E helps evaporating the liquid moisture.

With additional reference to Figure 25, in this embodiment, each of the active particles 84I-84E is a microporous particle that includes a multitude of pores 85I-85L (e.g., several thousands of pores) which can trap the liquid moisture.

Because of their pores 85I-85L, the active particles 84I-84E have a surface area which is very large, thereby vastly spreading the liquid moisture to aid evaporating it. For example, in some embodiments, the surface area of the active particles 84I-84E may be such that the surface area of the fabric 80 is at least
300 cm² per square centimeter of fabric, in some cases at least 400 cm² per square centimeter of fabric, in some cases at least 500 cm² per square centimeter of fabric, in some cases at least 600 cm² per square centimeter of fabric, and in some cases even more. Alternatively or additionally, in some embodiments, the surface area of the active particles 84₁-8₄ₑ may be at least 200 m² per gram of active particle, in some cases at least 400 m² per gram of active particle, in some cases at least 600 m² per gram of active particle, in some cases at least 800 m² per gram of active particle, in some cases at least 1000 m² per gram of active particle and in some cases even more. The surface area of the active particles 84₁-8₄ₑ may have any other suitable value in other embodiments.

Also, in this embodiment, the active particles 84₁-8₄ₑ use heat generated by the player’s body to vaporize moisture. For example, in some embodiments, a specific heat capacity of the active particles 84₁-8₄ₑ may be relatively low. For instance, in some embodiments, the specific heat capacity of the active particles 84₁-8₄ₑ may be less than a specific heat capacity of the fibrous base substance 8₁ of the fabric 80. Thus, in this example, the specific heat capacity of the active particles 84₁-8₄ₑ may be less than polyester’s specific heat capacity.. The specific heat capacity of the active particles 84₁-8₄ₑ may have any other suitable value in other embodiments. Additionally or alternatively, in some embodiments, a molar absorptivity at an infrared wavelength of the active particles 84₁-8₄ₑ may be relatively high. For instance, in some embodiments, the molar absorptivity at an infrared wavelength of the active particles 84₁-8₄ₑ may be greater than a molar absorptivity at that infrared wavelength of the fibrous base substance 8₁ of the fabric 80. For instance, in some embodiments, the molar absorptivity at an infrared wavelength of the active particles 84₁-8₄ₑ may be greater than polyester’s molar absorptivity at that infrared wavelength.. The molar absorptivity at the infrared wavelength of the active particles 84₁-8₄ₑ may have any other suitable value in other embodiments.
Furthermore, the adsorption of liquid moisture by the active particles 84I-84E is an exothermic reaction releasing heat that helps to accelerate the drying process.

The active particles 84I-84E may be implemented in any suitable way. In this embodiment, the active particles 84I-84E comprise activated carbon. The activated carbon may be produced in various known ways. For instance, the activated carbon may be produced from carbonaceous materials such as wood, nutshellfs, coconut husk, coir, peat, lignite, coal, or other carbonaceous substances using known processes (e.g., physical reactivation using hot gases which involves carbonization and/or oxidation, or chemical activation using chemicals on raw material prior to carbonization), or synthetically using known processes (e.g., pyrolysis of polystyrene beads). In other embodiments, the active particles 84I-84E may comprise activated alumina (aluminum oxide), silica gel, soda ash, aluminum trihydrate, baking soda, cinoxate (p-methoxy-2-ethoxyethyl ester cinnamic acid), zinc oxide, zeolites, titanium dioxide, or any other suitable material.

The active particles 84I-84E may be incorporated into the fabric 80 using any suitable process. For example, in some embodiments, the active particles 84I-84E may be joined to the fibrous base substance 81 of the fabric 80 using: an air dispersion process in which the active particles are entrained in a gaseous carrier onto the fibrous base substance 81 of the fabric 80 where they are fixed; a padding process in which the fibrous base substance 81 of the fabric 80 is passed through a bath of the active particles; a liquid suspension or mixture of a binder and the active particles applied to the fibrous base substance 81 of the fabric 80; or a xerographic process using electrostatic or magnetic attraction to transfer a toner formulation including the active particles towards the fibrous base substance 81 of the fabric 80. In some cases, a protective substance may be provided onto the active particles 84I-84E to protect these active particles during manufacturing of the fabric 80 and subsequently removed. Examples of such

Examples of materials that can be used for the fabric 80 including the active particles \(84_1,84_E\) may be commercially obtained from Cocona Inc., Boulder, Colorado.

The back 55 of the shoulder pads 13 is configured to cover at least part of the back side BS of the player's thorax. In this embodiment, the back 55 of the shoulder pads 13 comprises a spinal portion 85 for covering the thoracic spinal region TSR of the player, left and right trapezius portions 881, 882 for covering the left and right trapezius regions LTR, RTR of the player, left and right latissimus dorsi portions 89i, 892 for covering the left and right latissimus dorsi regions LLR, RLR of the player, and a top edge 89 delimiting the neck opening 58.

In this embodiment, with additional reference to Figure 26, the back 55 of the shoulder pads 13 comprises protective padding 90 disposed between an inner liner 91 and an outer covering 92. The protective padding 90 provides padded protection to the thoracic spinal region SR, the left and right trapezius regions LTR, RTR, and left and right latissimus dorsi regions LLR, RLR of the player. The inner liner 91 faces the player's body, while the outer covering 92 faces away from the player's body. In this example of implementation, these components of the back 55 of the shoulder pads 13 may be constructed similarly to the protective padding 75, the inner liner 76, and the outer covering 77 of the front 54 of the shoulder pads 13. Notably, in this embodiment, the inner liner 91 of the back 55 of the shoulder pads 13 comprises a quick-drying fabric 180 like the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 (e.g., including active elements such as the active particles \(84_1,84_E\) of the fabric 80).
The left and right shoulder arches 56i, 562 are configured to respectively arch over the left and right shoulders of the player and interconnect the front 54 and the back 55 of the shoulder pads 13.

In this embodiment, with additional reference to Figure 27, each of the shoulder arches 56i, 562 comprises protective padding 93 disposed between an inner liner 94 and an outer covering 95. The protective padding 93 provides padded protection, the inner liner 94 faces the player's body, and the outer covering 95 faces away from the player's body. In this example of implementation, these components of each of the shoulder arches 56i, 562 may be constructed similarly to the protective padding 75, the inner liner 76, and the outer covering 77 of the front 54 of the shoulder pads 13. Notably, in this embodiment, the inner liner 94 of each of the shoulder arches 56i, 562 comprises a quick-drying fabric 280 like the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 (e.g., including active elements such as the active particles 841-84 E of the fabric 80).

The shoulder protectors 57i, 572 are configured to respectively cover at least part of the left and right shoulders of the player. In this embodiment, each of the shoulder protectors 57i, 572 comprises an acromioclavicular joint portion and a deltoid portion for respectively covering at least part of the acromioclavicular joint region ACR and the deltoid region DR of the shoulder it protects.

Each shoulder protector 57x is connected to at least one of the front 54, the back 55, and a given one of the shoulder arches 56i, 562. In this embodiment, the shoulder protector 57x is connected to the shoulder arch 56x arching over the shoulder that it protects. Also, in this embodiment, the shoulder protector 57x is connected to the arm protector 59x which is on the arm extending from the shoulder it protects. The shoulder protector 57x may be directly connected (e.g., sewed) to the shoulder arch 56x and/or the arm protector 59x or may be indirectly connected (e.g., via one or more straps sewed) to the shoulder arch 56x and/or the arm protector 59x.
In this embodiment, with additional reference to Figure 28, the shoulder protector 57x comprises protective padding 96 disposed between an inner liner 97 and an outer covering 98. The protective padding 96 provides padded protection, the inner liner 97 faces the player’s body, and the outer covering 98 faces away from the player’s body. In this example of implementation, these components of the shoulder protector 57x may be constructed similarly to the protective padding 75, the inner liner 76, and the outer covering 77 of the front 54 of the shoulder pads 13. Notably, in this embodiment, the inner liner 97 of the shoulder protector 57x comprises a quick-drying fabric 380 like the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 (e.g., including active elements such as the active particles 84 of the fabric 80).

The upper arm protectors 59i, 592 are configured to cover at least part of the left and right arms of the player. Each of the upper arm protectors 59i, 592 comprises an outer arm portion for overlying an outer region of the arm it protects and a strap for retaining itself on the arm.

In this embodiment, with additional reference to Figure 29, each upper arm protector 59x comprises protective padding 99 disposed between an inner liner 100 and an outer covering 101. The protective padding 99 provides padded protection, the inner liner 100 faces the player’s body, and the outer covering 101 faces away from the player’s body. In this example of implementation, these components of the upper arm protector 59x may be constructed similarly to the protective padding 75, the inner liner 76, and the outer covering 77 of the front 54 of the shoulder pads 13. Notably, in this embodiment, the inner liner 97 of the upper arm protector 59x comprises a quick-drying fabric 480 like the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 (e.g., including active elements such as the active particles 84 of the fabric 80).
While the shoulder pads 30 are constructed in a particular way in this embodiment, the shoulder pads 30 may be constructed in various other ways in other embodiments.

For example, in some embodiments, as shown in Figures 30 and 31, the drying rate of the shoulder pads 13 may differ over a plurality of areas 1601-160H of the shoulder pads 13. That is, the drying rate of a given one of the areas 1601-160H of the shoulder pads 13 may be different from (i.e., greater or lesser than) the drying rate of another one of the areas 1601-160H of the shoulder pads 13. For instance, the drying rate of a first one of the areas 1601-160H of the shoulder pads 13 that is disposed to overlie a first region of the player's body which is expected to generate more sweat may be greater than the drying rate of a second one of the areas 1601-160H of the shoulder pads 13 that is disposed to overlie a second region of the player's body which is expected to generate less sweat.

In this embodiment, the area 160i of the shoulder pads 13 is an area of the front 54 of the shoulder pads 13 that is disposed to overlie a chest region of the player's torso, the area 1602 of the shoulder pads 13 is an area of the back of the shoulder pads 13 that is disposed to overlie a back region of the player's torso, and the areas 1603, 1604 of the shoulder pads 13 are areas of the shoulder protectors 57i, 572 that are disposed to overlie shoulder regions of the player's torso.

As an example, the drying rate of the areas 1601, 1602 of the shoulder pads 13, which are overlying regions of the player's body which may generate more sweat, may be greater than the drying rate of the areas 1603, 1604 of the shoulder pads 13, which are overlying regions of the player's body which may generate less sweat. As another example, the drying rate of the area 1602 of the back 55 of the shoulder pads 13, which overlies the back region of the player's body, may be greater than the drying rate of the area 1601 of the front 54 of the
shoulder pads 13, which overlies the front region of the player's body that may generate less sweat than the back region of the player's body.

For example, in some embodiments, a ratio of (i) the drying rate of a given area 160i of the shoulder pads 13 over (ii) the drying rate of another area 160j of the shoulder pads 13 may be at least 1.1, in some cases at least 1.2, in some cases at least 1.3, in some cases at least 1.4, in some cases at least 1.5, and in some cases even more (e.g., 2 or more). The difference between the drying rate of respective ones of the areas 160i -160H of the shoulder pads 13 may take on any other suitable value in other embodiments.

The variation of the drying rate over the areas 160i -160H of the shoulder pads 13 can be implemented in any suitable manner. In this embodiment, this may be achieved by varying a concentration or loading of active particles of a fabric, such as the active particles 84I -84 E of the fabric 80 of the front 54 of the shoulder pads 13 and similar active particles of the fabric of other parts of the shoulder pads 13, over the areas 160i -160H of the shoulder pads 13. The concentration or loading of the active particles of the fabric in a given area 160i of the shoulder pads may be greater than the concentration or loading of the active particles of the fabric in another area 160j of the shoulder pads 13 such that the drying rate of the area 160i of the shoulder pads 13 is greater than the drying rate of the area 160j of the shoulder pads 13. For example, in some embodiments, a ratio of (i) the concentration or loading of the active particles of the fabric in the given area 160i of the shoulder pads 13 over (ii) the concentration or loading of the active particles of the fabric in the other area 160j of the shoulder pads 13 may be at least 1.1, in some cases at least 1.2, in some cases at least 1.5, in some cases at least 2, in some cases at least 4, and in some cases even more (e.g., 8 or more). The concentration or loading of the active particles of the fabric in a particular area 160x of the shoulder pads 13 can be measured as a weight percent of the active particles in that particular area 160x of the shoulder pads 13, i.e., a weight of the active particles in the area 160x of the shoulder pads 13.
divided by a total weight of the fabric of the area 160x of the shoulder pads 13 and multiplied by one hundred. In some examples of implementation, an area 160x of the shoulder pads 13 may be free of active particles, i.e., there is no active particle in the area 160x of the shoulder pads 13, such that the concentration or loading of the active particles of the fabric in the area 160x of the shoulder pads 13 is substantially zero. The variation of the drying rate over the areas 1601-1604 of the shoulder pads 13 can be implemented in other ways in other embodiments (e.g., by varying a yarn size or fabric weight in different areas).

In some embodiments, the drying rate of a given area of the shirt 10 may be different from the drying rate of an overlapping area of the shoulder pads 13 which overlaps the given area of the shirt 10. For example, in some embodiments, the drying rate of the given area of the shirt 10 may be greater than the drying rate of the overlapping area of the shoulder pads 13 since the shirt 10 is more directly exposed to the player's sweat. For instance, in this example of implementation, the concentration or loading of the active particles of the fabric in the given area of the shirt 10 may be greater than the concentration or loading of the active particles of the fabric in the overlapping area of the shoulder pads 13 such that the drying rate of the given area of the shirt 10 is greater than the drying rate of the overlapping area of the shoulder pads 13. For example, in some embodiments, a ratio of (i) the concentration or loading of the active particles of the fabric in the given area of the shirt 10 over (ii) the concentration or loading of the active particles of the fabric in the overlapping area of the shoulder pads 13 may be at least 1.1, in some cases at least 1.2, in some cases at least 1.5, in some cases at least 2, in some cases at least 4, and in some cases even more (e.g., 8 or more).

To further enhance moisture management, in some embodiments, with additional reference to Figures 32 to 34, in addition to comprising a quick-drying material (i.e., the fabric 80 of the front 54 of the shoulder pads 13 and similar fabrics of
other parts of the shoulder pads 13 in this embodiment), the shoulder pads 13 may comprise a cooling material 165 providing a cooling effect perceivable by the player. As the quick-drying material works to accelerate moisture evaporation to help dry the shoulder pads 13, the cooling material 165 may help the player feel cooler. This may be particularly useful in a portion of the shoulder pads 13 contacting the player's body (e.g., in cases where the shirt 10 is not worn or another shirt covering less of the player's body is worn).

In this embodiment, the cooling material 165 is a fabric. The cooling fabric 165 comprises a fibrous base substance 137 including fibers 133i-133k, which may include any suitable natural or synthetic fibers (e.g., polyester, nylon, spandex (elastane), or other fibers, or blends of these fibers). In this example, the cooling fabric 165 is a woven fabric.

The cooling effect provided by the cooling fabric 165 may be implemented in any suitable way. In this embodiment, the cooling fabric 165 comprises active elements 170i-1 70c to generate the cooling effect. More particularly, in this embodiment, the active elements 170i-1 70c are connected to the fibers 133i-133K of the fibrous base substance 137. For example, in some embodiments, the cooling fabric 165 may be configured to cool down when absorbing moisture as the player sweats, i.e., a moisture-activated cooling fabric. For instance, the active elements 170i-1 70c may be swellable elements configured to swell when absorbing moisture to create the cooling effect. Examples of materials that can be used for the cooling fabric 165 that is moisture-activated are fabrics including Nexar™ polymers which may be commercially obtained from Kraton Performance Polymers Inc., Houston, Texas. As another example, in some embodiments, the cooling fabric 165 may be configured to cool down when absorbing heat from the player's body, i.e., a heat-activated cooling fabric. For instance, the active elements 170i-1 70c may be phase-change material (PCM) elements (e.g., microencapsulated PCM elements) configured to change phase when absorbing heat to create the cooling effect. Examples of materials that can
be used for the cooling fabric 165 that is heat-activated are fabrics including Thermocules™ PCM elements which may be commercially obtained from Outlast Technologies LLC, Boulder, Colorado. In other embodiments, the fibers 133ι-133K of the cooling fabric 165 may themselves be the active elements 170ι-1 70c that generate the cooling effect on their own, without having distinct active elements connected to the fibers 133ι-133κ of the fibrous base substance 137. For instance, the fibers 133ι-133κ of the cooling fabric 165 may be configured to cool down when absorbing and trapping moisture inside them as the player sweats. Examples of materials that can be used for this purpose may be commercially obtained from CoolCore, Portsmouth, New Hampshire. Other examples of materials that can be used for the cooling fabric 165 may include IceFil by Ventex, Luxicool, Cool Jade, Advansa’s Thermo Cool, and HeiQ’s Adaptive.

The quick-drying material (i.e., the fabric 80 of the front 54 of the shoulder pads 13 and similar fabrics of other parts of the shoulder pads 13 in this embodiment) and the cooling fabric 165 may be arranged in any suitable manner in the shoulder pads 13. For example, in this embodiment, a quantity of the quick-drying material in the shoulder pads 13 is greater than a quantity of the cooling fabric 165 in the shoulder pads 13. For instance, in this embodiment, the cooling fabric 165 may be present only in a limited area of the shoulder pads 13 where the cooling effect may be better perceived by the player. Thus, in this embodiment, the cooling fabric 165 is present in a quick-cooling spot of the player’s body, i.e., a spot of the player’s body that is more efficient at cooling. In this example, the cooling fabric 165 is disposed about the neck opening 58 since the cooling effect at the player’s neck may be well perceived by the player. In other examples, the cooling fabric 165 may be disposed in other quick-cooling spots of the player’s body (e.g., a crook of the elbow, a wrist, a forehead, an inner thigh, a bend of the knee, or an ankle).
In some embodiments, a fabric of an inner liner of the shoulder pads 13 (e.g., the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 or a similar fabric of another inner liner of the shoulder pads 13) may be a quick-drying and cooling fabric. That is, the fabric may be configured such that (1) its drying rate is relatively high and (2) it provides a cooling effect perceivable by the player. For example, in some embodiments, as shown in Figures 35 and 36, the fabric 80 of the front 54 of the shoulder pads 13 may comprise (1) the active elements 84i-84E for quick-drying and (2) the active elements 170i-1 70c for the cooling effect connected to the fibrous base substance 81. This may be done by applying the active elements 84i-84E and the active elements 170i-1 70c to the fibrous base substance 81 in a common process or sequential processes using known techniques (e.g., from companies mentioned above) to provide these elements in fabrics.

In some embodiments, as shown in Figure 51 and 52, the shoulder pads 13 may comprise vents 166i-166F for ventilation. Facilitating air circulation may further enhance the quick-drying capability of the shoulder pads 13. Each of the vents 166i-166F allows a greater air flow than parts of the shoulder pads 13 outside of the vents 166i-166F.

More particularly, in this embodiment, each of the vents 166i-166F comprises an opening 163 and a mesh material 263 (i.e., a material having an open texture) disposed within the opening 163 for ventilation. In this example, the vents 166i-166F are respectively located in front and back areas of the shoulder pads 13. The vents 166i-166F may be disposed in any other suitable manner in other examples.

In some embodiments, as shown in Figure 53, a vent 166i of the shoulder pads 13 may overlap a vent 66i of the shirt 10. This may further facilitate air flow though the athletic gear 11. For instance, in some embodiments, such as shown
in Figures 49 to 52, each of the vents 1665-166s in the back of the shoulder pads 13 may overlap a respective one of the vents 66s-66n in the back of the shirt 10.

The vents 1661-166F may be implemented in various other ways in other embodiments. For example, in some embodiments, a vent 166x may include the opening 163 without any mesh material in it (e.g., a through-hole extending through the shoulder pads 13). As another example, in some embodiments, as shown in Figures 54 and 55, a vent 166x may comprise a channel 257 to direct air flow in a particular direction or to a particular location (e.g., a particular location on the shirt 10 or the player's body that is expected to have more moisture). The channel 257 may extend within the shoulder pads 13, as shown in the embodiment of Figure 54, and/or may extend on an inner side 240 of the shoulder pads 13 as shown in the embodiment of Figure 55.

In some embodiments, the shoulder pads 13 may comprise an indicator 171 to indicate a current quick-drying effectiveness of a quick-drying fabric (e.g., the fabric 80 of the front 54 of the shoulder pads 13 or a similar fabric of another part of the shoulder pads 13 in this embodiment). This "quick-drying effectiveness indicator" 171 may be useful in cases where the effectiveness of the fabric at quickly-drying itself can decrease (e.g., after the shoulder pads 13 have been repeatedly used or has been washed with a detergent) in order to allow the player to know when the shoulder pads 13 may no longer work as desired.

While in embodiments considered above the shoulder pads 13 comprise a quick-drying material that is a fabric making up at least part of an inner liner of the shoulder pads 13 (e.g., the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 or a similar fabric of another inner liner of the shoulder pads 13), in other embodiments, the shoulder pads 13 may comprise a quick-drying material that is another type of material making up another part of the shoulder pads 13. For example, in some embodiments, as shown in Figure 37, the shoulder pads 13 may comprise a quick-drying material 230 that is foam making
up protective padding 232 of the shoulder pads. For instance, the quick-drying foam 232 may comprise a cellular (i.e., foamed) base substance 267 (e.g., EVA, EPP, EPE, VN, PU or any other suitable cellular substance) and active elements 268-1-268w, such as the active particles 84i-84 e discussed above, connected to the cellular base substance 267 to enhance evaporation of liquid moisture in the foam 232. For example, in some embodiments, the protective padding 232 may be the protective padding 75 of the front 54 of the shoulder pads 13, the protective padding 90 of the back 55 of the shoulder pads 13, the protective padding 93 of each of the shoulder arches 56i, 562, the protective padding 96 of each of the shoulder protector 57i, 572, or the protective padding 99 of each of the upper arm protectors 59i, 592.

In some embodiments, the quick-drying material may be anti-microbial. For instance, in some embodiments in which it is a fabric, the quick-drying material may be treated (e.g., via a pad bath or exhaust process) or may have yarn-based anti-microbial or anti-odor technology.

The elbow pads 15i, 152 are wearable to protect the player's elbows and adjacent parts his/her arms. Each elbow pad 15x comprises an inner surface 123 for facing towards the player and an outer surface 125 for facing away from the player. In this example in which the elbow pad 15x is to be worn over the shirt 10, the inner surface 123 of the elbow pad 15x is configured to contact the outer surface 19 of the shirt 10. In this embodiment, with additional reference to Figure 38, each elbow pad 15x comprises protective padding 190 disposed between an inner liner 191 and an outer covering 192. The protective padding 190 provides padded protection to the elbow and adjacent parts of the player's arm. The inner liner 191 faces the player's body, while the outer covering 192 faces away from the player's body. In this example of implementation, these components of the elbow pad 15x may be constructed similarly to the protective padding 75, the inner liner 76, and the outer covering 77 of the front 54 of the shoulder pads 13.

Notably, in this embodiment, the inner liner 191 of elbow pad 15x comprises a
quick-drying fabric 680 like the fabric 80 of the inner liner 76 of the front 54 of the shoulder pads 13 (e.g., including active elements such as the active particles 841-84E of the fabric 80). Also, in this example of implementation, any feature or variant mentioned above in respect of the shoulder pads 13 (e.g., areas of different drying rates, inclusion of a cooling material, etc.) is applicable to the elbow pad 15x.

While in this embodiment the protective athletic equipment 12 comprises the shoulder pads 13 and the elbow pads 15i, 152, in other embodiments, other articles of protective athletic equipment may be constructed using principles described herein in respect of the shoulder pads 13 and the elbow pads 15i, 152 to provide enhanced moisture management.

For example, in some embodiments, as shown in Figures 39 and 40, a protective glove 200 may be constructed using principles described herein in respect of the shoulder pads 13 and the elbow pads 15i, 152. The protective glove 200 comprises an inner surface 223 for facing towards the player and an outer surface 225 for facing away from the player. For instance, the protective glove 200 may comprise a quick-drying material making up at least part of an inner liner 202 or protective padding 204 of the glove 200 and/or may comprise a cooling material making up at least part of the inner liner 202 of the glove 200.

As another example, in some embodiments, as shown in Figure 41, protective pants 300 may be constructed using principles described herein in respect of the shoulder pads 13 and the elbow pads 15i, 152. The protective pants 300 comprises an inner surface 323 for facing towards the player and an outer surface 325 for facing away from the player. For instance, the protective pants 300 may comprise a quick-drying material making up at least part of an inner liner 302 or protective padding 304 of the protective pants 300 and/or may comprise a cooling material making up at least part of the inner liner 302 of the protective pants 300.
As another example, in some embodiments, as shown in Figures 42 and 43, a leg pad 400 (i.e., a shin guard) may be constructed using principles described herein in respect of the shoulder pads 13 and the elbow pads 15i, 152. The leg pad 400 comprises an inner surface 423 for facing towards the player and an outer surface 425 for facing away from the player. For instance, the leg pad 400 may comprise a quick-drying material making up at least part of an inner liner 402 or protective padding 404 of the leg pad 400 and/or may comprise a cooling material making up at least part of the inner liner 402 of the leg pad 400.

As another example, in some embodiments, as shown in Figures 44 and 45, a helmet 500 may be constructed using principles described herein in respect of the shoulder pads 13 and the elbow pads 15i, 152. The helmet 500 comprises an inner surface 523 for facing towards the player and an outer surface 525 for facing away from the player. For instance, the helmet 500 may comprise a quick-drying material making up at least part of an inner liner 502 or protective padding 504 of the helmet 500 and/or may comprise a cooling material making up at least part of the inner liner 502 of the helmet 500.

As another example, in some embodiments, as shown in Figure 46, a neck guard 600 may be constructed using principles described herein in respect of the shoulder pads 13 and the elbow pads 15i, 152. The neck guard 600 comprises an inner surface 623 for facing towards the player and an outer surface 625 for facing away from the player. For instance, the neck guard 600 may comprise a quick-drying material making up at least part of an inner liner 602 or protective padding 604 of the neck guard 600 and/or may comprise a cooling material making up at least part of the inner liner 602 of the neck guard 600.

The athletic gear 11 may comprise any other athletic equipment constructed using principles described herein in respect of the shoulder pads 13 and the elbow pads 15i, 152 to provide enhanced moisture management. For example, in
some embodiments, as shown in Figures 47 and 48, a skate 700 may be constructed using principles described herein in respect of the shoulder pads 13 and the elbow pads 15i, 152. In this example, the skate 700 is an ice skate. In other examples, the skate 700 may be a roller skate (e.g., an inline skate). The skate 700 comprises an inner surface 723 for facing towards the player and an outer surface 725 for facing away from the player. For instance, the skate 700 may comprise a quick-drying material making up at least part of an inner liner 702 of a skate boot 704 and/or may comprise a cooling material making up at least part of the inner liner 702 of the skate boot 704. Other parts of the skate 700, such as a tongue 709 for example, may comprise a quick-drying material and/or a cooling material in other embodiments.

Although in this embodiment the athletic gear 11 is hockey gear, in other embodiments, athletic gear constructed using principles described herein in respect of the athletic gear 11 may be other athletic gear wearable a player playing another type of contact sport (e.g., a “full-contact” sport) in which there are significant impact forces on the player due to player-to-player and/or player-to-object contact. For example, in other embodiments, athletic gear constructed using principles described herein in respect of the athletic gear 11 may be lacrosse gear for a lacrosse player, football gear for a football player, or baseball gear for a baseball player.

While in embodiments considered above the athletic gear 11 is for a user playing a contact sport, in other embodiments, athletic gear 11 constructed using principles described herein in respect of the athletic gear 11 may be used in athletic activities other than contact sports in which impact protection is desired.

In some embodiments, any feature of any embodiment described herein may be used in combination with any feature of any other embodiment described herein.
 Certain additional elements that may be needed for operation of certain embodiments have not been described or illustrated as they are assumed to be within the purview of those of ordinary skill in the art. Moreover, certain embodiments may be free of, may lack and/or may function without any element that is not specifically disclosed herein.

Although various embodiments and examples have been presented, this was for the purpose of describing, but not limiting, the invention. Various modifications and enhancements will become apparent to those of ordinary skill in the art and are within the scope of the invention, which is defined by the appended claims.
CLAIMS

1. An athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer, the athletic garment comprising:
   a) a surface to contact the protective athletic equipment; and
   b) a material comprising active elements to manage moisture as the wearer sweats.

2. The athletic garment claimed in claim 1, wherein the active elements are configured to facilitate drying of the material.

3. The athletic garment claimed in claim 1, wherein the material comprises a base substance and the active elements are connected to the base substance.

4. The athletic garment claimed in claim 3, wherein the material is a fabric and the base substance is a fibrous substance.

5. The athletic garment claimed in claim 3, wherein the material is a foam and the base substance is a cellular substance.

6. The athletic garment claimed in claim 1, wherein the active elements are active particles.

7. The athletic garment claimed in claim 6, wherein the active particles are microporous particles.

8. The athletic garment claimed in claim 7, wherein the active particles comprise activated carbon.
9. The athletic garment claimed in claim 1, wherein the active elements adsorb liquid moisture as the wearer sweats.

10. The athletic garment claimed in claim 1, wherein a drying rate of the material is at least 2.1 ml/hr according to AATCC Test Method 201.

11. The athletic garment claimed in claim 1, wherein a drying rate of the material is at least 2.3 ml/hr according to AATCC Test Method 201.

12. The athletic garment claimed in claim 1, wherein a drying rate of the material is at least 2.5 ml/hr according to AATCC Test Method 201.

13. The athletic garment claimed in claim 1, wherein a drying rate of the material is at least 15 ml/hr according to AATCC Test Method 200.

14. The athletic garment claimed in claim 1, wherein a drying rate of the material is at least 20 ml/hr according to AATCC Test Method 200.

15. The athletic garment claimed in claim 1, wherein a drying rate of the material is at least 25 ml/hr according to AATCC Test Method 200.

16. The athletic garment claimed in claim 1, wherein a surface area of the material is at least 300 cm² per square centimeter of the material.

17. The athletic garment claimed in claim 1, wherein a surface area of the material is at least 400 cm² per square centimeter of the material.

18. The athletic garment claimed in claim 1, wherein a surface area of the material is at least 500 cm² per square centimeter of the material.
19. The athletic garment claimed in claim 1, wherein a surface area of the material is at least 600 cm$^2$ per square centimeter of the material.

20. The athletic garment claimed in claim 1, wherein a surface area of the active elements is at least 200 m$^2$ per gram of the active elements.

21. The athletic garment claimed in claim 1, wherein a surface area of the active elements is at least 400 m$^2$ per gram of the active elements.

22. The athletic garment claimed in claim 1, wherein a surface area of the active elements is at least 800 m$^2$ per gram of the active elements.

23. The athletic garment claimed in claim 1, wherein the active elements are responsive to heat generated by the wearer's body to vaporize liquid moisture in contact with the material.

24. The athletic garment claimed in claim 3, wherein a specific heat capacity of the active elements is less than a specific heat capacity of the base substance.

25. The athletic garment claimed in claim 3, wherein a molar absorptivity at an infrared wavelength of the active elements is greater than a molar absorptivity at the infrared wavelength of the base substance.

26. The athletic garment claimed in claim 1, wherein the active elements are configured to exothermically react with liquid moisture.

27. The athletic garment claimed in claim 1, wherein the material has an abrasion resistance of at least 10000 rubs according to ASTM 4966 - Option 1.
28. The athletic garment claimed in claim 1, wherein the material has a bursting strength of at least 40 psi if the material weighs 3.4 oz./yd.² or less or at least 55 psi if the material weighs 3.5 oz./yd.² or more, according to ASTM D3788.

29. The athletic garment claimed in claim 1, wherein the material has a snagging resistance of at least 3 according to ASTM D3939.

30. The athletic garment claimed in claim 1, comprising a gripper for engaging and gripping the protective athletic equipment.

31. The athletic garment claimed in claim 30, wherein a coefficient of friction between the gripper and the protective athletic equipment is greater than a coefficient of friction between the material and the protective athletic equipment.

32. The athletic garment claimed in claim 31, wherein the gripper comprises a tackifying material.

33. The athletic garment claimed in claim 32, wherein the tackifying material includes at least one of a thermoplastic elastomer, polyvinyl chloride, and silicone.

34. The athletic garment claimed in claim 31, wherein the gripper comprises a plurality of frictional gripping members spaced from one another.

35. The athletic garment claimed in claim 1, comprising a protector for protecting a body part of the wearer.

36. The athletic garment claimed in claim 35, wherein the athletic garment is a shirt, the body part of the wearer is a neck of the wearer, and the protector comprises a neck guard to protect the wearer's neck.
37. The athletic garment claimed in claim 35, wherein the protector comprises a portion of the material.

38. The athletic garment claimed in claim 2, wherein a drying rate of a first area of the athletic garment is greater than a drying rate of a second area of the athletic garment.

39. The athletic garment claimed in claim 38, wherein the first area of the athletic garment is disposed to be covered by the protective athletic equipment and the second area of the athletic garment is disposed to not be covered by the protective athletic equipment.

40. The athletic garment claimed in claim 38, wherein the first area of the athletic garment is disposed to overlie a first region of the wearer's body expected to generate more sweat than a second region of the wearer's body and the second area of the athletic garment is disposed to overlie the second region of the wearer's body.

41. The athletic garment claimed in claim 38, wherein a ratio of the drying rate of the first area of the athletic garment over the drying rate of the second area of the athletic garment is at least 1.1.

42. The athletic garment claimed in claim 38, wherein a ratio of the drying rate of the first area of the athletic garment over the drying rate of the second area of the athletic garment is at least 1.3.

43. The athletic garment claimed in claim 38, wherein a ratio of the drying rate of the first area of the athletic garment over the drying rate of the second area of the athletic garment is at least 1.5.
44. The athletic garment claimed in claim 38, wherein a concentration of the active elements in the first area of the athletic garment is greater than a concentration of the active elements in the second area of the athletic garment.

45. The athletic garment claimed in claim 44, wherein a ratio of the concentration of the active elements in the first area of the athletic garment over the concentration of the active elements in the second area of the athletic garment is at least 1.1.

46. The athletic garment claimed in claim 44, wherein a ratio of the concentration of the active elements in the first area of the athletic garment over the concentration of the active elements in the second area of the athletic garment is at least 1.5.

47. The athletic garment claimed in claim 44, wherein a ratio of the concentration of the active elements in the first area of the athletic garment over the concentration of the active elements in the second area of the athletic garment is at least 2.

48. The athletic garment claimed in claim 44, wherein the concentration of the active elements in the second area of the athletic garment is substantially zero.

49. The athletic garment claimed in claim 1, wherein a concentration of the active elements in a first area of the athletic garment is greater than a concentration of the active elements in a second area of the athletic garment.

50. The athletic garment claimed in claim 49, wherein the concentration of the active elements in the second area of the athletic garment is substantially zero.
51. The athletic garment claimed in claim 1, wherein the athletic garment is a baselayer garment configured to be worn under the protective athletic equipment.

52. The athletic garment claimed in claim 51, wherein the baselayer garment is a shirt.

53. The athletic garment claimed in claim 52, wherein the shirt is a compression shirt.

54. The athletic garment claimed in claim 51, wherein the active elements are configured to provide a cooling effect perceivable by the wearer as the wearer sweats.

55. The athletic garment claimed in claim 54, wherein the material is configured to cool down when absorbing moisture as the wearer sweats.

56. The athletic garment claimed in claim 54, wherein the material is configured to cool down when absorbing heat from the wearer's body as the wearer sweats.

57. The athletic garment claimed in claim 54, wherein the active elements are swellable elements configured to swell when absorbing moisture to create the cooling effect.

58. The athletic garment claimed in claim 54, wherein the active elements are phase-change elements configured to change phase when absorbing heat to create the cooling effect.
59. The athletic garment claimed in claim 51, wherein the material is a first material, the active elements are first active elements configured to facilitate drying of the first material as the wearer sweats, and the athletic garment comprises a second material comprising second active elements configured to provide a cooling effect perceivable by the wearer as the wearer sweats.

60. The athletic garment claimed in claim 59, wherein the second material is configured to cool down when absorbing moisture as the wearer sweats.

61. The athletic garment claimed in claim 59, wherein the second material is configured to cool down when absorbing heat from the wearer's body as the wearer sweats.

62. The athletic garment claimed in claim 59, wherein the second material comprises a base substance and the second active elements are connected to the base substance of the second material.

63. The athletic garment claimed in claim 62, wherein the second material is a fabric and the base substance of the second material is a fibrous substance.

64. The athletic garment claimed in claim 59, wherein the second active elements are swellable elements configured to swell when absorbing moisture to create the cooling effect.

65. The athletic garment claimed in claim 59, wherein the active elements are phase-change elements configured to change phase when absorbing heat to create the cooling effect.

66. The athletic garment claimed in claim 59, wherein a quantity of the first material in the athletic garment is greater than a quantity of the second material in the athletic garment.
67. The athletic garment claimed in claim 66, wherein the first material constitutes a bulk of the athletic garment.

68. The athletic garment claimed in claim 67, wherein the second material is disposed to be located adjacent to a quick-cooling spot of the wearer's body.

69. The athletic garment claimed in claim 68, wherein the quick-cooling spot of the wearer's body is a neck, a wrist, an elbow, a forehead, a knee, an ankle, or an inner thigh.

70. The athletic garment claimed in claim 59, wherein the athletic garment is a shirt and the second material is disposed in a collar of the shirt.

71. The athletic garment claimed in claim 59, wherein the athletic garment is a shirt and the second material is disposed in a wrist portion of the shirt.

72. The athletic garment claimed in claim 59, wherein the athletic garment is a shirt and the second material is disposed in an elbow portion of the shirt.

73. The athletic garment claimed in claim 59, wherein the athletic garment is a pant and the second material is disposed in a knee portion of the pant.

74. The athletic garment claimed in claim 59, wherein the athletic garment is a pant and the second material is disposed in an ankle portion of the pant.

75. The athletic garment claimed in claim 59, wherein the athletic garment is a pant and the second material is disposed in an inner thigh portion of the pant.
76. The athletic garment claimed in claim 59, wherein the athletic garment is a head cap and the second material is disposed in a forehead portion of the head cap.

77. The athletic garment claimed in claim 1, wherein the active elements comprise first active elements configured to facilitate drying of the material as the wearer sweats and second active elements configured to provide a cooling effect perceivable by the wearer as the wearer sweats.

78. The athletic garment claimed in claim 1, comprising a vent for ventilation.

79. The athletic garment claimed in claim 78, wherein the vent comprises a mesh material.

80. The athletic garment claimed in claim 51, wherein the baselayer garment is a pant, a sock, a compression sleeve, or a head cap.

81. An athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer, the athletic garment comprising:
   a) a surface to contact the protective athletic equipment; and
   b) a material comprising active elements to facilitate drying of the material as the wearer sweats.

82. An athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer, the athletic garment comprising:
   a) a surface to contact the protective athletic equipment; and
   b) a material to manage moisture as the wearer sweats, the material comprising:
      i. a base substance; and
ii. active elements connected to the base substance.

83. An athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer, the athletic garment comprising:
   a) a surface to contact the protective athletic equipment; and
   b) a material to manage moisture as the wearer sweats, a drying rate of the material being at least 2.1 ml/hr according to AATCC Test Method 201.

84. An athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer, the athletic garment comprising:
   a) a surface to contact the protective athletic equipment; and
   b) a material to manage moisture as the wearer sweats, a drying rate of the material being at least 15 ml/hr according to AATCC Test Method 200.

85. An athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer, the athletic garment comprising:
   a) a surface to contact the protective athletic equipment; and
   b) a material to manage moisture as the wearer sweats, a surface area of the material being at least 300 cm² per square centimeter of the material.

86. An athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer, the athletic garment comprising:
   a) a surface to contact the protective athletic equipment; and
   b) a material comprising active elements to manage moisture as the wearer sweats, a surface area of the active elements being at least 200 m² per gram of the active elements.
87. An athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer, the athletic garment comprising:
   a) a surface to contact the protective athletic equipment; and
   b) a material to manage moisture as the wearer sweats, the material being responsive to heat generated by the wearer’s body to vaporize liquid moisture in contact with the material.

88. An athletic garment configured to be worn by a wearer under or over protective athletic equipment worn by the wearer, the athletic garment comprising:
   a) a surface to contact the protective athletic equipment; and
   b) a material comprising active elements to provide a cooling effect perceivable by the wearer as the wearer sweats.

89. An article of protective athletic equipment to be worn by a wearer, the article of protective athletic equipment comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material comprising active elements to manage moisture as the wearer sweats.

90. The article of protective athletic equipment claimed in claim 89, wherein the active elements are configured to facilitate drying of the material.

91. The article of protective athletic equipment claimed in claim 89, wherein the material comprises a base substance and the active elements are connected to the base substance.

92. The article of protective athletic equipment claimed in claim 91, wherein the material is a fabric and the base substance is a fibrous substance.
93. The article of protective athletic equipment claimed in claim 91, wherein the material is a foam and the base substance is a cellular substance.

94. The article of protective athletic equipment claimed in claim 89, comprising protective padding and an inner liner, wherein the material constitutes at least part of a given one of the protective padding and the inner liner.

95. The article of protective athletic equipment claimed in claim 94, wherein the given one of the protective padding and the inner liner is the inner liner.

96. The article of protective athletic equipment claimed in claim 94, wherein the given one of the protective padding and the inner liner is the protective padding.

97. The article of protective athletic equipment claimed in claim 89, wherein the active elements are active particles.

98. The article of protective athletic equipment claimed in claim 97, wherein the active particles are microporous particles.

99. The article of protective athletic equipment claimed in claim 97, wherein the active particles comprise activated carbon.

100. The article of protective athletic equipment claimed in claim 89, wherein the active elements adsorb liquid moisture as the wearer sweats.

101. The article of protective athletic equipment claimed in claim 89, wherein a drying rate of the material is at least 2.1 ml/hr according to AATCC Test Method 201.
102. The article of protective athletic equipment claimed in claim 89, wherein a drying rate of the material is at least 2.3 ml/hr according to AATCC Test Method 201.

103. The article of protective athletic equipment claimed in claim 89, wherein a drying rate of the material is at least 2.5 ml/hr according to AATCC Test Method 201.

104. The article of protective athletic equipment claimed in claim 89, wherein a drying rate of the material is at least 15 ml/hr according to AATCC Test Method 200.

105. The article of protective athletic equipment claimed in claim 89, wherein a drying rate of the material is at least 20 ml/hr according to AATCC Test Method 200.

106. The article of protective athletic equipment claimed in claim 89, wherein a drying rate of the material is at least 25 ml/hr according to AATCC Test Method 200.

107. The article of protective athletic equipment claimed in claim 89, wherein a surface area of the material is at least 300 cm$^2$ per square centimeter of the material.

108. The article of protective athletic equipment claimed in claim 89, wherein a surface area of the material is at least 400 cm$^2$ per square centimeter of the material.

109. The article of protective athletic equipment claimed in claim 89, wherein a surface area of the material is at least 500 cm$^2$ per square centimeter of the material.
110. The article of protective athletic equipment claimed in claim 89, wherein a surface area of the material is at least 600 cm\(^2\) per square centimeter of the material.

111. The article of protective athletic equipment claimed in claim 89, wherein a surface area of the active elements is at least 200 m\(^2\) per gram of the active elements.

112. The article of protective athletic equipment claimed in claim 89, wherein a surface area of the active elements is at least 400 m\(^2\) per gram of the active elements.

113. The article of protective athletic equipment claimed in claim 89, wherein a surface area of the active elements is at least 800 m\(^2\) per gram of the active elements.

114. The article of protective athletic equipment claimed in claim 89, wherein the active elements are responsive to heat generated by the wearer’s body to vaporize liquid moisture in contact with the material.

115. The article of protective athletic equipment claimed in claim 91, wherein a specific heat capacity of the active elements is less than a specific heat capacity of the base substance.

116. The article of protective athletic equipment claimed in claim 91, wherein a molar absorptivity at an infrared wavelength of the active elements is greater than a molar absorptivity at the infrared wavelength of the base substance.
117. The article of protective athletic equipment claimed in claim 89, wherein the active elements are configured to exothermically react with liquid moisture.

118. The article of protective athletic equipment claimed in claim 90, wherein a drying rate of a first area of the article of protective athletic equipment is greater than a drying rate of a second area of the article of protective athletic equipment.

119. The article of protective athletic equipment claimed in claim 118, wherein the first area of the article of protective athletic equipment is disposed to overlie a first region of the wearer's body expected to generate more sweat than a second region of the wearer's body and the second area of the article of protective athletic equipment is disposed to overlie the second region of the wearer's body.

120. The article of protective athletic equipment claimed in claim 118, wherein a ratio of the drying rate of the first area of the article of protective athletic equipment over the drying rate of the second area of the article of protective athletic equipment is at least 1.1.

121. The article of protective athletic equipment claimed in claim 118, wherein a ratio of the drying rate of the first area of the article of protective athletic equipment over the drying rate of the second area of the article of protective athletic equipment is at least 1.3.

122. The article of protective athletic equipment claimed in claim 118, wherein a ratio of the drying rate of the first area of the article of protective athletic equipment over the drying rate of the second area of the article of protective athletic equipment is at least 1.5.
123. The article of protective athletic equipment claimed in claim 118, wherein a concentration of the active elements in the first area of the article of protective athletic equipment is greater than a concentration of the active elements in the second area of the article of protective athletic equipment.

124. The article of protective athletic equipment claimed in claim 123, wherein a ratio of the concentration of the active elements in the first area of the article of protective athletic equipment over the concentration of the active elements in the second area of the article of protective athletic equipment is at least 1.1.

125. The article of protective athletic equipment claimed in claim 123, wherein a ratio of the concentration of the active elements in the first area of the article of protective athletic equipment over the concentration of the active elements in the second area of the article of protective athletic equipment is at least 1.5.

126. The article of protective athletic equipment claimed in claim 123, wherein a ratio of the concentration of the active elements in the first area of the article of protective athletic equipment over the concentration of the active elements in the second area of the article of protective athletic equipment is at least 2.

127. The article of protective athletic equipment in claim 123, wherein the concentration of the active elements in the second area of the article of protective athletic equipment is substantially zero.

128. The article of protective athletic equipment claimed in claim 89, wherein a concentration of the active elements in a first area of the article of protective athletic equipment is greater than a concentration of the active elements in a second area of the article of protective athletic equipment.
129. The article of protective athletic equipment claimed in claim 128, wherein the concentration of the active elements in the second area of the article of protective athletic equipment is substantially zero.

130. The article of protective athletic equipment claimed in claim 89, wherein the active elements are configured to provide a cooling effect perceivable by the wearer as the wearer sweats.

131. The article of protective athletic equipment claimed in claim 130, wherein the material is configured to cool down when absorbing moisture as the wearer sweats.

132. The article of protective athletic equipment claimed in claim 130, wherein the material is configured to cool down when absorbing heat from the wearer's body as the wearer sweats.

133. The article of protective athletic equipment claimed in claim 130, wherein the active elements are swellable elements configured to swell when absorbing moisture to create the cooling effect.

134. The article of protective athletic equipment claimed in claim 130, wherein the active elements are phase-change elements configured to change phase when absorbing heat to create the cooling effect.

135. The article of protective athletic equipment claimed in claim 89, wherein the material is a first material, the active elements are first active elements configured to facilitate drying of the first material as the wearer sweats, and the article of protective athletic equipment comprises a second material comprising second active elements configured to provide a cooling effect perceivable by the wearer as the wearer sweats.
136. The article of protective athletic equipment claimed in claim 135, wherein
the second material is configured to cool down when absorbing moisture as
the wearer sweats.

137. The article of protective athletic equipment claimed in claim 135, wherein
the second material is configured to cool down when absorbing heat from the
wearer’s body as the wearer sweats.

138. The article of protective athletic equipment claimed in claim 135, wherein
the second material comprises a base substance and the second active
elements are connected to the base substance of the second material.

139. The article of protective athletic equipment claimed in claim 138, wherein
the second material is a fabric and the base substance of the second material
is a fibrous substance.

140. The article of protective athletic equipment claimed in claim 135, wherein
the second active elements are swellable elements configured to swell when
absorbing moisture to create the cooling effect.

141. The article of protective athletic equipment claimed in claim 135, wherein
the active elements are phase-change elements configured to change phase
when absorbing heat to create the cooling effect.

142. The article of protective athletic equipment claimed in claim 135, wherein
a quantity of the first material in the article of protective athletic equipment is
greater than a quantity of the second material in the article of protective
athletic equipment.
143. The article of protective athletic equipment claimed in claim 135, wherein the second material is disposed to be located adjacent to a quick-cooling spot of the wearer's body.

144. The article of protective athletic equipment claimed in claim 143, wherein the quick-cooling spot of the wearer's body is a neck, a wrist, an elbow, a forehead, a knee, an ankle, or an inner thigh.

145. The article of protective athletic equipment claimed in claim 135, wherein the article of protective athletic equipment is shoulder pads and the second material is disposed about a neck opening of the shoulder pads.

146. The article of protective athletic equipment claimed in claim 135, wherein the article of protective athletic equipment is a protective glove and the second material is disposed in a wrist portion of the protective glove.

147. The article of protective athletic equipment claimed in claim 135, wherein the article of protective athletic equipment is an arm pad and the second material is disposed in an elbow portion of the arm pad.

148. The article of protective athletic equipment claimed in claim 135, wherein the article of protective athletic equipment is a pant and the second material is disposed in a knee portion of the pant.

149. The article of protective athletic equipment claimed in claim 135, wherein the article of protective athletic equipment is a pant and the second material is disposed in an ankle portion of the pant.

150. The article of protective athletic equipment claimed in claim 135, wherein the article of protective athletic equipment is a pant and the second material is disposed in an inner thigh portion of the pant.
151. The article of protective athletic equipment claimed in claim 135, wherein the athletic garment is a helmet and the second material is disposed in a forehead portion of the helmet.

152. The article of protective athletic equipment claimed in claim 89, wherein the active elements comprise first active elements configured to facilitate drying of the material as the wearer sweats and second active elements configured to provide a cooling effect perceivable by the wearer as the wearer sweats.

153. The article of protective athletic equipment claimed in claim 89, comprising a vent for ventilation.

154. The article of protective athletic equipment claimed in claim 153, wherein the vent comprises an opening.

155. The article of protective athletic equipment claimed in claim 154, wherein the vent comprises a mesh material disposed within the opening.

156. The article of protective athletic equipment claimed in claim 153, wherein the vent comprises a channel to direct air flow.

157. The article of protective athletic equipment claimed in claim 89, wherein the article of protective athletic equipment is shoulder pads.

158. The article of protective athletic equipment claimed in claim 89, wherein the article of protective athletic equipment is an arm pad, a protective pant, a leg pad, a protective glove, or a helmet.
159. An article of protective athletic equipment to be worn by a wearer, the article of protective athletic equipment comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material comprising active elements to facilitate drying of the material as the wearer sweats.

160. An article of protective athletic equipment to be worn by a wearer, the article of protective athletic equipment comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material to manage moisture as the wearer sweats, the material comprising:
      i. a base substance; and
      ii. active elements connected to the base substance.

161. An article of protective athletic equipment to be worn by a wearer, the article of protective athletic equipment comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material to manage moisture as the wearer sweats, a drying rate of the material being at least 2.1 ml/hr according to AATCC Test Method 201.

162. An article of protective athletic equipment to be worn by a wearer, the article of protective athletic equipment comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material to manage moisture as the wearer sweats, a drying rate of the material being at least 15 ml/hr according to AATCC Test Method 200.
163. An article of protective athletic equipment to be worn by a wearer, the article of protective athletic equipment comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material to manage moisture as the wearer sweats, a surface area of the material being at least 300 cm² per square centimeter of the material.

164. An article of protective athletic equipment to be worn by a wearer, the article of protective athletic equipment comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material comprising active elements to manage moisture as the wearer sweats, a surface area of the active elements being at least 200 m² per gram of the active elements.

165. An article of protective athletic equipment to be worn by a wearer, the article of protective athletic equipment comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material to manage moisture as the wearer sweats, the material being responsive to heat generated by the wearer's body to vaporize liquid moisture in contact with the material.

166. An article of protective athletic equipment to be worn by a wearer, the article of protective athletic equipment comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material comprising active elements to provide a cooling effect perceivable by the wearer as the wearer sweats.

167. Athletic gear to be worn by a wearer, the athletic gear comprising:
a) an article of protective athletic equipment; and
b) an athletic garment to be worn under or over the article of protective athletic equipment;
wherein a given one of the article of protective athletic equipment and the athletic garment comprises a material comprising active elements to manage moisture as the wearer sweats.

168. The athletic gear claimed in claim 167, wherein the given one of the article of protective athletic equipment and the athletic garment is the athletic garment.

169. The athletic gear claimed in claim 167, wherein the given one of the article of protective athletic equipment and the athletic garment is the article of protective athletic equipment.

170. The athletic gear claimed in claim 168, wherein the article of protective athletic equipment comprises a material comprising active elements to manage moisture as the wearer sweats.

171. The athletic gear claimed in claim 170, wherein a drying rate of the material of the athletic garment in a given area of the athletic garment is different from a drying rate of the material of the article of protective athletic equipment in an overlapping area of the article of protective athletic equipment which overlaps the given area of the athletic garment.

172. The athletic gear claimed in claim 171, wherein the drying rate of the material of the athletic garment in the given area of the athletic garment is greater than the drying rate of the material of the article of protective athletic equipment in the overlapping area of the article of protective athletic equipment.
173. The athletic gear claimed in claim 170, wherein a concentration of the active elements of the material of the athletic garment in a given area of the athletic garment is different from a concentration of the active elements of the material of the article of protective athletic equipment in an overlapping area of the article of protective athletic equipment which overlaps the given area of the athletic garment.

174. Athletic gear to be worn by a wearer, the athletic gear comprising:
   a) an article of protective athletic equipment; and
   b) an athletic garment to be worn under or over the article of protective athletic equipment;
wherein a given one of the article of protective athletic equipment and the athletic garment comprises a material comprising active elements to facilitate drying of the material as the wearer sweats.

175. Athletic gear to be worn by a wearer, the athletic gear comprising:
   a) an article of protective athletic equipment; and
   b) an athletic garment to be worn under or over the article of protective athletic equipment;
wherein a given one of the article of protective athletic equipment and the athletic garment comprises a material to manage moisture as the wearer sweats, the material comprising:
   i. a base substance; and
   ii. active elements connected to the base substance.

176. Athletic gear to be worn by a wearer, the athletic gear comprising:
   a) an article of protective athletic equipment; and
   b) an athletic garment to be worn under or over the article of protective athletic equipment;
wherein a given one of the article of protective athletic equipment and the athletic garment comprises a material to manage moisture as the wearer
sweats, a drying rate of the material being at least 2.1 ml/hr according to AATCC Test Method 201.

177. Athletic gear to be worn by a wearer, the athletic gear comprising:
   a) an article of protective athletic equipment; and
   b) an athletic garment to be worn under or over the article of protective athletic equipment;
   wherein a given one of the article of protective athletic equipment and the athletic garment comprises a material to manage moisture as the wearer sweats, a drying rate of the material being at least 15 ml/hr according to AATCC Test Method 200.

178. Athletic gear to be worn by a wearer, the athletic gear comprising:
   a) an article of protective athletic equipment; and
   b) an athletic garment to be worn under or over the article of protective athletic equipment;
   wherein a given one of the article of protective athletic equipment and the athletic garment comprises a material to manage moisture as the wearer sweats, a surface area of the material being at least 300 cm² per square centimeter of the material.

179. Athletic gear to be worn by a wearer, the athletic gear comprising:
   a) an article of protective athletic equipment; and
   b) an athletic garment to be worn under or over the article of protective athletic equipment;
   wherein a given one of the article of protective athletic equipment and the athletic garment comprises a material comprising active elements to manage moisture as the wearer sweats, a surface area of the active elements being at least 200 m² per gram of the active elements.

180. Athletic gear to be worn by a wearer, the athletic gear comprising:
a) an article of protective athletic equipment; and
b) an athletic garment to be worn under or over the article of protective athletic equipment;
wherein a given one of the article of protective athletic equipment and the athletic garment comprises a material to manage moisture as the wearer sweats, the material being responsive to heat generated by the wearer's body to vaporize liquid moisture in contact with the material.

181. Athletic gear to be worn by a wearer, the athletic gear comprising:
   a) an article of protective athletic equipment, the article of protective athletic equipment comprising a vent; and
   b) an athletic garment to be worn under or over the article of protective athletic equipment, the athletic garment comprising a vent;
   wherein the vent of the article of protective athletic equipment and the vent of the athletic garment overlap when the athletic gear is worn by the wearer.

182. A skate to be worn by a wearer, the skate comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material comprising active elements to manage moisture as the wearer sweats.

183. The skate claimed in claim 182, wherein the active elements are configured to facilitate drying of the material.

184. The skate claimed in claim 182, wherein the material comprises a base substance and the active elements are connected to the base substance.

185. The skate claimed in claim 184, wherein the material is a fabric and the base substance is a fibrous substance.
186. The skate claimed in claim 184, wherein the material is a foam and the base substance is a cellular substance.

187. The skate claimed in claim 182, comprising an inner liner, wherein the material constitutes at least part of the inner liner.

188. The skate claimed in claim 182, comprising a tongue, wherein the material constitutes at least part of the tongue.

189. The skate claimed in claim 182, wherein the active elements are active particles.

190. The skate claimed in claim 189, wherein the active particles are microporous particles.

191. The skate claimed in claim 189, wherein the active particles comprise activated carbon.

192. The skate claimed in claim 182, wherein the active elements adsorb liquid moisture as the wearer sweats.

193. The skate claimed in claim 182, wherein a drying rate of the material is at least 2.1 ml/hr according to AATCC Test Method 201.

194. The skate claimed in claim 182, wherein a drying rate of the material is at least 2.3 ml/hr according to AATCC Test Method 201.

195. The skate claimed in claim 182, wherein a drying rate of the material is at least 2.5 ml/hr according to AATCC Test Method 201.
196. The skate claimed in claim 182, wherein a drying rate of the material is at least 15 ml/hr according to AATCC Test Method 200.

197. The skate claimed in claim 182, wherein a drying rate of the material is at least 20 ml/hr according to AATCC Test Method 200.

198. The skate claimed in claim 182, wherein a drying rate of the material is at least 25 ml/hr according to AATCC Test Method 200.

199. The skate claimed in claim 182, wherein a surface area of the material is at least 300 cm² per square centimeter of the material.

200. The skate claimed in claim 182, wherein a surface area of the material is at least 400 cm² per square centimeter of the material.

201. The skate claimed in claim 182, wherein a surface area of the material is at least 500 cm² per square centimeter of the material.

202. The skate claimed in claim 182, wherein a surface area of the material is at least 600 cm² per square centimeter of the material.

203. The skate claimed in claim 182, wherein a surface area of the active elements is at least 200 m² per gram of the active elements.

204. The skate claimed in claim 182, wherein a surface area of the active elements is at least 400 m² per gram of the active elements.

205. The skate claimed in claim 182, wherein a surface area of the active elements is at least 800 m² per gram of the active elements.
206. The skate claimed in claim 182, wherein the active elements are responsive to heat generated by the wearer's body to vaporize liquid moisture in contact with the material.

207. The skate claimed in claim 184, wherein a specific heat capacity of the active elements is less than a specific heat capacity of the base substance.

208. The skate claimed in claim 184, wherein a molar absorptivity at an infrared wavelength of the active elements is greater than a molar absorptivity at the infrared wavelength of the base substance.

209. The skate claimed in claim 182, wherein the active elements are configured to exothermically react with liquid moisture.

210. The skate claimed in claim 182, wherein a drying rate of a first area of the skate is greater than a drying rate of a second area of the skate.

211. The skate claimed in claim 210, wherein the first area of the skate is disposed to overlie a first region of the wearer's body expected to generate more sweat than a second region of the wearer's body and the second area of the skate is disposed to overlie the second region of the wearer's body.

212. The skate claimed in claim 210, wherein a ratio of the drying rate of the first area of the skate over the drying rate of the second area of the skate is at least 1.1.

213. The skate claimed in claim 210, wherein a ratio of the drying rate of the first area of the skate over the drying rate of the second area of the skate is at least 1.3.
214. The skate claimed in claim 210, wherein a ratio of the drying rate of the first area of the skate over the drying rate of the second area of the skate is at least 1.5.

215. The skate claimed in claim 210, wherein a concentration of the active elements in the first area of the skate is greater than a concentration of the active elements in the second area of the skate.

216. The skate claimed in claim 215, wherein a ratio of the concentration of the active elements in the first area of the skate over the concentration of the active elements in the second area of the skate is at least 1.1.

217. The skate claimed in claim 215, wherein a ratio of the concentration of the active elements in the first area of the skate over the concentration of the active elements in the second area of the skate is at least 1.5.

218. The skate claimed in claim 215, wherein a ratio of the concentration of the active elements in the first area of the skate over the concentration of the active elements in the second area of the skate is at least 2.

219. The skate in claim 215, wherein the concentration of the active elements in the second area of the skate is substantially zero.

220. The skate claimed in claim 182, wherein a concentration of the active elements in a first area of the skate is greater than a concentration of the active elements in a second area of the skate.

221. The skate claimed in claim 220, wherein the concentration of the active elements in the second area of the skate is substantially zero.
The skate claimed in claim 182, wherein the active elements are configured to provide a cooling effect perceivable by the wearer as the wearer sweats.

The skate claimed in claim 222, wherein the material is configured to cool down when absorbing moisture as the wearer sweats.

The skate claimed in claim 222, wherein the material is configured to cool down when absorbing heat from the wearer’s body as the wearer sweats.

The skate claimed in claim 222, wherein the active elements are swellable elements configured to swell when absorbing moisture to create the cooling effect.

The skate claimed in claim 222, wherein the active elements are phase-change elements configured to change phase when absorbing heat to create the cooling effect.

The skate claimed in claim 182, wherein the material is a first material, the active elements are first active elements configured to facilitate drying of the first material as the wearer sweats, and the skate comprises a second material comprising second active elements configured to provide a cooling effect perceivable by the wearer as the wearer sweats.

The skate claimed in claim 227, wherein the second material is configured to cool down when absorbing moisture as the wearer sweats.

The skate claimed in claim 227, wherein the second material is configured to cool down when absorbing heat from the wearer’s body as the wearer sweats.
230. The skate claimed in claim 227, wherein the second material comprises a base substance and the second active elements are connected to the base substance of the second material.

231. The skate claimed in claim 230, wherein the second material is a fabric and the base substance of the second material is a fibrous substance.

232. The skate claimed in claim 227, wherein the second active elements are swellable elements configured to swell when absorbing moisture to create the cooling effect.

233. The skate claimed in claim 227, wherein the active elements are phase-change elements configured to change phase when absorbing heat to create the cooling effect.

234. The skate claimed in claim 227, wherein a quantity of the first material in the skate is greater than a quantity of the second material in the skate.

235. The skate claimed in claim 227, wherein the second material is disposed to be located adjacent to an ankle of the wearer.

236. The skate claimed in claim 182, wherein the active elements comprise first active elements configured to facilitate drying of the material as the wearer sweats and second active elements configured to provide a cooling effect perceivable by the wearer as the wearer sweats.

237. A skate to be worn by a wearer, the skate comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material comprising active elements to facilitate drying of the material as the wearer sweats.
238. A skate to be worn by a wearer, the skate comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material to manage moisture as the wearer sweats, the material
      comprising:
      i. a base substance; and
      ii. active elements connected to the base substance.

239. A skate to be worn by a wearer, the skate comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material to manage moisture as the wearer sweats, a drying rate of the
      material being at least 2.1 ml/hr according to AATCC Test Method 201.

240. A skate to be worn by a wearer, the article of protective athletic equipment
      comprising:
      a) an inner surface for facing towards the wearer;
      b) an outer surface for facing away from the wearer; and
      c) a material to manage moisture as the wearer sweats, a drying rate of the
         material being at least 15 ml/hr according to AATCC Test Method 200.

241. A skate to be worn by a wearer, the skate comprising:
      a) an inner surface for facing towards the wearer;
      b) an outer surface for facing away from the wearer; and
      c) a material to manage moisture as the wearer sweats, a surface area of the
         material being at least 300 cm² per square centimeter of the material.

242. A skate to be worn by a wearer, the skate comprising:
      a) an inner surface for facing towards the wearer;
      b) an outer surface for facing away from the wearer; and
c) a material comprising active elements to manage moisture as the wearer sweats, a surface area of the active elements being at least 200 m² per gram of the active elements.

243. A skate to be worn by a wearer, the skate comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material to manage moisture as the wearer sweats, the material being responsive to heat generated by the wearer's body to vaporize liquid moisture in contact with the material.

244. A skate to be worn by a wearer, the skate comprising:
   a) an inner surface for facing towards the wearer;
   b) an outer surface for facing away from the wearer; and
   c) a material comprising active elements to provide a cooling effect perceivable by the wearer as the wearer sweats.
**INTERNATIONAL SEARCH REPORT**

**International application No.**
PCT/US2014/050934

**A. CLASSIFICATION OF SUBJECT MATTER**

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**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):

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<td>A41B 3/7125</td>
<td>A63B 7/08</td>
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**USPC - 2/16, 22, 455, 459, 463; 36/1 17.3 (keyword delimited)**

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase, Google Patent, Google

Search terms used: moisture protective garment, wick anti moisture, AATCC drying test method, quick cooling, activelywick

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>US 4,754,499 A (PIRIE) 05 July 1988 (05.07.1988) entire document</td>
<td>31-34</td>
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</table>

Further documents are listed in the continuation of Box C.

- **"A"** special category of cited documents: 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
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**Date of the actual completion of the international search:** 05 November 2014

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