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(54) **TIGHTS**

(57) Tights include a heat retaining fabric and a heat dissipating fabric. The heat retaining fabric (2a, 2b, 3a, 3b) is configured to be arranged in portions of the front of the tights, each of which covers the entire belly of the quadriceps femoris muscle, and in portions of the back of the tights, each of which covers the entire belly of each of the biceps femoris muscle, the semimembranosus muscle, and the semitendinosus muscle, when the tights are worn. The heat dissipating fabric (5) is configured to be arranged in a portion of the tights that goes all around the waist and covers the ilium, the lower abdomen, and the bellies of the gluteus maximus muscle and the gluteus medius muscle, when the tights are worn. The heat retaining fabric is not arranged in the portion of the tights that goes all around the waist. With this configuration, the tights distinguish the portion that is designed to retain heat during exercise from the portion that is designed to dissipate heat during exercise. The heat retaining fabric and the heat dissipating fabric are arranged in the portions of the tights that are to be used for heat retention and heat dissipation, respectively.

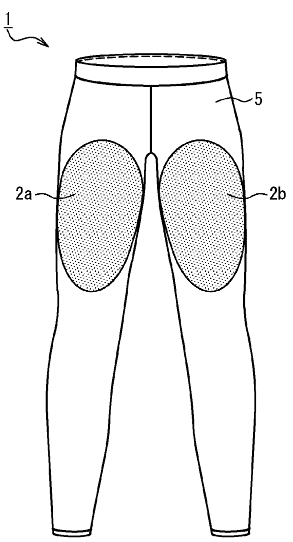

FIG. 1A

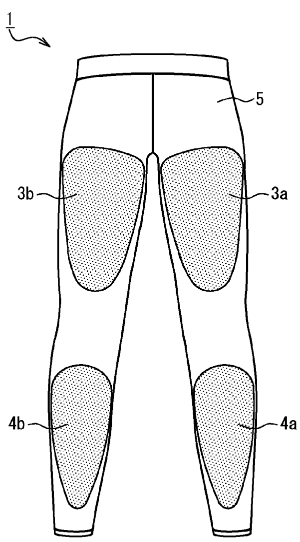

FIG. 1B

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to tights suitable for sports.

2. Description of Related Art

[0002] Tights are a piece of clothing that is worn on the lower part of the human body. Tights can be used as underwear, inner garments, etc. in cold conditions and are also suitable for sports activities. In many sports including, e.g., baseball, soccer, rugby, marathons, running, walking, cycling, mountain climbing, and tennis, warm-ups are essential to improve athletic performance. Patent Document 1 proposes a garment that has the function of keeping the legs warm. Patent Document 2 proposes a garment for the upper body that includes a heat retention region extending from the forearm to the hand, and a garment for the lower body that includes a heat retention region covering the buttocks and the hamstrings. Patent Document 3 proposes a leg wear that is made of a heat insulating material, but partially has a heat dissipating portion.

Prior Art Documents

Patent Documents

[0003]

Patent Document 1: JP 2005-248389 A
Patent Document 2: JP 2010-535296 A
Patent Document 3: JP 2020-133093 A

SUMMARY OF THE INVENTION

[0004] However, the above conventional techniques fail to make a proper distinction between the portion of clothing that should be designed to . retain heat during exercise and the portion of the clothing that should be designed to dissipate heat during exercise. In this regard, further improvements are required in the conventional techniques.

[0005] To solve the conventional problems, the present invention provides tights that distinguish the portion that is designed to retain heat during exercise from the portion that is designed to dissipate heat during exercise, in which a heat retaining fabric and a heat dissipating fabric are arranged in the portions of the tights that are to be used for heat retention and heat dissipation, respectively.

[0006] The present invention relates to tights that include a heat retaining fabric and a heat dissipating fabric. The heat retaining fabric (2a, 2b, 3a, 3b) is configured to be arranged in portions of a front of the tights, each of which covers the entire belly of the quadriceps femoris muscle, and in portions of a back of the tights, each of which covers the entire belly of each of the biceps femoris muscle, the semimembranosus muscle, and the semitendinosus muscle, when the tights are worn. The heat dissipating fabric (5) is configured to be arranged in a portion of the tights that goes all around the waist and covers the ilium, the lower abdomen, and the bellies of the gluteus maximus muscle and the gluteus medius muscle, when the tights are worn. The heat retaining fabric is not arranged in the portion of the tights that goes all around the waist.

[0007] In the tights of the present invention, the heat retaining fabric is configured to be arranged in the portions of the front, each of which covers the entire belly of the quadriceps femoris muscle, and in the portions of the back, each of which covers the entire belly of each of the biceps femoris muscle, the semimembranosus muscle, and the semitendinosus muscle, when the tights are worn. The heat dissipating fabric is configured to be arranged in the portion that goes all around the waist and covers the ilium, the lower abdomen, and the bellies of the gluteus maximus muscle and the gluteus medius muscle, when the tights are worn. The heat retaining fabric is not arranged in the portion that goes all around the waist. With this configuration, the tights can warm the agonist muscles during exercise to improve the power output of the muscles and to promote supercompensation, and at the same time they can dissipate heat from the heat dissipation areas of the body to reduce an increase in the core temperature. Consequently, the tights allow the wearer to continue exercise without reducing the thermal comfort. Moreover, the tights serve to shorten the warm-up time and also enable the body to prepare for taking part in a sport.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

[FIG. 1] FIGS. 1A and 1B are a schematic front view and a schematic back view of tights in an embodiment of the present invention, respectively.
[FIG. 2] FIGS. 2A and 2B are a schematic front view and a schematic back view of tights in another embodiment of the present invention, respectively.
[FIG. 3] FIGS. 3A and 3B are a schematic front view and a schematic back view of tights in another embodiment of the present invention, respectively.
[FIG. 4] FIGS. 4A and 4B are a schematic front view and a schematic back view of tights in another embodiment of the present invention, respectively.
[FIG. 5] FIGS. 5A, 5B, and 5C are a schematic front view, a schematic side view, and a schematic back view of long tights in another embodiment of the present invention, respectively.
[FIG. 6] FIGS. 6A, 6B, and 6C are a schematic front

view, a schematic side view, and a schematic back view of short tights in another embodiment of the present invention, respectively.

[FIG. 7] FIGS. 7A, 7B, and 7C are a schematic front view, a schematic side view, and a schematic back view of half tights in another embodiment of the present invention, respectively.

[FIG. 8] FIG. 8 is a muscle diagram of the lower part of the human body.

[FIG. 9] FIG. 9 is a skeleton diagram of the lumbar region of the human body.

DETAILED DESCRIPTION OF THE INVENTION

[0009] Physical exercise is necessary to improve physical performance. During exercise, the temperature of muscles is increased, which may improve the power output of the muscles and promote supercompensation. Since muscles are composed of chemical substances, an increase in muscle temperature leads to a high energy state, in which a chemical reaction is accelerated so that neurotransmission and muscle movement can be enhanced. If the whole body is warmed up, the muscle temperature may be increased to improve the power output of the muscles and to promote supercompensation. However, warming up the whole body causes a rise in temperature inside the body (i.e., the core temperature), and the body feels hot. This may reduce the thermal comfort and result in low physical performance. Assuming that people continue to exercise while keeping the body warm, they can suffer heat syncope, heat cramps, heat exhaustion, or heatstroke due to the increased core temperature, and will find it difficult to do the exercise.

[0010] The present invention provides clothing that allows the wearer to continue exercise without reducing the thermal comfort. For this purpose, the clothing of the present invention can warm the agonist muscles during exercise to improve the power output of the muscles and to promote supercompensation, and at the same time it can dissipate heat from the heat dissipation areas of the body to reduce an increase in the core temperature.

[0011] The present invention relates to tights that include a heat retaining fabric and a heat dissipating fabric. The heat retaining fabric is configured to be arranged in portions of the tights, each of which covers at least a part of the quadriceps femoris muscle, and the heat dissipating fabric is configured to be arranged in a portion of the tights that covers at least a part of the ilium, when the tights are worn. The arrangement of the heat retaining fabric in the portions, each of which covers at least a part of the quadriceps femoris muscle, which is the main muscle of the lower body, can improve physical performance for various movements. The arrangement of the heat dissipating fabric in the portion that covers at least a part of the ilium can efficiently cool the heat dissipation area of the body which is in the vicinity of the ilium. The ilium is located near the common femoral artery and the inferior vena cava. These blood vessels are large and likely to be affected by the heat dissipating fabric, and thus can be efficiently cooled. It is preferable that the heat dissipating fabric is configured to be arranged in a portion of the tights that covers at least a part of the external iliac vein running along the ilium, when the tights are worn. The external iliac vein is a large blood vessel located in the vicinity of the inferior vena cava. Accordingly, the external iliac vein is also likely to be affected by the heat dissipating fabric and can be efficiently cooled. This embodiment is effective for short tights, half tights above the knee, three-quarter tights below the knee, and half pants. The tights of the present invention serve to shorten the warm-up time and also enable the body to prepare for taking part in a sport while saving enough energy for the sport. Any fabric used for normal sports tights may be arranged in the remaining portion of the tights other than the heat retaining fabric portion and the heat dissipating fabric portion. The same is true for other examples of the tights. The present specification uses the term tights as including pants.

[0012] In the present invention, it is preferable that the heat retaining fabric is configured to be further arranged in portions of the tights, each of which covers at least one selected from the biceps femoris muscle, the semimembranosus muscle, and the semitendinosus muscle, when the tights are worn. This arrangement can improve the reactivity, operativity, and muscular strength of the lower limbs. This embodiment is effective for short tights, half tights above the knee, and three-quarter tights below the knee.

[0013] It is also preferable that the heat retaining fabric is configured to be further arranged in portions of the tights, each of which covers at least a part of the triceps surae muscle, when the tights are worn. This arrangement can improve the reactivity, operativity, and muscular strength of the lower limbs. This embodiment is effective for ankle-length long tights.

[0014] In the present invention, it is preferable that the heat dissipating fabric is configured to be further arranged in a portion of the tights that covers at least one selected from the gluteus maximus muscle and the gluteus medius muscle, when the tights are worn. This arrangement can reduce an increase in the core temperature of the body. This embodiment is effective for any form of tights.

[0015] In the present invention, it is preferable that the heat dissipating fabric is configured to be further arranged in portions of the tights, each of which covers at least a part of the small saphenous vein in the vicinity of the Achilles tendon of the lower leg, when the tights are worn. The arrangement of the heat dissipating fabric in the portions, each of which covers at least a part of the small saphenous vein in the vicinity of the Achilles tendon of the lower leg, may be advantageous to efficiently cool the ends of the lower limbs. The small saphenous vein is a large blood vessel in the lower leg and is connected to the femoral vein. When the small saphenous vein is cooled by the heat dissipating fabric, the blood flowing through it is also cooled. The cooled blood then flows into the femoral vein, so that the femoral vein can be cooled. This embodiment is effective for ankle-length long tights and warm-up pants.

[0016] In the present invention, the space between the skin and the inner surface of the clothing is preferably as small as possible. The space is preferably 20 mm or less, and more preferably 10 mm or less. Alternatively, the inner surface of the clothing may be in direct contact with the skin. Thus, the muscles in the desired region can easily be warmed by the heat retaining fabric while reducing heat loss.

[0017] The heat retaining fabric preferably has water absorbability. When the muscle temperature is increased, sweat (in the liquid phase) comes out on the skin surface. A lack of water absorbability is undesirable because sweat may remain on the skin surface and absorb heat from the muscles, resulting in a decrease in the muscle temperature. The water absorbability is preferably 60 seconds or less, and more preferably 30 seconds or less, as measured in accordance with JIS L 1907 (dropping method).

[0018] The heat retaining fabric covers preferably 50% or more, and more preferably 70% or more of the specified muscle in the body region when the tights are worn. This ensures that the main part of the specified muscle becomes warm. In the present specification, the specified muscle represents the belly of the muscle and does not include the tendon of the muscle.

[0019] The amount of heat dissipation of the heat retaining fabric is preferably as small as possible. The amount of heat dissipation is preferably 2.0 W or less, and more preferably 1.8 W or less. The amount of heat dissipation is determined by measuring the power consumption of an evaluation device for heat retention properties ("KES-F7" manufactured by KATO TECH CO., LTD.) in accordance with JIS L 1927, where ΔT is set to 20°C. In this case, the power consumption can be used to quantify the phenomenon of heat dissipation through the fabric. The smaller the value of the power consumption, the better the ability of the fabric to keep warmth.

[0020] Preferred examples of the heat retaining fabric include the following.

(1) Moisture-absorbent heat-generating fabric
A moisture-absorbent heat-generating fabric contains highly crosslinked polyacrylate fibers. The highly crosslinked polyacrylate fibers alone can generate enough heat to burn the skin, and therefore are usually blended with polyester fibers so that the amount of the highly crosslinked polyacrylate fibers is 10 to 40% by mass. Then, the blended fibers are twisted together to form a spun yarn. The spun yarn is used to make a woven or knitted fabric. The moisture-absorbent heat-generating fabric is now on the market as a trade name "BREATH THERMO" manufactured by Mizuno Corporation.

(2) Fabric containing fiber with low thermal conductivity
Fibers with low thermal conductivity include, e.g., wool, nylon, and polyester whose thermal conductivities are 0.19, 0.22, and 0.25 kcal $m^{-1}h^{-1}°C^{-1}$, respectively (Fiber Handbook, Third Edition, edited by the Society of Fiber Science and Technology, Japan, published by MARUZEN Co., Ltd., December 15, 2004, page 462). The fibers with low thermal conductivity may also include polypropylene whose thermal conductivity is 0.12 W/m·°C (Plastic Data Book, published by Kogyo Chosakai Publishing Co., Ltd., January 20, 2006, page 60).

(3) Fabric containing heat storage fiber
Heat storage fibers are produced by incorporating a heat storage material into a polymer and spinning the mixture. Examples of the heat storage material include ceramic particles, graphite silica powder, volcanic ash, and tungsten powder.

(4) Fluffy fabric
A fluffy fabric may be, e.g., a boa fabric, a pile fabric, a raised fabric, a stitched double fabric, or a stretchy knitted fabric made of a false twist crimped yarn.

(5) Point-contact fabric
A point-contact fabric makes point contact with the skin of the human body. This structure can be formed by, e.g., weaving, knitting, or embossing.

(6) Vapor-deposited fabric having radiation effect
A vapor-deposited fabric having a radiation effect may be produced by depositing meal such as aluminum on fibers or fabric.

(7) Fabric with low breathability
A fabric with low breathability preferably has an air permeability of 150 cm^3/cm^2·sec or less, as measured in accordance with JIS L 1096 (Frajour method). Heat retention increases with a decrease in air permeability. However, if the air permeability of a fabric is too low, the fabric becomes sticky when wet. Therefore, the lower limit of the air permeability is preferably 1 cm^3/cm^2·sec or more.

[0021] The above fabrics may be used alone or in combination of two or more.

[0022] The heat dissipating fabric is configured to be arranged in a portion of the tights that covers at least a part of the ilium, and preferably in a portion of the tights that covers at least a part of the external iliac vein running along the ilium. The external iliac vein is connected to the inferior vena cava, which is one of the largest blood vessels just below the heart. When the external iliac vein is cooled by the heat dissipating fabric, the blood flowing through it is also cooled. The cooled blood efficiently returns to the heart, which helps to prevent an increase in the core temperature. It is more preferable that the heat dissipating fabric is also configured to be arranged in portions of the tights, each of which covers at least a part of the femoral vein that branches from the external iliac vein. This arrangement can facilitate more efficient cooling of blood. It is further preferable that the heat dissipating fabric is also configured to be arranged in portions of the tights, each of which covers at least a part of the small saphenous vein that branches from the femoral vein. This arrangement can facilitate more efficient cooling of blood. The above blood vessels may be cooled by the outside air if they are not covered with the tights or pants. The heat dissipating fabric covers preferably 50% or more, and more preferably 70% or more of the specified area in the body region when the tights are worn. This ensures that heat can be efficiently released from the main part of the specified area.

[0023] The amount of heat dissipation of the heat dissipating fabric is preferably as large as possible. The amount of heat dissipation is preferably 1.0 W or more, and more preferably 1.2 W or more. The amount of heat dissipation is determined by measuring the power consumption of an evaluation device for heat retention properties ("KES-F7" manufactured by KATO TECH CO., LTD.) in accordance with JIS L 1927, where ΔT is set to 20°C. In this case, the power consumption can be used to quantify the phenomenon of heat dissipation through the fabric. The larger the value of the power consumption, the better the ability of the fabric to dissipate heat.

[0024] Preferred examples of the heat dissipating fabric include the following.

(1) Fabric containing quick-drying fiber

[0025] A fabric containing quick-drying fibers may be, e.g., a water-absorbent quick-drying polyester fabric. This fabric allows moisture such as sweat to evaporate easily and dissipates the body heat due to latent heat of evaporation of the moisture. The water-absorbent quick-drying polyester fabric may be obtained by, e.g., treating fibers with a hydrophilic polyester resin. A hydrophilic polyester resin treatment agent to be used has the same function as a disperse dye, and at least a part of the treatment agent is absorbed in the fibers (exhaustive diffusion). The hydrophilic polyester resin treatment agent may contain a linear copolymer, and preferably a block copolymer, in which the polyester end groups and the hydrophilic end groups are bonded to each other. The molecular weight is preferably 5000 to 8000, and more preferably 6000 to 7000. The polymerization ratio of the polyester group to the hydrophilic group is preferably 90/10 to 10/90, and more preferably 60/40 to 20/80. The hydrophilic group may be, e.g., polyethylene glycol, sodium 5-sulfoisophthalate, or trimellitic anhydride, and is more preferably polyethylene glycol. Such a treatment agent may be, e.g., KMZ-902 (product number) manufactured by TAKAMATSU OIL & FAT CO., LTD.

[0026] The water absorbability is preferably 20 seconds or less, and more preferably 10 seconds or less, as measured in accordance with JIS L 1907 (dropping method). The quick-drying properties are evaluated in accordance with ISO 17617-2014 A1, and the drying time is preferably 80 minutes or less, and more preferably 70 minutes or less. The fabric with these features absorbs and diffuses moisture away from the skin, dries quickly, and dissipates the body heat due to latent heat of evaporation of the moisture, thereby keeping the fabric temperature low.

(2) Fabric containing fiber with high thermal conductivity

[0027] Fibers with high thermal conductivity include, e.g., cotton with a thermal conductivity of 0.56 kcal $m^{-1}h^{-1}{}^{\circ}C^{-1}$ and rayon having about the same thermal conductivity as cotton (Fiber Handbook, Third Edition, edited by the Society of Fiber Science and Technology, Japan, published by MARUZEN Co., Ltd., December 15, 2004, page 462). The fibers with high thermal conductivity may also include polyethylene whose thermal conductivity is 0.33 W/m·°C for LDPE and 0.46 to 0.50 W/m·°C for HDPE (Plastic Data Book, published by Kogyo Chosakai Publishing Co., Ltd., January 20, 2006, page 60). Moreover, ethylene vinyl alcohol fibers derived from ethylene fibers may also be used, which are now on the market as a trade name "SOPHISTA" manufactured by Kuraray Co., Ltd.

(3) Thin fabric

[0028] A fabric with a relatively small thickness compared to the heat retaining fabric may also be used. The thickness of the heat dissipating fabric is preferably at least 0.1 mm, more preferably at least 0.13 mm, and further preferably at least 0.15 mm smaller than that of the heat retaining fabric.

(4) Fabric with high breathability

[0029] A fabric with high breathability preferably has an air permeability of 100 cm^3/cm^2·sec or more, as measured in accordance with JIS L 1096 (Frajour method). Heat dissipation increases with an increase in air permeability. However, if the air permeability of a fabric is too high, the strength of the fabric is reduced. Therefore, the upper limit of the air permeability is preferably 500 cm^3/cm^2·sec or less.

(5) Fabric containing cooling fiber

[0030] Cellulose fibers such as cotton and rayon are hydrophilic fibers and have the property that once the fibers absorb moisture, they do not release it. Moreover, the cellulose fibers are cold when wet. For this reason, a fabric containing these cooling fibers may also be used.

[0031] The above fabrics may be used alone or in combination of two or more. In particular, the water-absorbent quick-drying polyester fabric is preferred.

[0032] The heat retaining fabric and the heat dissipating fabric preferably have the following relationship.

(1) Difference in thickness: heat retaining fabric - heat dissipating fabric > 0.1 mm

[0033] A thick fabric is likely to trap dead air, which can enhance the thermal insulation properties of clothing. When the heat retaining fabric is thicker than the heat dissipating fabric, heat is not easily transferred from the inside to the outside of clothing. This configuration can increase the muscle temperature and also reduce an increase in the core temperature of the body. If the thickness difference is 0.1 mm or less, a difference in thermal insulation performance between the two fabrics becomes small, and it may not be possible to appropriately increase the muscle temperature or to maintain the core temperature. Clothing can be designed to be adaptable to the environment by reducing the thickness of both the heat retaining fabric and the heat dissipating fabric in a hot environment and by increasing the thickness of both the heat retaining fabric and the heat dissipating fabric in a cold environment. In addition, setting the difference in the thickness between the heat retaining fabric and the heat dissipating fabric to more than 0.1 mm can impart functionality to the clothing.

(2) Difference in amount of heat dissipation: heat dissipating fabric - heat retaining fabric > 0.3 W

[0034] The amount of heat dissipation is determined by measuring the power consumption of an evaluation device for heat retention properties ("KES-F7" manufactured by KATO TECH CO., LTD.) in accordance with JIS L 1927, where ΔT is set to 20°C. In this case, the power consumption can be used to quantify the phenomenon of heat dissipation through the fabric. The larger the value of the power consumption, the better the ability of the fabric to dissipate heat. If the difference in the amount of heat dissipation is 0.3 W or less, it may not be possible to appropriately increase the muscle temperature or to maintain the core temperature. Clothing can be designed to be adaptable to the environment by increasing the amount of heat dissipation of both the heat retaining fabric and the heat dissipating fabric in a hot environment and by reducing the amount of heat dissipation of both the heat retaining fabric and the heat dissipating fabric in a cold environment. In addition, setting the difference in the amount of heat dissipation between the heat retaining fabric and the heat dissipating fabric to more than 0.3 W can impart functionality to the clothing.

(3) Difference in air permeability: heat dissipating fabric - heat retaining fabric > 50 $cm^3/cm^2 \cdot sec$

[0035] The air permeability is determined by the air permeability test in accordance with JIS L 1096. Heat dissipation increases with an increase in air permeability because air can easily pass through the fabric. If the difference in the air permeability is 50 $cm^3/cm^2 \cdot sec$ or less, it may not be possible to appropriately increase the muscle temperature or to maintain the core temperature. Clothing can be designed to be adaptable to the environment by increasing the air permeability of both the heat retaining fabric and the heat dissipating fabric in a hot environment and by reducing the air permeability of both the heat retaining fabric and the heat dissipating fabric in a cold environment. In addition, setting the difference in the air permeability between the heat retaining fabric and the heat dissipating fabric to more than 50 $cm^3/cm^2 \cdot sec$ can impart functionality to the clothing.

[0036] (4) In particular, a combination of the moisture-absorbent heat-generating fabric containing highly crosslinked polyacrylate fibers (i.e., the heat retaining fabric) and the water-absorbent quick-drying polyester fabric (i.e., the heat dissipating fabric) is preferably used. The human body produces moisture in the form of perspiration on the skin surface during exercise. The moisture-absorbent heat-generating fabric absorbs the moisture and converts it into heat, and thus can achieve high heat retention performance. On the other hand, the water-absorbent quick-drying polyester fabric absorbs the moisture and allows it to evaporate, and thus can achieve high heat dissipation performance due to latent heat of evaporation of the moisture.

[0037] In the tights of the present invention, the space between the skin and the inner surface of the clothing is preferably 20 mm or less, and more preferably 10 mm or less. Alternatively, the inner surface of the clothing may be in direct contact with the skin. Thus, the muscles in the desired region can easily be warmed by the heat retaining fabric while reducing heat loss. Moreover, heat dissipation through blood flow in the desired region can be accelerated by the heat dissipating fabric, thereby reducing an increase in the core temperature.

[0038] There are several ways of producing the clothing of the present invention. For example, the clothing can be made by sewing pieces of the heat retaining fabric and the heat dissipating fabric together. Alternatively, the entire clothing may be made of the heat dissipating fabric, and a piece of the heat retaining fabric may be sewed on the target portion of this clothing. Moreover, the entire clothing may be made of the heat retaining fabric, and part of the fabric surface that corresponds to the target portion of the clothing may be melted or cut. The pieces of fabric may be joined together, e.g., by stitching, hot-melt adhesive, or welding.

[0039] A garment that fits tightly to the body, leaving almost no space inside the garment, is called a compression garment. The compression garment can efficiently maintain the muscle temperature and increase blood flow for heat dissipation. The tights of the present invention may be provided as compression-type tights. In such a case, the fabric that will cover a larger area of the body surface should have better stretchability. The stretchability of the fabric is determined by measuring an elongation rate in accordance with JIS L 1096 8.14.1 A, where the load is 17.6 N and the tensile speed is 200 mm/min. The fabric with an elongation rate of 50% or more in the body width direction may be suitable for the compression-type tights. This is because if the size of the compression-type tights is equal to or slightly smaller than the body size, the tights allow for free movement, even though they are tight fitting. The tights of the present invention may also be loose fitting (as compared to the compression garment) so that the space between the skin and the inner surface of the clothing is 20 mm or less. In this case, the stretchability of the fabric can be determined by the above manner, and the elongation rate is preferably 10% or more in the body width direction.

[0040] The tights of the present invention are preferably used for sports. Preferred examples of the tights include short tights, half tights above the knee, half pants, three-quarter tights below the knee, ankle-length long tights, and warm-up pants. The tights of the present invention may be made by sewing pieces of the heat retaining fabric and the heat dissipating fabric, and optionally pieces of common tights fabric, together. Alternatively, the entire structure of the tights may be made of the heat dissipating fabric, and a piece of the heat retaining fabric may be attached to or sewed on the target portion of the tights.

[0041] Hereinafter, the present invention will be described with reference to the drawings. In the following drawings, the same components are denoted by the same reference numerals. FIGS. 1A and 1B are a schematic front view and a schematic back view of long tights in an embodiment of the present invention, respectively. Long tights 1 include a heat retaining fabric and a heat dissipating fabric. As illustrated in FIGS. 1A and 1B, the entire structure of the long tights 1 is made of the heat dissipating fabric 5, and pieces of the heat retaining fabric may be attached to the target portions of the tights. Specifically, the heat retaining fabric 2a, 2b is configured to be arranged in portions of the tights, each of which covers the quadriceps femoris muscle. The heat retaining fabric 3a, 3b is configured to be arranged in portions of the tights, each of which covers the biceps femoris muscle, the semimembranosus muscle, and the semitendinosus muscle. Moreover, the heat retaining fabric 4a, 4b is configured to be arranged in portions of the tights, each of which covers the triceps surae muscle. Since the entire structure of the tights has been made of the heat dissipating fabric 5, the heat dissipating fabric 5 is configured to be arranged in the following portions of the tights: the portion that covers the ilium; the portion that covers the gluteus maximus muscle and the gluteus medius muscle; the portion that covers the external iliac vein running along the ilium; and the portions, each of which covers the small saphenous vein in the vicinity of the Achilles tendon of the lower leg.

[0042] FIGS. 1A to 1B represent the inner side of the tights that comes into contact with the skin, and no sea-island pattern appears on the outer side of the tights.

[0043] FIGS. 2A and 2B are a schematic front view and a schematic back view of short tights in another embodiment of the present invention, respectively. Short tights 6 include a heat retaining fabric and a heat dissipating fabric. As illustrated in FIGS. 2A and 2B, the entire structure of the short tights 6 is made of the heat dissipating fabric 9, and pieces of the heat retaining fabric may be attached to the target portions of the tights. Specifically, the heat retaining fabric 7a, 7b is configured to be arranged in portions of the tights, each of which covers a part of the quadriceps femoris muscle. The heat retaining fabric 8a, 8b is configured to be arranged in portions of the tights, each of which covers the upper parts of the biceps femoris muscle and the semitendinosus muscle. Since the entire structure of the tights has been made of the heat dissipating fabric 9, the heat dissipating fabric 9 is configured to be arranged in the following portions of the tights: the portion that covers the ilium; and the portion that covers the gluteus maximus muscle and the gluteus medius muscle.

[0044] FIGS. 3A and 3B are a schematic front view and a schematic back view of half tights in another embodiment of the present invention, respectively. Half tights 10 include a heat retaining fabric and a heat dissipating fabric. As illustrated in FIGS. 3A and 3B, the entire structure of the half tights 10 is made of the heat dissipating fabric 13, and pieces of the heat retaining fabric may be attached to the target portions of the tights. Specifically, the heat retaining fabric 11a, 11b is configured to be arranged in portions of the tights, each of which covers the quadriceps femoris muscle. The heat retaining fabric 12a, 12b is configured to be arranged in portions of the tights, each of which covers the biceps femoris muscle and the semitendinosus muscle. Since the entire structure of the tights has been made of the heat dissipating fabric 13, the heat dissipating fabric 13 is configured to be arranged in the following portions of the tights: the portion that covers the ilium; and the portion that covers the gluteus maximus muscle and the gluteus medius muscle.

[0045] FIGS. 4A and 4B are a schematic front view and a schematic back view of three-quarter tights in another embodiment of the present invention, respectively. Three-quarter tights 14 include a heat retaining fabric and a heat dissipating fabric. As illustrated in FIGS. 4A and 4B, the entire structure of the three-quarter tights 14 is made of the heat dissipating fabric 17, and pieces of the heat retaining fabric may be attached to the target portions of the tights. Specifically, the heat retaining fabric 15a, 15b is configured to be arranged in portions of the tights, each of which covers the quadriceps femoris muscle. The heat retaining fabric 16a, 16b is configured to be arranged in portions of the tights, each of which covers the biceps femoris muscle and the semitendinosus muscle. Since the entire structure of the tights has been made of the heat dissipating fabric 17, the heat dissipating fabric 17 is configured to be arranged in the following portions of the tights: the portion that covers the ilium; and the portion that covers the gluteus maximus muscle and the gluteus medius muscle.

[0046] FIGS. 5A, 5B, and 5C are a schematic front view, a schematic side view, and a schematic back view of long tights in another embodiment of the present invention, respectively. Long tights 18 have a different design from the long tights 1 in FIG. 1. The long tights 18 include a heat retaining fabric and a heat dissipating fabric. Specifically, the heat retaining fabric 19a, 19b is configured to be arranged in portions of the tights, each of which covers the quadriceps femoris muscle, the biceps femoris muscle, the semimembranosus muscle, and semitendinosus muscle. The heat retaining fabric 20a, 20b is configured to be arranged in portions of the tights, each of which covers the triceps surae muscle. The heat dissipating fabric 21 is configured to be arranged in a portion of the tights that covers the ilium, the gluteus maximus muscle and the gluteus medius muscle, and the external iliac vein running along the ilium. The heat dissipating fabric 22a, 22b is configured to be arranged in portions of the tights, each of which covers the small saphenous vein in the vicinity of the Achilles tendon of the lower leg. The heat dissipating fabric 23a, 23b is configured to be arranged in portions of the tights, each of which covers the back of the knee. The pieces (parts) of the heat retaining fabric and the pieces (parts) of the heat dissipating fabric are joined together by sewing. The configuration in FIG. 5 is similar to those in FIGS. 6 and 7.

[0047] FIGS. 6A, 6B, and 6C are a schematic front view, a schematic side view, and a schematic back view of short tights in another embodiment of the present invention, respectively. FIGS. 7A, 7B, and 7C are a schematic front view, a schematic side view, and a schematic back view of half tights in another embodiment of the present invention, respectively. In each of the drawings, the dotted portion represents the heat retaining fabric and the solid white portion represents the heat dissipating fabric.

[0048] FIG. 8 is a muscle diagram of the lower part of the human body. FIG. 8 is a reference diagram that represents the positional relationship between the heat retaining fabric and the heat dissipating fabric of the present invention. FIG. 9 is a skeleton diagram of the lumbar region of the human body and indicates the position of the ilium.

Examples

[0049] The present invention will be described in more detail by way of examples. However, the present invention should not be interpreted solely by the following examples.

<Method for measuring air permeability>

[0050] The air permeability was measured in accordance with JIS L 1096 A (Frajour method).

<Method for measuring amount of heat dissipation>

[0051] The amount of heat dissipation was determined by measuring the power consumption of an evaluation device for heat retention properties ("KES-F7" manufactured by KATO TECH CO., LTD.) in accordance with JIS L 1927, where ΔT was set to 20°C.

<Method for measuring stretchability>

[0052] The stretchability was measured at a load of 17.6 N and a tensile speed of 200 mm/min in accordance with JIS L 1096 8.14.1 A.

(Example 1)

Heat retaining fabric A

[0053] A heat retaining fabric A was a circular-knitted fabric composed of 90% by mass of polyethylene terephthalate (PET) fibers and 10% by mass of highly crosslinked polyacrylate fibers. The yarns used were (i) a PET false twist yarn having a yarn fineness of 83 dtex and 48 filaments, (ii) a PET false twist yarn having a yarn fineness of 55 dtex and 24 filaments, and (iii) a spun yarn with a metric count of 40 (i.e., a blended yarn of 70% by mass of PET fibers and 30% by mass of highly crosslinked polyacrylate fibers). The circular-knitted fabric had a mass per unit area of 130 g/m^2, a thickness of 0.7 mm, a heat dissipation amount of 0.8 W, an air permeability of 130 cm^3/cm^2·sec, and a stretchability of 30%.

Heat dissipating fabric A

[0054] A heat dissipating fabric A was a circular-knitted fabric composed of 100% by mass of polyester fibers. The yarns used were (i) a PET false twist yarn having a yarn fineness of 83 dtex and 48 filaments and (ii) a PET false twist yarn having a yarn fineness of 83 dtex and 36 filaments. The fabric was knitted from these yarns and subjected to a water-absorbent quick-drying treatment. In the water-absorbent quick-drying treatment, the knitted fabric was immersed in a 5% o.w.f. (on the weight of fiber) aqueous solution of KMZ-902 (product number) manufactured by TAKAMATSU OIL & FAT CO., LTD., and the temperature was increased from room temperature to 130°C at 2°C/min. Then, the knitted fabric was treated at 130°C for 60 minutes, followed by cooling, washing with water, drying, tentering, and heat setting. The resulting circular-knitted fabric had a mass per unit area of 115 g/m^2, a thickness of 0.5 mm, a heat dissipation amount of 1.2 W, an air permeability of 200 cm^3/cm^2·sec, and a stretchability of 40%.

Production of clothing

[0055] Long tights were made by sewing pieces of the heat retaining fabric A and the heat dissipating fabric A together so that the heat retaining fabric A and the heat dissipating fabric A were arranged in their respective portions of the tights, as indicated by FIG. 5. The space between the skin and the inner surface of the clothing was 20 mm.

(Example 2)

Heat retaining fabric B

[0056] A heat retaining fabric B was a circular-knitted fabric composed of 87% by mass of PET fibers, 10% by mass of highly crosslinked polyacrylate fibers, and 3% by mass of polyurethane fibers. The yarns used were (i) a PET false twist yarn having a yarn fineness of 83 dtex and 48 filaments, (ii) a polyurethane yarn having a yarn fineness of 33 dtex, and (iii) a spun yarn with a metric count of 40 (i.e., a blended yarn of 70% by mass of PET fibers and 30% by mass of highly crosslinked polyacrylate fibers). The circular-knitted fabric had a mass per unit area of 150 g/m^2, a thickness of 0.9 mm, a heat dissipation amount of 1.1 W, an air permeability of 100 cm^3/cm^2·sec, and a stretchability of 80%.

Heat dissipating fabric B

[0057] A heat dissipating fabric B was a warp-knitted fabric composed of 97% by mass of polyester fibers and 3% by mass of polyurethane fibers. The yarns used were (i) a PET false twist yarn having a yarn fineness of 83 dtex and 48 filaments and (ii) a polyurethane yarn having a yarn fineness of 33 dtex. The fabric was knitted from these yarns and subjected to a water-absorbent quick-drying treatment in the same manner as Example 1. The resulting warp-knitted fabric had a mass per unit area of 160 g/m^2, a thickness of 0.6 mm, a heat dissipation amount of 2.0 W, an air permeability of 150 cm^3/cm^2·sec, and a stretchability of 120%.

Production of clothing

[0058] Long tights were made by using the heat dissipating fabric B to form the entire structure of the tights and then attaching pieces of the heat retaining fabric B to the portions of the tights, as indicated by FIG. 1. The space between the skin and the inner surface of the clothing was 10 mm or less. The long tights of Example 2 were compression-type long tights.

(Comparative Example 1)

[0059] Long tights having the same shape as Example 1 were made by using only the heat dissipating fabric A.

(Comparative Example 2)

[0060] Long tights having the same shape as Example 2 were made by using only the heat dissipating fabric B.

(Evaluation)

[0061] Each of 10 healthy male subjects wore the tights of Example 1 and the tights of Comparative Example 1. The subjects rested for 30 minutes and then started to do squats when they heard a sound signal. Both the time it took before the individual subjects did a squat in response to the sound signal (i.e., the time between the sound signal and the start of squat motion) and the time it took for them to do one squat were measured. The average of the times spent before starting the squat motion and the average of the times required for one squat were obtained. Further, the average values of Example 1 were compared to those of Comparative Example 1. The results are as follows.

Time spent before starting squat: Example 1 < Comparative Example 1

Time required for one squat: Example 1 < Comparative Example 1

[0062] Since the tights of Example 1 used the heat retaining fabric, the muscle temperature was increased to improve the reaction and the power output of the muscles. Therefore, it was confirmed that the tights of Example 1 helped to reduce both the time spent before starting the squat motion and the time required for one squat.

[0063] Next, the thermal comfort of the body was evaluated after the individual subjects did 50 squats at a rate of one per second. The results are as follows.

Example 1: slightly warm

Comparative Example 1: slightly warm

[0064] The tights of Example 1 were able to efficiently cool the blood vessels due to the presence of the heat dissipating fabric, and thus achieved the thermal comfort substantially comparable to the tights of Comparative Example 1.

[0065] Next, each of 10 healthy male subjects wore the tights of Example 2 and the tights of Comparative Example 2. The subjects rested for 30 minutes and then started to do squats when they heard a sound signal. Both the time it took before the individual subjects did a squat in response to the sound signal (i.e., the time between the sound signal and the start of squat motion) and the time it took for them to do one squat were measured. The average of the times spent before starting the squat motion and the average of the times required for one squat were obtained. Further, the average values of Example 2 were compared to those of Comparative Example 2. The results are as follows.

Time spent before starting squat: Example 2 < Comparative Example 2

Time required for one squat: Example 2 < Comparative Example 2

[0066] Since the tights of Example 2 used the heat retaining fabric, the muscle temperature was increased to improve the reaction and the power output of the muscles. Therefore, it was confirmed that the tights of Example 2 helped to reduce both the time spent before starting the squat motion and the time required for one squat.

[0067] Next, the thermal comfort of the body was evaluated after the individual subjects did 50 squats at a rate of one per second. The results are as follows.

Example 2: slightly warm

Comparative Example 2: slightly warm

[0068] The tights of Example 2 were able to efficiently cool the blood vessels due to the presence of the heat dissipating fabric, and thus achieved the thermal comfort substantially comparable to the tights of Comparative Example 2.

[0069] As is evident from the above evaluation, the tights of Examples 1, 2 can warm the agonist muscles during exercise to improve the power output of the muscles and to promote supercompensation, and at the same time they can dissipate heat from the heat dissipation areas of the body to reduce an increase in the core temperature. Consequently, the tights of Examples 1, 2 allow the wearer to continue exercise without reducing the thermal comfort. Moreover, the tights serve to shorten the warm-up time and also enable the body to prepare for taking part in a sport.

Industrial Applicability

[0070] The tights of the present invention are applicable to various types of tights, including short tights, half tights, three-quarter tights, and long tights. Moreover, the tights of the present invention are suitable for inner tights for sports such as baseball, soccer, rugby, marathons, running, walking, cycling, mountain climbing, and tennis.

Description of Reference Numerals

[0071]

1, 18 Long tights
2a, 2b Heat retaining fabric arranged to cover quadriceps femoris muscle
3a, 3b Heat retaining fabric arranged to cover biceps femoris muscle, semimembranosus muscle, and semitendinosus muscle
4a, 4b Heat retaining fabric arranged to cover triceps surae muscle
5 Heat dissipating fabric
2 Short tights
7a, 7b Heat retaining fabric arranged to cover part of quadriceps femoris muscle
8a, 8b Heat retaining fabric arranged to cover upper parts of biceps femoris muscle and semitendinosus muscle
9 Heat dissipating fabric
10 Half tights
11a, 11b Heat retaining fabric arranged to cover quadriceps femoris muscle
12a, 12b Heat retaining fabric arranged to cover biceps femoris muscle, semimembranosus muscle, and semitendinosus muscle
13 Heat dissipating fabric
14 Three-quarter tights
15a, 15b Heat retaining fabric arranged to cover quadriceps femoris muscle
16a, 16b Heat retaining fabric arranged to cover biceps femoris muscle, semimembranosus muscle, and semitendinosus muscle
17 Heat dissipating fabric
19a, 19b Heat retaining fabric arranged to cover quadriceps femoris muscle, biceps femoris muscle, semimembranosus muscle, and semitendinosus muscle
20a, 20b Heat retaining fabric arranged to cover triceps surae muscle
21 Heat dissipating fabric arranged to cover ilium, gluteus maximus muscle, and gluteus medius muscle
22a, 22b Heat dissipating fabric arranged to cover small saphenous vein near Achilles tendon
23a, 23b Heat dissipating fabric arranged to cover back of knee

[0072] The invention may be embodied in other forms without departing from the spirit or essential characteristics thereof. The embodiments disclosed in this application are to be considered in all respects as illustrative and not limiting. The scope of the invention is indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

Claims

1. Tights comprising a heat retaining fabric and a heat dissipating fabric,

   wherein the heat retaining fabric (2a, 2b, 3a, 3b) is configured to be arranged in portions of a front of the tights, each of which covers an entire belly of the quadriceps femoris muscle, and in portions of a back of the tights, each of which covers an entire belly of each of the biceps femoris muscle, the semimembranosus muscle, and the semitendinosus muscle, when the tights are worn,

the heat dissipating fabric (5) is configured to be arranged in a portion of the tights that goes all around the waist and covers the ilium, the lower abdomen, and bellies of the gluteus maximus muscle and the gluteus medius muscle, when the tights are worn, and

the heat retaining fabric is not arranged in the portion of the tights that goes all around the waist.

2. The tights according to claim 1, wherein the heat retaining fabric (4a, 4b) is configured to be further arranged in portions of the tights, each of which covers at least a part of the triceps surae muscle, when the tights are worn.

3. The tights according to claim 1 or 2, wherein the heat dissipating fabric is configured to be further arranged in portions of the tights, each of which covers at least a part of the small saphenous vein in the vicinity of the Achilles tendon of the lower leg, when the tights are worn.

4. The tights according to any one of claims 1 to 3, wherein the heat retaining fabric is at least one fabric selected from the group consisting of a moisture-absorbent heat-generating fabric, a fabric containing fibers with low thermal conductivity, a fabric containing heat storage fibers, a fluffy fabric, a point-contact fabric, a vapor-deposited fabric having a radiation effect, and a fabric with low breathability.

5. The tights according to any one of claims 1 to 4, wherein the heat dissipating fabric is at least one fabric selected from the group consisting of a fabric containing quick-drying fibers, a fabric containing fibers with high thermal conductivity, a thin fabric, a fabric with high breathability, and a fabric containing cooling fibers.

6. The tights according to any one of claims 1 to 5, wherein the heat retaining fabric is a moisture-absorbent heat-generating fabric containing highly crosslinked polyacrylate fibers and the heat dissipating fabric is a water-absorbent quick-drying polyester fabric.

7. The tights according to any one of claims 1 to 6, wherein the tights are compression-type tights.

8. The tights according to any one of claims 1 to 7, wherein the tights are sports tights.

9. Use of the tights according to any one of claims 1 to 8.

10. Use of the tights according to claim 9, wherein the tights are short tights, half tights above the knee, half pants, three-quarter tights below the knee, or ankle-length long tights.

11. Use of the tights according to claim 9 or 10, wherein the tights are warm-up tights for sports.

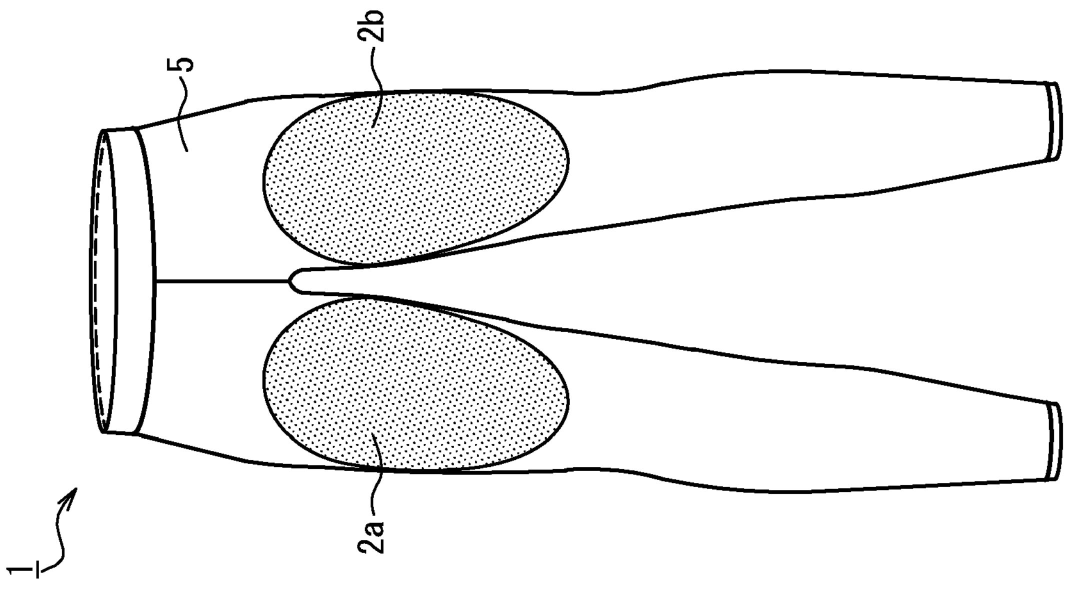

FIG. 1A

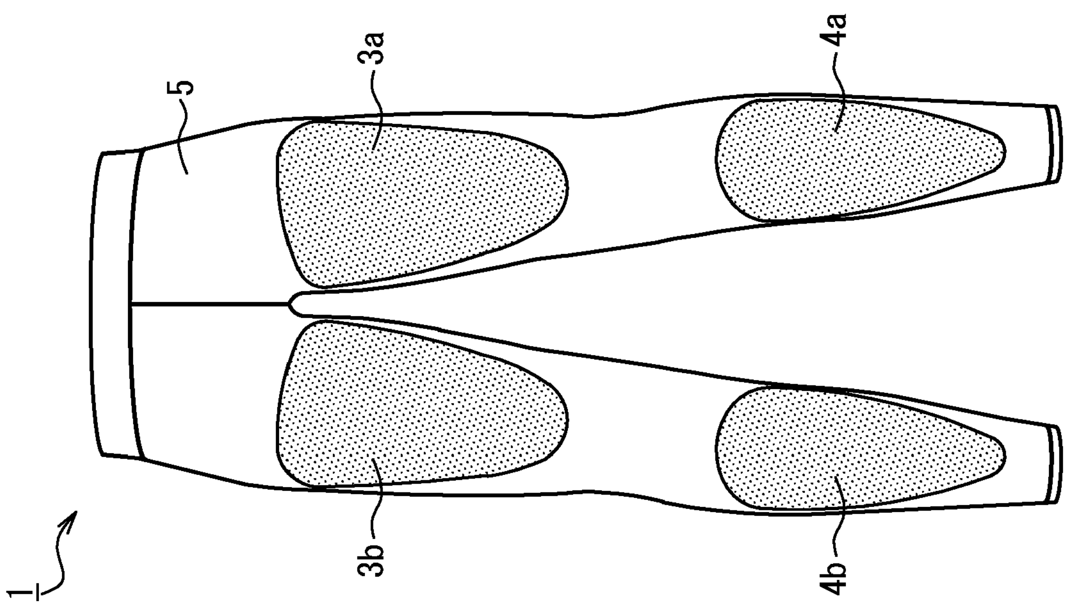

FIG. 1B

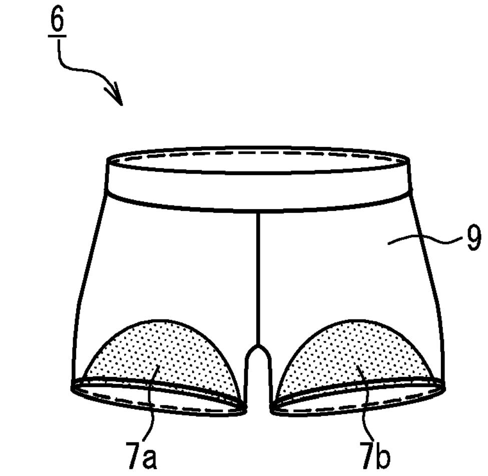

FIG. 2A

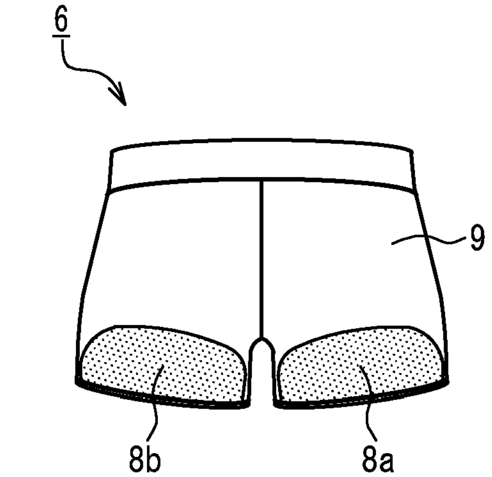

FIG. 2B

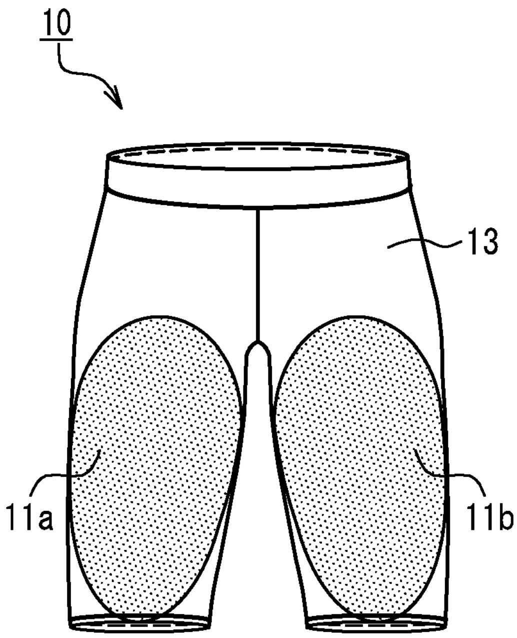

FIG. 3A

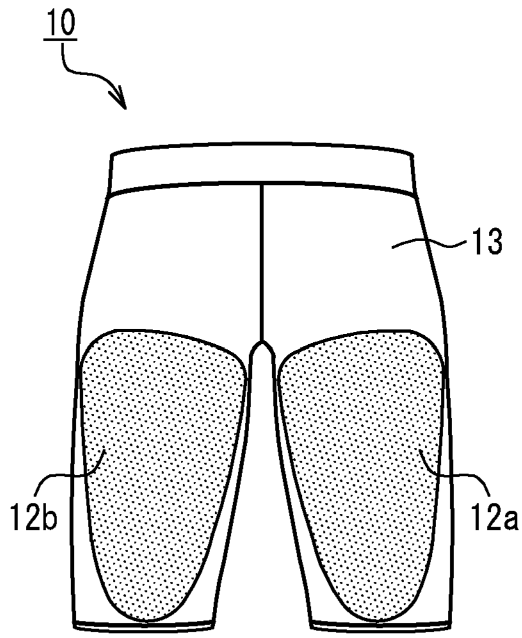

FIG. 3B

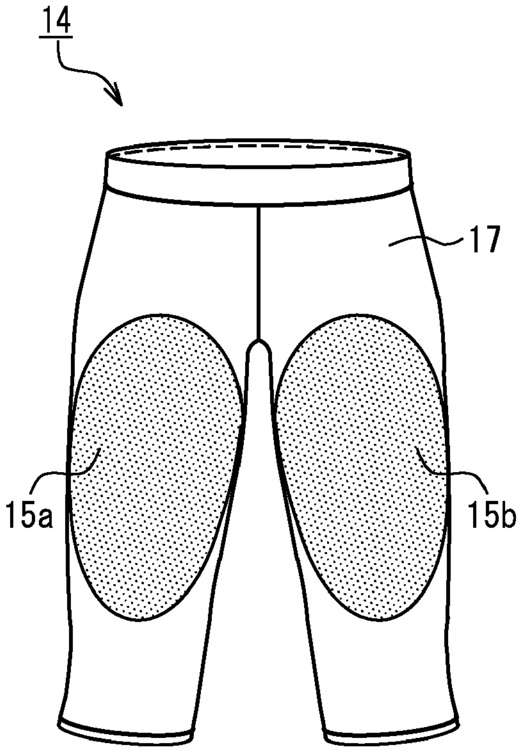

FIG. 4A

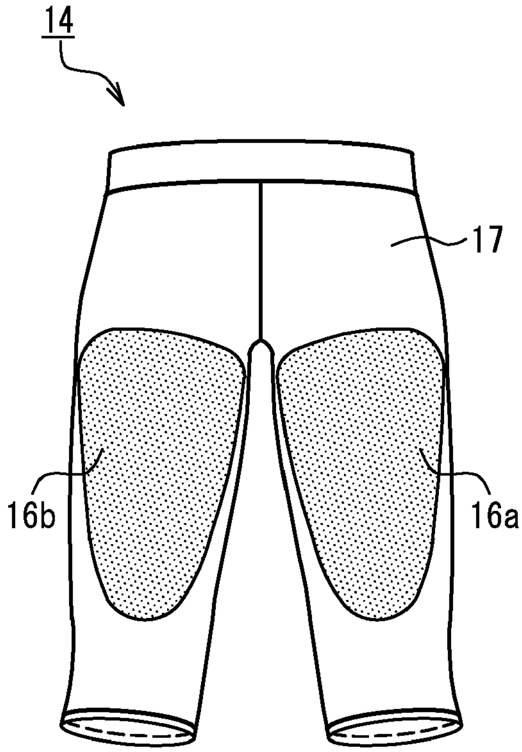

FIG. 4B

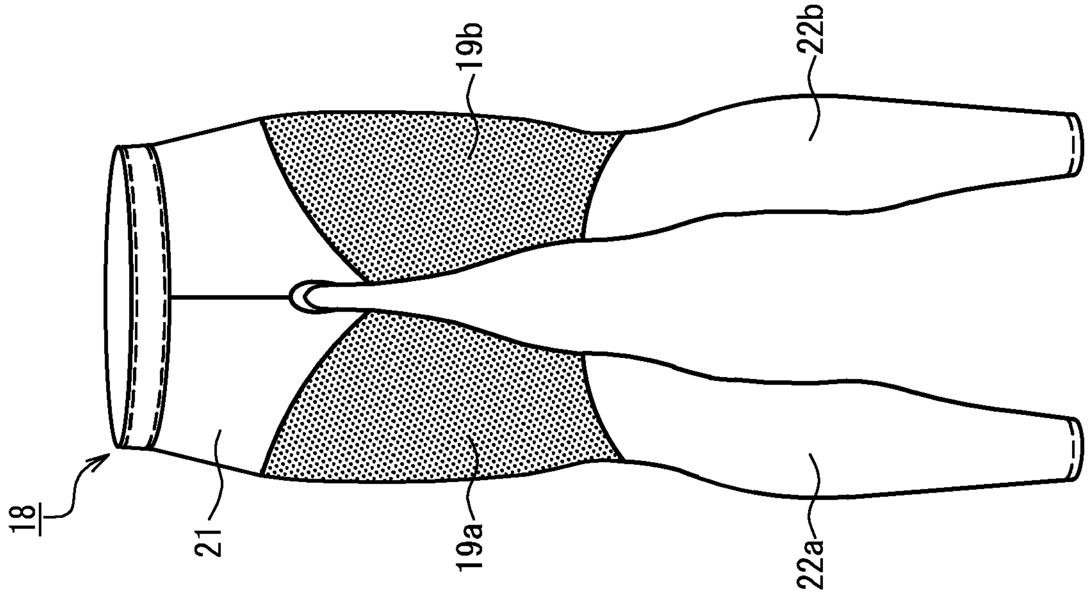

FIG. 5A

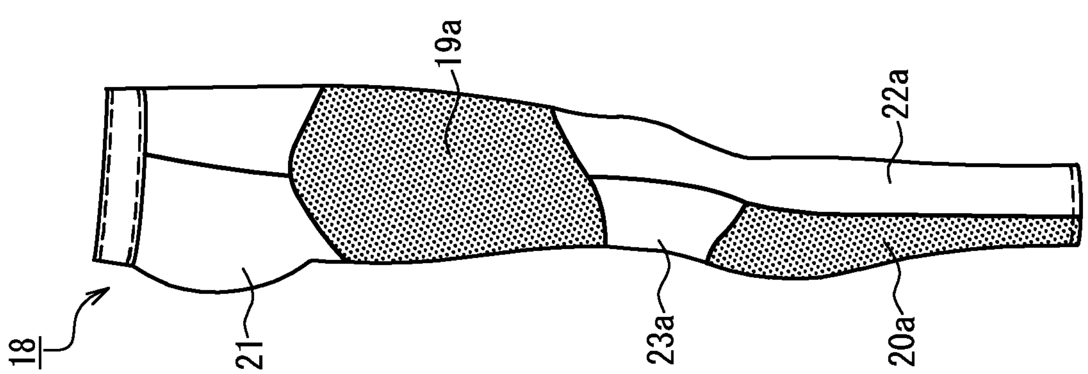

FIG. 5B

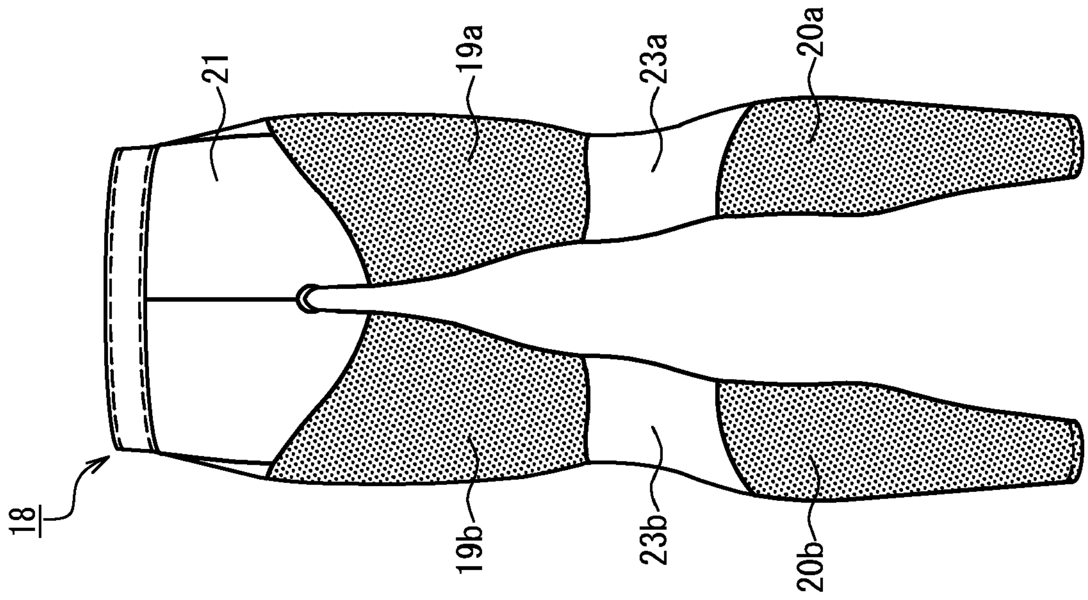

FIG. 5C

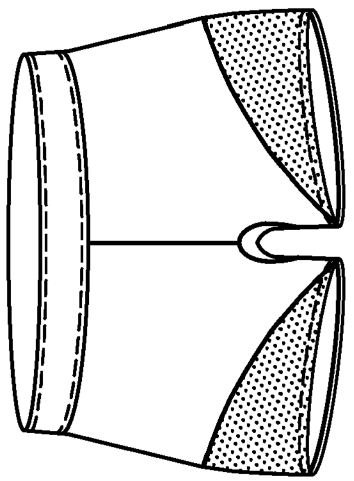

FIG. 6A

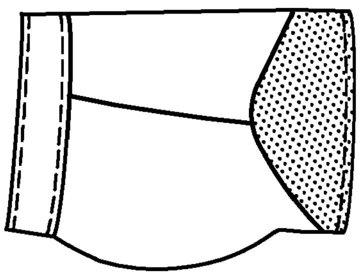

FIG. 6B

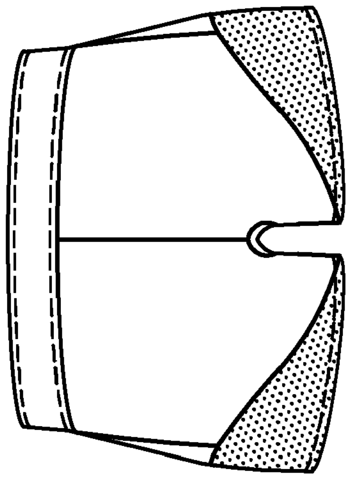

FIG. 6C

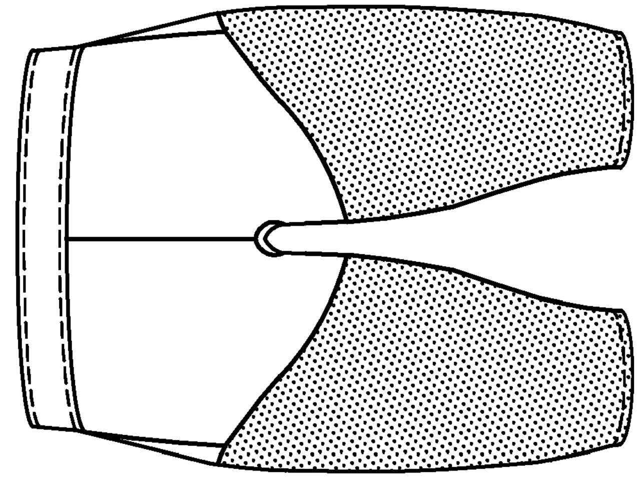

FIG. 7C

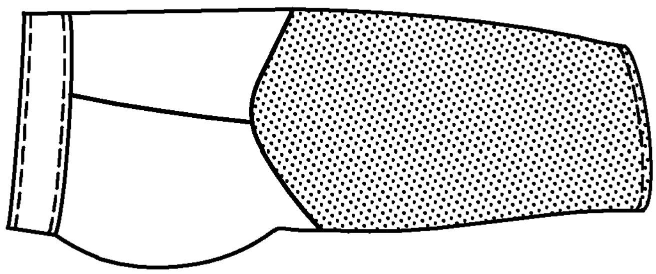

FIG. 7B

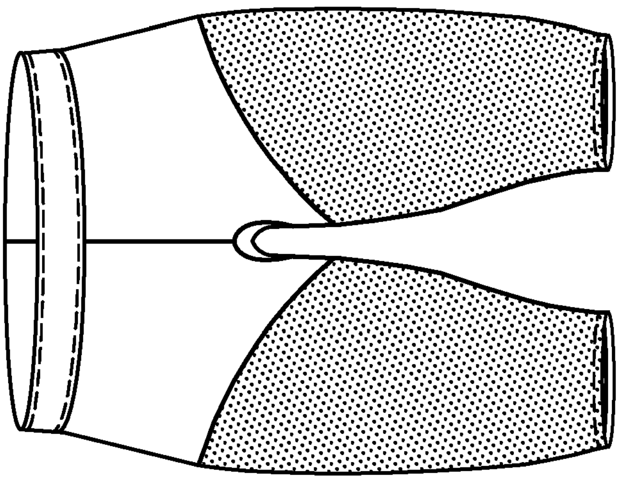

FIG. 7A

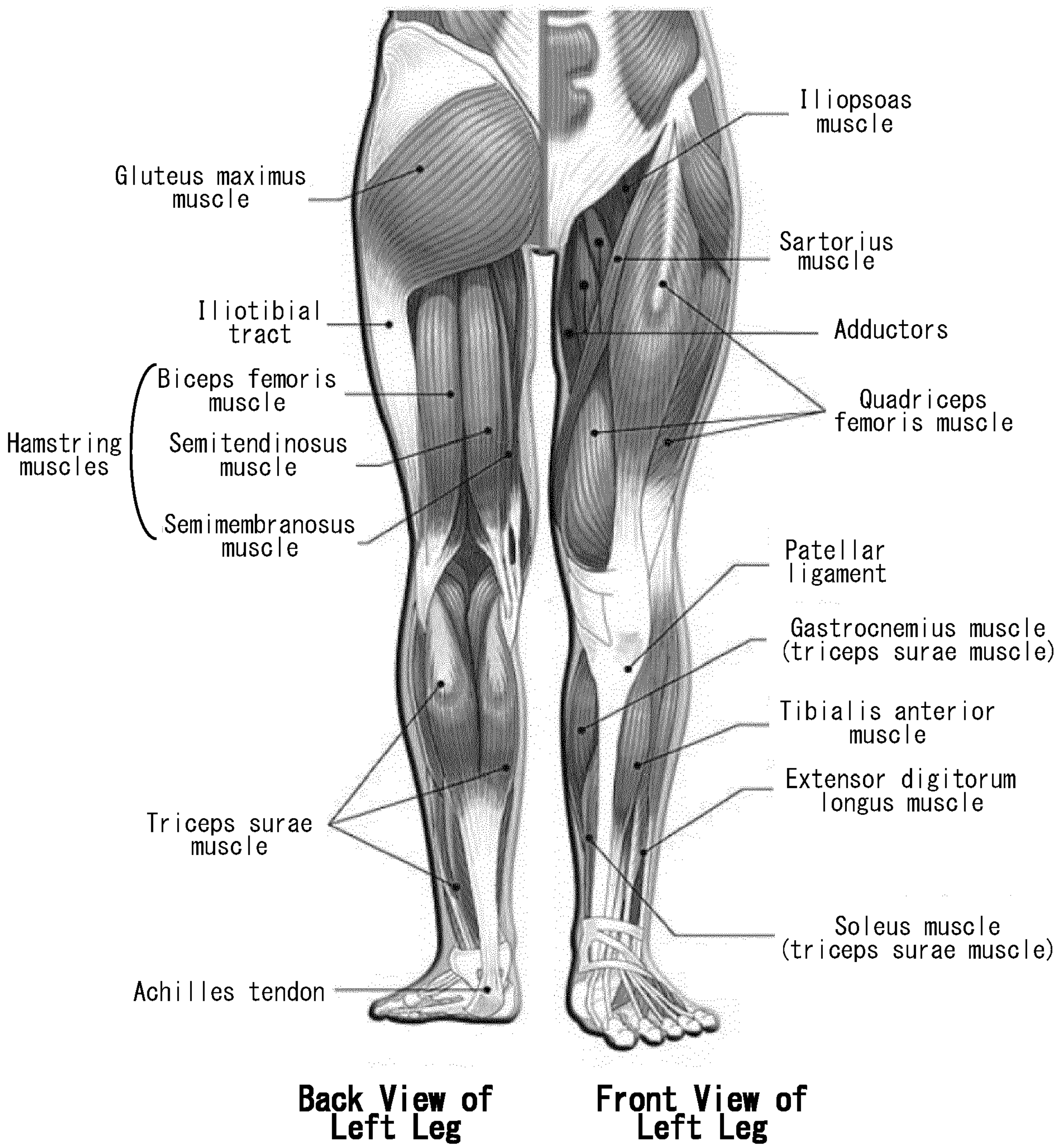
Iliopsoas muscle
Gluteus maximus muscle
Sartorius muscle
Iliotibial tract
Adductors
Biceps femoris muscle
Hamstring muscles
Semitendinosus muscle
Quadriceps femoris muscle
Semimembranosus muscle
Patellar ligament
Gastrocnemius muscle (triceps surae muscle)
Tibialis anterior muscle
Extensor digitorum longus muscle
Triceps surae muscle
Soleus muscle (triceps surae muscle)
Achilles tendon
Back View of Left Leg
Front View of Left Leg

FIG. 8

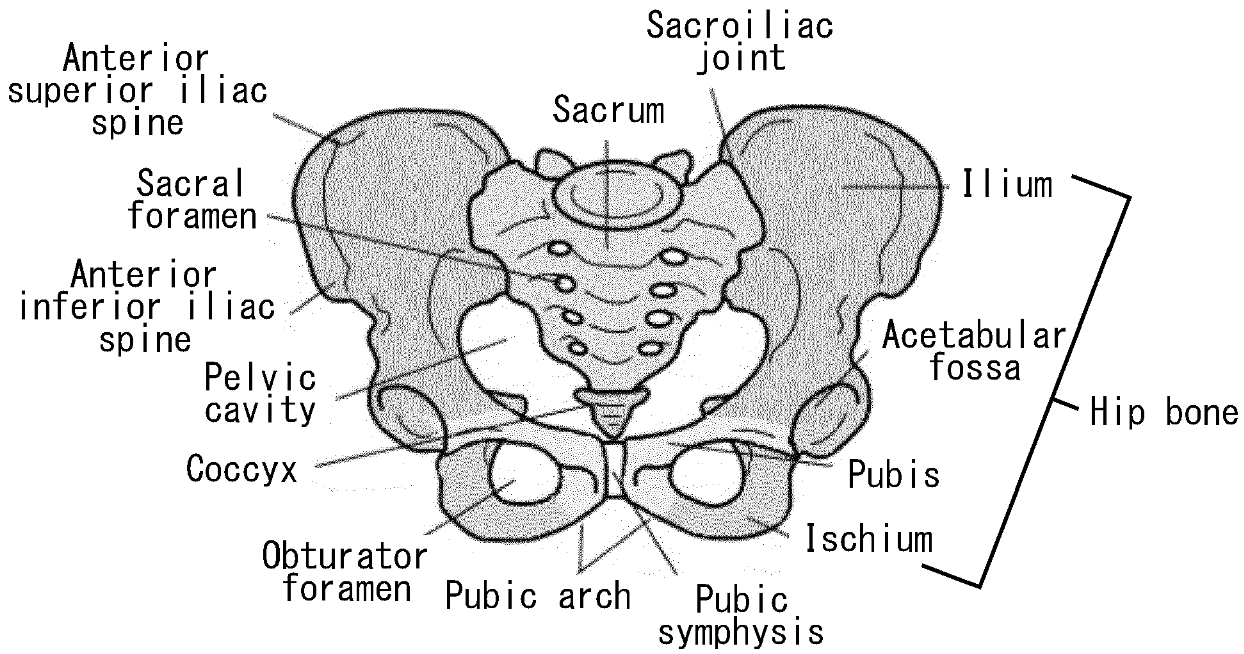
Anterior
superior iliac
spine
Sacroiliac
joint
Sacrum
Sacral
foramen
Ilium
Anterior
inferior iliac
spine
Acetabular
fossa
Pelvic
cavity
Hip bone
Coccyx
Pubis
Ischium
Obturator
foramen
Pubic arch
Pubic
symphysis

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 5077

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2011/271415 A1 (TORRY MICHAEL RAY [US]) 10 November 2011 (2011-11-10) * paragraphs [0021], [0024] - [0028] * * figures 1, 2 *	1-11	INV. A41D1/08 A41D13/002
X	US 5 539 926 A (MANTOS PHILLIP J [US]) 30 July 1996 (1996-07-30) * paragraphs [0085], [0086] * * figures 4A, 4B * * page 13; claims 10, 11 *	1-3,8,9	
A	EP 2 182 819 A1 (NIKE INTERNATIONAL LTD [US]) 12 May 2010 (2010-05-12) * column 2, line 34 - column 3, line 34; figures 1, 2, 4 *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)

A41D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	21 June 2022	Baytekin, Hüseyin

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21-06-2022

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