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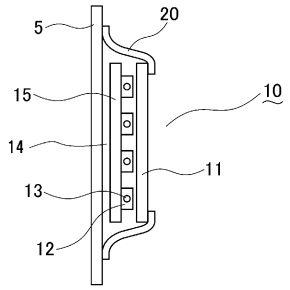
(54) FUNCTIONAL LAYER AND COOLING LAYER USED WHILE SUPERIMPOSED WITH FUNCTIONAL USE OBJECT

(57) [Abstract] A technical problem is to provide a mechanism capable of using a function such as a cooling function obtained through processing in which a liquid such as cold water, warm water, or a chemical flows through a water pipe such as a hollow fiber membrane, exudes from the water pipe such as a hollow fiber membrane, and is absorbed and diffused. Another technical problem is to provide a mechanism capable of cooling clothing or the like by using heat of vaporization of water exuding from the hollow fiber membrane. Still another technical problem is to provide a mechanism that uses heat of vaporization of water to cool a surrounding area while not getting a wearer or clothing wet. Still another technical problem is to provide a mechanism that uses water exuding from the hollow fiber membrane to humidify a surrounding area. The mechanism includes a water pipe such as a hollow fiber membrane, a layer that absorbs and diffuses water exuding from the water pipe such as a hollow fiber membrane, and an air layer, enabling a surrounding area to be cooled. Shaking the layer promotes exchange of air between an inside and an outside of the air layer, promotes water absorption and diffusion, and promotes cooling of the surrounding area.

[Figure 3]



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Description

Technical Field

[0001] The present invention relates to a functional layer that uses a function such as a cooling function obtained through processing in which a liquid such as cold water, warm water, or a chemical flows through a water pipe such as a hollow fiber membrane, exudes from the water pipe such as a hollow fiber membrane, and is absorbed and diffused.

Background Art

[0002] To relieve the heat, conventionally, there has been a technique in which a hollow fiber membrane or the like is spread around the fabric that makes up clothing, water is injected into the hollow fiber membrane, and the area around the hollow fiber membrane is cooled by the heat of vaporization of the water that exudes from the micropores on the surface of the hollow fiber membranes.

[0003] Patent Literature 1 describes clothing using the above technique. In the clothing described in Patent Literature 1, the hollow fiber membrane 50 is sewn directly onto the clothing, as shown in Figure 10. Water from the pump 52 is injected into the hollow fiber membrane 50, and the water exudes into the fabric making up the clothing via the hollow fiber membrane spread around the clothing. The heat of vaporization when the water exuding into the clothing evaporates takes away body heat from a person wearing this clothing, making the person feel cool.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Patent Laid-Open No. 2019-218666

Summary of Invention

Technical Problem

[0005] A technical problem is to provide a mechanism capable of using a function such as a cooling function obtained through processing in which a liquid such as cold water, warm water, or a chemical flows through a water pipe such as a hollow fiber membrane, exudes from the water pipe such as a hollow fiber membrane, and is absorbed and diffused.

[0006] Another technical problem is to provide a mechanism capable of cooling clothing or the like by using heat of vaporization of water exuding from the hollow fiber membrane. Still another technical problem is to provide a mechanism that uses heat of vaporization of water to cool a surrounding area while not getting a wearer or clothing wet. Still another technical problem is to provide a mechanism that uses water exuding from the hollow fiber membrane to humidify a surrounding area.

Solution to Problem

[0007]

(1) The technical problems are solved with a functional layer including: a water pipe that exudes liquid; a substrate layer to which the water pipe is attached; and a water absorption and diffusion layer placed in contact with a surface, to which the water pipe is attached, of the substrate layer, in which the functional layer is used by being layered on an object of using function for which a function provided to the functional layer is used.

(2) The technical problems are solved with the functional layer according to (1), in which the water pipe is a hollow fiber membrane having micropores in a pipe wall and the liquid is water.

(3) The technical problems are solved with the functional layer according to (1) or (2), in which an air layer is present between the functional layer and the object of using function.

(4) The technical problems are solved with the functional layer according to any of (1) to (3), further including a heat generating layer on a side of the water absorption and diffusion layer, the side being opposite to a side that is in contact with a surface, to which the water pipe is attached, of the substrate layer.

(5) The technical problems are solved with the functional layer according to any of (1) to (4), further including a filter layer on a side of the water absorption and diffusion layer, the filter layer allowing water vapor to pass through and not allowing water to pass through, the side being opposite to a side that is in contact with a surface, to which the water pipe is attached, of the substrate layer.

(6) The technical problems are solved with the functional layer according to any of (1) to (5), further including a filter layer on a side of the substrate layer, the filter layer allowing water vapor to pass through and not allowing water to pass through, the side being opposite to a side of a surface, to which the water pipe is attached, of the substrate layer.

(7) The technical problems are solved with the functional layer according to any of (3) to (6), in which the functional layer or the object of using function is shaken, and thereby air exchange between air in the air layer and air outside the air layer is promoted.

(8) The technical problems are solved with a cooling layer including: a hollow fiber membrane having micropores in a pipe wall, water exuding from the micropores; an interlining layer to which the hollow fiber membrane is attached; and a water absorption and diffusion layer placed in contact with a surface, to which the hollow fiber membrane is attached, of the

interlining layer, in which the cooling layer is used by being layered on an object to be cooled that uses a cooling function provided to the cooling layer.

(9) The technical problems are solved with the cooling layer according to (8), in which the object to be cooled is clothing or a human body.

(10) The technical problems are solved with the cooling layer according to (9), in which an air layer is present between the cooling layer and clothing or a human body.

(11) The technical problems are solved with the cooling layer according to any of (8) to (10), further including a filter layer on a side of the water absorption and diffusion layer, the filter layer allowing water vapor to pass through and not allowing water to pass through, the side being opposite to a side that is in contact with a surface, to which the hollow fiber membrane is attached, of the interlining layer.

(12) The technical problems are solved with the cooling layer according to any of (8) to (11), further including a filter layer on a side of the interlining layer, the filter layer allowing water vapor to pass through and not allowing water to pass through, the side being opposite to a side of a surface to which the hollow fiber membrane is attached.

(13) The technical problems are solved with the cooling layer according to any of (10) to (12), in which the cooling layer or the object to be cooled is shaken, and thereby air exchange between air in the air layer and air outside the air layer is promoted.

[0008] Examples of the liquid exuding from the water pipe include water and chemicals. The water includes room temperature water, cold water, and warm water. In the case of water, functions such as cooling the surrounding area can be used. Examples of the chemicals include antibacterial agents, deodorants, warming and cooling agents, decomposition agents, water absorption and diffusion agents, water repellents, and the function of each chemical can be used. Some effects can be obtained by vaporization of the chemical.

[0009] In this application, "liquid" includes liquid nitrogen. The rapid cooling function of liquid nitrogen can be used. For example, if it is necessary to rapidly cool the muscles during exercise while wearing clothing that is difficult to take off, such as compression wear, the muscles can be cooled from the outside of the clothing without taking off the clothing. Liquid nitrogen functionality can be used.

[0010] The examples also include a liquid, passing through the pipe, mixed with particulate solids that have various functions.

[0011] The liquid exudes from the micropores on the side surface of the water pipe and the opening at the head end of the water pipe. To cause the liquid to exude from the water pipe, a pump or the like is used to inject the liquid into the water pipe.

[0012] The water absorption and diffusion layer is in contact with the water pipe, and thereby absorbs and diffuses liquid having exuded from the water pipe.

[0013] It is desirable that the surface, to which the water pipe is attached, of the substrate layer be in contact with the water absorption and diffusion layer to the extent that sufficient water absorption is possible.

[0014] The edges of the functional layer may be partially in close contact with the object of using function. All the edges of the functional layer may be in close contact with the object of using function. It is just required that the edges of the functional layer be in close contact with the object of using function to form a loosely closed layer of air between the functional layer and the object of using function so that the air can be retained to some extent. For example, to obtain a cooling function, it is just required that the cooled air be able to remain there to some extent.

[0015] The functions provided by the functional layer mean functions provided to the human body, functions provided to food and beverages, and functions provided to other products. In terms of functions provided to the human body, the objects of using function include clothing, hats, bags, towels, scarves, masks, supporters, shoes, chair covers, and car seats. There are both objects that use their functions by coming into contact with the human body, and objects that use their functions by being placed near a human. In terms of functions provided to food and beverages, objects of using function include vegetables, fish, meat, and beverages. The functions provided to food and beverages can be used to cool or warm food and beverages, or to give them effects of chemicals.

[0016] Use of a hollow fiber membrane as a water pipe causes water to exude from the micropores provided on the side surface of the hollow fiber membrane and the opening at the head end of the hollow fiber membrane.

[0017] The water absorption and diffusion layer can be provided with a heat generating layer on a side thereof, which side is opposite to the side that is in contact with the surface, to which the water pipe is attached, of the substrate layer, allowing the heat generating layer to heat the water that is about to be absorbed and diffused. As a result, the surrounding area can be humidified.

[0018] The water absorption and diffusion layer can be provided with a filter layer, which allows water vapor to pass through and does not allow water to pass through, on a side thereof, which side is opposite to the side that is in contact with the surface, to which the water pipe is attached, of the substrate layer. "The side of the water absorption and diffusion layer, which side is opposite to the side that is in contact with the surface, to which the water pipe is attached, of the substrate layer" means the side where the functional layer is in contact with the outside of the functional layer. Furthermore, the substrate layer can be provided with a similar filter layer on a side thereof, which side is opposite to the side of the surface, to which the water pipe is attached, of the substrate layer. "The side of the substrate layer, which side is opposite

to the side of the surface, to which the water pipe is attached, of the substrate layer" also means the side where the functional layer is in contact with the outside thereof. In this manner, when a filter layer is provided, which allows water vapor to pass through but does not allow water to pass through, on the sides of the functional layer that are in contact with the outside, the water is prevented from flowing out from the functional layer to the outside. As a result, the object that uses the function of the functional layer can be prevented from coming into contact with water.

[0019] Preferably, the functional layer or the object of using function can be shaken. Furthermore, the functional layer or the object of using function is preferably a material, such as fabric, that allows heat, moisture and air to move appropriately, and is soft and easily deformable. This allows a certain amount of air to accumulate between the functional layer and the object of using function, creating an air layer. Furthermore, the functional layer or the object of using function is pinched with fingers and moved back and forth, and thereby the functional layer etc. are shaken and air exchange is promoted between the inside of the air layer and the outside of the air layer.

Brief Description of Drawings

[0020]

[Figure 1] Figure 1 shows a T-shirt to which a cooling unit of Example 1 is attached.
[Figure 2] Figure 2 shows a T-shirt to which the cooling units of Example 1 are attached.
[Figure 3] Figure 3 shows a configuration of the cooling unit of Example 1.
[Figure 4] Figure 4 shows a configuration of the cooling unit of Example 1.
[Figure 5] Figure 5 shows experimental results of a cooling effect of the cooling unit of Example 1.
[Figure 6] Figure 6 shows experimental results of the cooling effect of the cooling unit of Example 1.
[Figure 7] Figure 7 shows experimental results of the cooling effect of the cooling unit of Example 1.
[Figure 8] Figure 8 shows a configuration of a cooling unit of Example 2.
[Figure 9] Figure 9 shows a configuration of a cooling unit of Example 3.
[Figure 10] Figure 10 shows a configuration of a cooling unit of Example 4.
[Figure 11] Figure 11 shows a configuration of the cooling unit of Example 4.
[Figure 12] Figure 12 shows a conventional example.

Description of Embodiments

[0021] Preferred embodiments of the present invention will be described below with reference to drawings.

Example 1

[0022] Example 1 will be described with reference to Figures 1 to 7. Figure 1 shows a T-shirt with a cooling unit attached, viewed from the front side. A cooling unit 10 is attached to the back side of the T-shirt. A water inlet 30 of the cooling unit is exposed on the front side of the T-shirt. Exposure of the water inlet 30 to the front side of the clothing in this manner allows water to be supplied into the cooling unit from outside the T-shirt.

[0023] Figure 2 shows a T-shirt with a cooling unit attached, viewed from the back side. Figure 2(a) shows the back side of a front body, and Figure 2(b) shows the back side of a back body. To enhance the cooling effect, the cooling units 10 are respectively attached to the front body and the back body. The edge of each cooling unit 10 is fixed with seam tape 20, and the cooling unit 10 is attached to the T-shirt.

[0024] Each cooling unit 10 has a layered structure. Figure 3 schematically shows the layered structure of the cooling unit 10 attached to the T-shirt 5. The cooling unit 10 includes an interlining 15, a hollow fiber membrane woven ribbon 12 attached to the interlining 15, and a water absorption and diffusion layer 11. The interlining 15 is made of a material with weak water absorption, such as wadding. The hollow fiber membrane woven ribbon 12 is a ribbon into which a hollow fiber membrane is woven, and the ribbon is made of a material with high water absorption and diffusion properties. The ribbon fabric portion of the hollow fiber membrane woven ribbon 12 is sewn onto the interlining 15. Details of the hollow fiber membrane woven ribbon are exemplified in Japanese Patent Application No. 2021-58676.

[0025] A mesh or the like with high water absorption and diffusion properties is used for the water absorption and diffusion layer 11. The water absorption and diffusion layer 11 is in contact with the hollow fiber membrane woven ribbon 12 attached to the interlining 15, absorbs water exuding from the hollow fiber membrane in a very short time, and diffuses it into the air. The strong water absorption and diffusion power of the water absorption and diffusion layer 11 causes the interlining 15 to hardly retain the water exuding from the hollow fiber membrane.

[0026] In wearing this T-shirt 5, the human body is on the right side of the water absorption and diffusion layer 11 in Figure 3, and the outside is on the left side of the T-shirt 5 in Figure 3. While it is desirable to prevent water exuding from the hollow fiber membrane 13 from reaching the human body, the water absorption and diffusion layer 11 placed on the human body side has high water absorption and diffusion properties, so that water exuding from the hollow fiber membrane 13 does not reach the human body. Furthermore, it is also desirable to prevent water exuding from the hollow fiber membrane 13 from reaching the T-shirt because the T-shirt will get wet if the water reaches the T-shirt. For this desire, the high water absorption and diffusion function of the water absorption and diffusion layer 11 prevents the water exuding from

the hollow fiber membrane 13 from reaching the T-shirt. If the water absorption and diffusion layer 11 absorbs water and left some behind, the interlining 15 absorbs the left water.

[0027] The cooling unit 10 has its edges 18 to which seam tape applied, and is thereby attached to the T-shirt 5. As a result, only the edges 18 of the cooling unit 10 are in close contact with the T-shirt, and an air layer 14 is provided between the interlining 15 and the T-shirt 5.

[0028] Figure 4 shows the cooling unit 10 in a plan view. As shown in Figure 4, the hollow fiber membrane woven ribbon 12 is sewn onto the interlining 15 in a zigzag pattern so as to spread widely over the interlining 15. The hollow fiber membrane 13 is woven into the center of the hollow fiber membrane woven ribbon 12. The water inlet 30 for injecting water into the hollow fiber membrane is provided at one end of the hollow fiber membrane. The water inlet 30 is attached so as to be exposed to the outside of the T-shirt by making a hole in the T-shirt or using a buttonhole or the like originally provided in the T-shirt.

[0029] Water is poured into the hollow fiber membrane 13 from the water inlet 30. The water flows through the hollow fiber membrane 13 and reaches the hollow fiber membrane end portion 31. When the water flows through the hollow fiber membrane, the water exudes outside from the micropores provided in the side wall of the hollow fiber membrane. In other words, the water exudes outside from the circumference and the end of the hollow fiber membrane. Since the ribbon fabric of the hollow fiber membrane woven ribbon 12 and the water absorption and diffusion layer 11 in contact therewith have high water absorption and diffusion power, water that has soaked into the ribbon is absorbed, diffused, and vaporized. At this time, the surrounding temperature decreases due to the heat of vaporization.

[0030] As shown in Figure 3, the air layer 14 is provided between the T-shirt 5 and the cooling unit 10. Therefore, the air in the air layer can be exchanged by pinching the cooling unit 10 from the outside with fingers and shaking it in the back-and-forth direction. The exchange of air in the air layer promotes water diffusion, and as a result, the surrounding temperature decreases.

[0031] The air cooled by vaporization in the water absorption and diffusion layer 11 is discharged toward the skin, and is also discharged toward the air layer. The air discharged toward the air layer is less affected by the surrounding environment due to the heat insulating effect provided by the air layer. In other words, it is possible to maintain decrease in temperature.

[0032] Figures 5 to 7 show the temperature changes of the T-shirt with the cooling unit attached. The measurements were conducted indoors on June 29, 2021, at a temperature of 30°C and humidity of 300. Figure 5(a), (b), (c), Figure 6(d), (e), (f), and Figure 7(g), (h) show, in chronological order, the state of the T-shirt from the time when the measurement started to the time when the measurement ended at 1 minute 02 seconds later. The details of each are as follows. The temperature scale in each figure shows the color and the temperature corresponding to the color.

[0033] Figure 5(a) at the start of measurement, Figure 5(b) 20 seconds later, Figure 5(c) 33 seconds later

[0034] Because the measurement was started after several minutes of water injection, the temperature at the position of the cooling unit was approximately 24°C from the start of the measurement. After that, the temperature drop around the cooling unit was also observed.

Figure 6(d) 51 seconds later

[0035] The wearer pinched part of the fabric of the T-shirt and began movement of moving it back and forth. This movement continued for a little over 10 seconds until 1 minute 02 seconds had passed.

Figure 6(e) 52 seconds later, Figure 6(f) 53 seconds later, Figure 7(g) 57 seconds later, Figure 7(h) 1 minute 02 seconds later

[0036] From 1 second after the start of the movement of moving the T-shirt fabric back and forth, a further temperature drop at the position of the cooling unit was observed remarkably. One second after the start of the back-and-forth movement, the temperature decreased by about 3°C, and, five seconds later, the temperature further decreased by about 2°C. After that, when the back-and-forth movement was stopped, the temperature gradually increased (not shown).

Example 2

[0037] Example 2 will be described with reference to Figure 8. In Example 2, a heat generating layer 17 that is in contact with the water absorption and diffusion layer 11 is provided closer to the skin than the water absorption and diffusion layer 11. The heat may be generated by electricity, for example. Heating the water that is about to be absorbed and diffused can humidify the surrounding area.

[0038] In Example 2, the air layer 14 functions as a heat insulating layer from the outside, and the air layer 14 increases the heat insulating effect. Furthermore, since a loosely closed space is formed by the seam tape 20, thermal convection occurs inside the air layer 14, so that the temperature within the closed space is made uniform.

Example 3

[0039] Example 3 will be described with reference to Figure 9. The water absorption function of the water absorption and diffusion layer prevents the water exuding from the hollow fiber membrane from exuding to the skin side or T-shirt side. However, various conditions such as temperature, humidity, or clothing material may provide

insufficient water absorption and diffusion. Example 3 is a means for solving such a problem.

[0040] In Example 3, filter layers 19 are respectively provided on the skin side relative to the water absorption and diffusion layer 11 and on the T-shirt side relative to the interlining 15. The filter layer separates water vapor and water to perform filtering, allowing water vapor to pass through but not water.

[0041] For example, nanofiber fabric is used for the filter layer 19. The presence of the filter layer prevents water from passing through both the skin side and the T-shirt side. No leakage of the water to the skin side eliminates discomfort for the wearer. No leakage of the water to the T-shirt side can prevent water stains and deterioration of the appearance.

[0042] Although Figure 9 shows an example in which the cooling unit is attached to a T-shirt, a structure in which a filter layer prevents liquid such as water from leaking to the outside can be used without being limited to this example. When the function, which is exhibited by liquid or liquefied gas that has passed through a hollow fiber membrane, is used for a product rather than the human body, it is possible to prevent problems due to liquid leakage such as product corrosion and electrical leakage.

Example 4

[0043] Example 4 is an example in which the hollow fiber membranes (61a, 61b, 61c, 61d) are placed so as to extend in the vertical direction (up-down direction when the wearer is in an upright posture). Furthermore, this is an example in which the hollow fiber membrane extends only in one vertical direction and does not turn. This is also an example in which the water inlet device 70 for injecting water to be sent to the hollow fiber membrane is provided in a lower part of the clothing. In this example, a tube 63 connected to the water inlet device branches in front and the hollow fiber membranes each extend to the other end thereof (64a, 64b, 64c, 64d) in a straight line without turning, and the other ends of the hollow fiber membranes (64a, 64b, 64c, 64d) are open. Furthermore, in this example, the hollow fiber membranes (61a, 61b, 61c, 61d) are relatively short, each approximately 33 cm. Each hollow fiber membrane has an outer diameter of about 500 μ and an inner diameter of about 300 μ. The outer diameter may be about 1300 μ and the inner diameter may be about 700 μ.

[0044] With reference to Figures 10 and 11, the T-shirt 50 includes side cloths 51 each between the front body and the back body. Each cooling unit 60 is attached to the side cloth 51 by sewing or other means.

[0045] With reference to Figure 11, the cooling unit 60 includes four hollow fiber membranes (61a, 61b, 61c, 61d) extending in the vertical direction. One ends (water inlet side) of the four hollow fiber membranes (61a, 61b, 61c, 61d) are integrated into one by the tube 63. The other ends of the four hollow fiber membranes (61a, 61b, 61c, 61d) are open.

[0046] The hollow fiber membranes (61a, 61b, 61c, 61d) are each attached near the center of a water absorption and diffusion cloth 62 extending in a ribbon shape. At the center of each water absorption and diffusion cloth 62 in the left and right direction, a bag-shaped space extends in the length direction. Each of hollow fiber membranes (61a, 61b, 61c, 61d) fits into the bag-shaped space and is covered with the water absorption and diffusion cloth 62.

[0047] Water is injected into the cooling unit 60 via the water inlet 75 of the water inlet device 70. The injected water enters the hollow fiber membranes (61a, 61b, 61c, 61d) extending in the length direction of the cooling unit 60 through the tube 63. Water flows from bottom to top in the hollow fiber membranes (61a, 61b, 61c, 61d) due to the action of the pump in injection. Each hollow fiber membrane has micropores on its surface, and water in the hollow fiber membrane exudes to the water absorption and diffusion cloth 62 through the micropores on the surface.

[0048] Water can be injected into the cooling unit from outside the T-shirt 50 through the water inlet 75. The water inlet 75 is connected to the tube 63 of the cooling unit 60 via a guide pipe (not shown). The tube 63 branches and communicates with the hollow fiber membranes (61a, 61b, 61c, 61d).

[0049] Each hollow fiber membrane extends in a straight line without turning and the length of the hollow fiber membrane is relatively short, so that the pressure applied by water onto the wall of the hollow fiber membrane is small when the water passes through the hollow fiber membrane. Furthermore, the short distance between the upstream (inlet side) and the downstream (exit side) gives small difference in water pressure between the upstream and the downstream. Therefore, the amount of water that exudes and diffuses from the micropores on the surface of the hollow fiber membrane is uniform from the upstream to the downstream. When the amount of water to be diffused is small, the water dries quickly, and when the amount of water to be diffused is large, the water causes sticky feeling, both of which are undesirable.

Reference Signs List

[0050]

1 T-shirt with cooling unit
5 T-shirt
10 cooling unit
11 water absorption and diffusion layer
12 hollow fiber membrane woven ribbon
13 hollow fiber membrane
14 air layer
15 interlining
17 heat generating layer
18 edge

19 filter layer
20 seam tape
25 air layer
30 water inlet
31 hollow fiber membrane end portion
50 T-shirt
51 side cloth
60 cooling unit
61a, 61b, 61c, 61d hollow fiber membrane
62 water absorption and diffusion cloth
63 tube
64a, 64b, 64c, 64d other end of hollow fiber membrane
70 water inlet device
75 water inlet
100 hollow fiber membrane
102 pump

Claims

1. A functional layer comprising:

   a water pipe that exudes liquid;
   a substrate layer to which the water pipe is attached; and
   a water absorption and diffusion layer placed in contact with a surface, to which the water pipe is attached, of the substrate layer, wherein
   the functional layer is used by being layered on an object of using function for which a function provided to the functional layer is used.

2. The functional layer according to claim 1, wherein the water pipe is a hollow fiber membrane having micropores in a pipe wall and the liquid is water.

3. The functional layer according to claim 1, wherein an air layer is present between the functional layer and the object of using function.

4. The functional layer according to claim 1, further comprising a heat generating layer on a side of the water absorption and diffusion layer, the side being opposite to a side that is in contact with a surface, to which the water pipe is attached, of the substrate layer.

5. The functional layer according to any of claims 1 to 4, further comprising a filter layer on a side of the water absorption and diffusion layer, the filter layer allowing water vapor to pass through and not allowing water to pass through, the side being opposite to a side that is in contact with a surface, to which the water pipe is attached, of the substrate layer.

6. The functional layer according to any of claims 1 to 4, further comprising a filter layer on a side of the substrate layer, the filter layer allowing water vapor to pass through and not allowing water to pass through, the side being opposite to a side of a surface, to which the water pipe is attached, of the substrate layer.

7. The functional layer according to claim 3, wherein the functional layer or the object of using function is shaken, and thereby air exchange between air in the air layer and air outside the air layer is promoted.

8. A cooling layer comprising:

   a hollow fiber membrane having micropores in a pipe wall, water exuding from the micropores;
   an interlining layer to which the hollow fiber membrane is attached; and
   a water absorption and diffusion layer placed in contact with a surface, to which the hollow fiber membrane is attached, of the interlining layer, wherein
   the cooling layer is used by being layered on an object to be cooled that uses a cooling function provided to the cooling layer.

9. The cooling layer according to claim 8, wherein the object to be cooled is clothing or a human body.

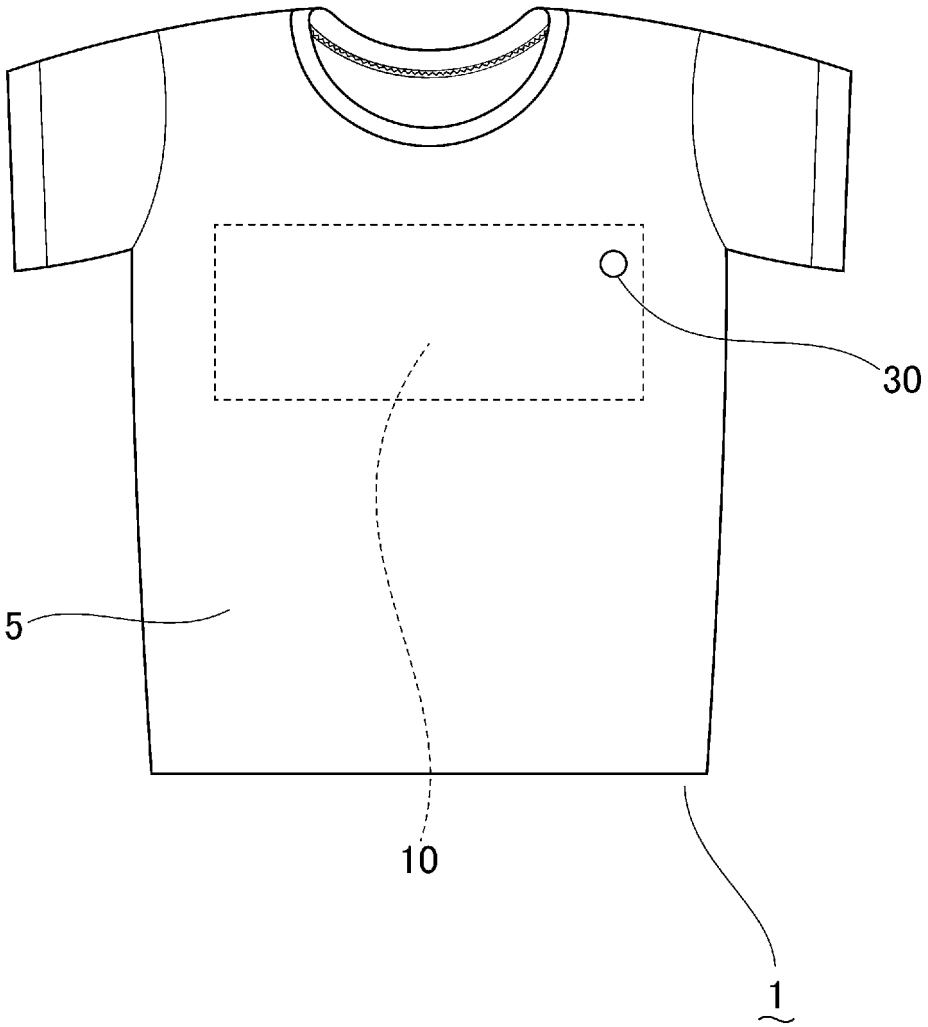
10. The cooling layer according to claim 9, wherein an air layer is present between the cooling layer and clothing or a human body.

11. The cooling layer according to claim 9 or 10, further comprising a filter layer on a side of the water absorption and diffusion layer, the filter layer allowing water vapor to pass through and not allowing water to pass through, the side being opposite to a side that is in contact with a surface, to which the hollow fiber membrane is attached, of the interlining layer.

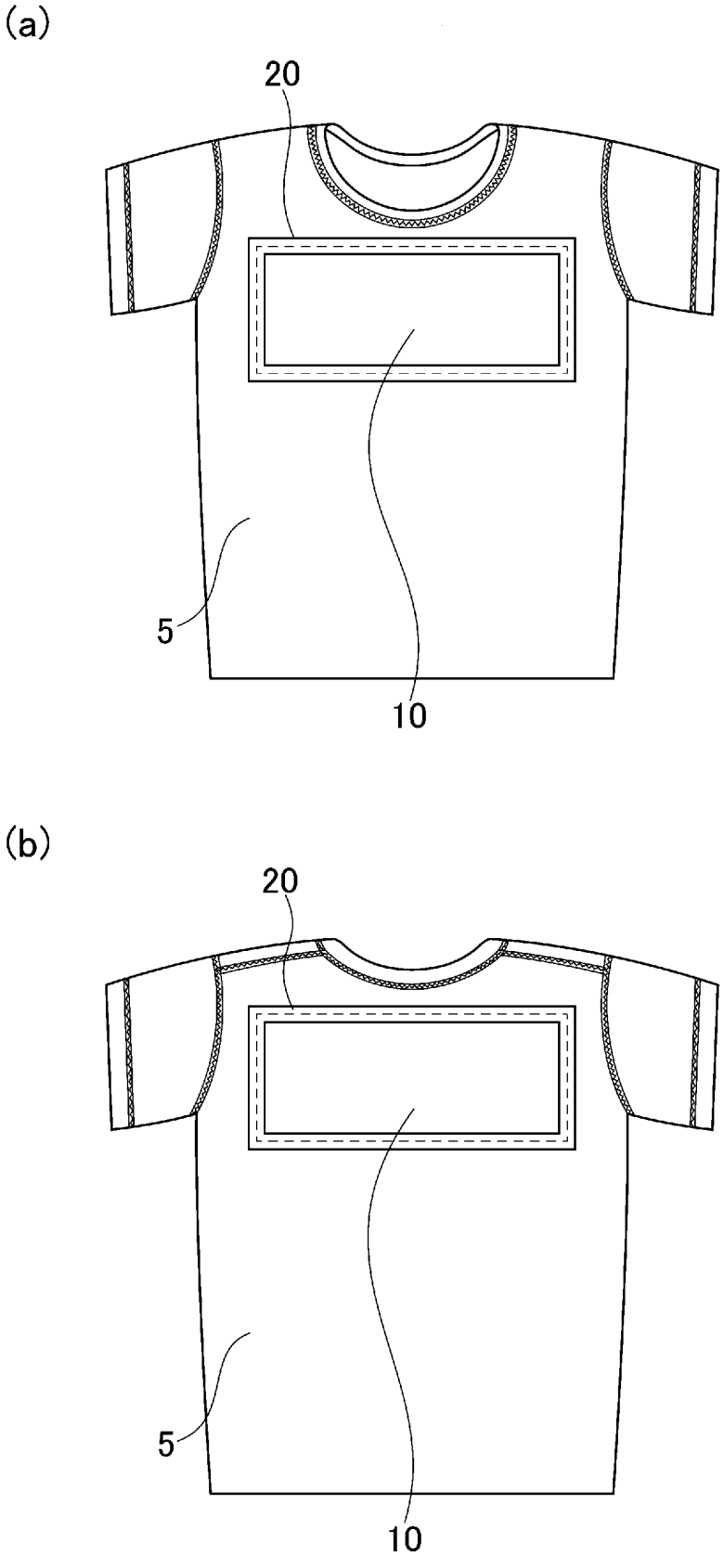
12. The cooling layer according to claim 9 or 10, further comprising a filter layer on a side of the interlining layer, the filter layer allowing water vapor to pass through and not allowing water to pass through, the side being opposite to a side of a surface to which the hollow fiber membrane is attached.

13. The cooling layer according to claim 10, wherein the cooling layer or the object to be cooled is shaken, and thereby air exchange between air in the air layer and air outside the air layer is promoted.

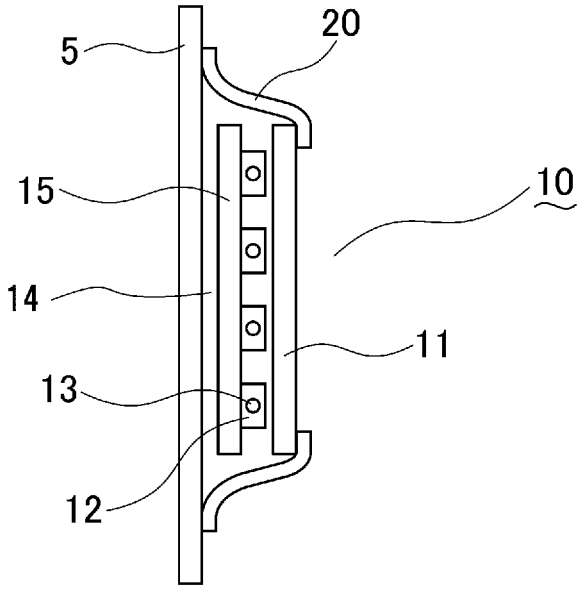
[Figure 1]



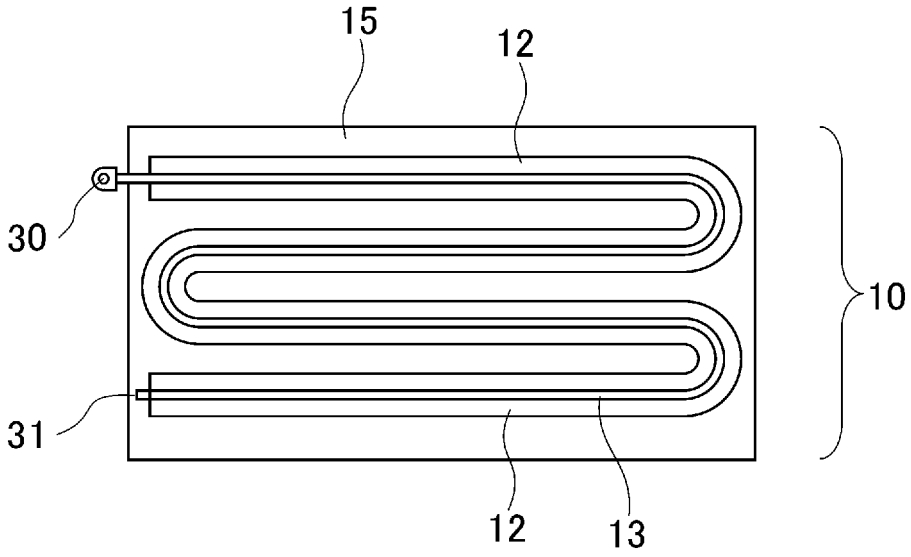
[Figure 2]



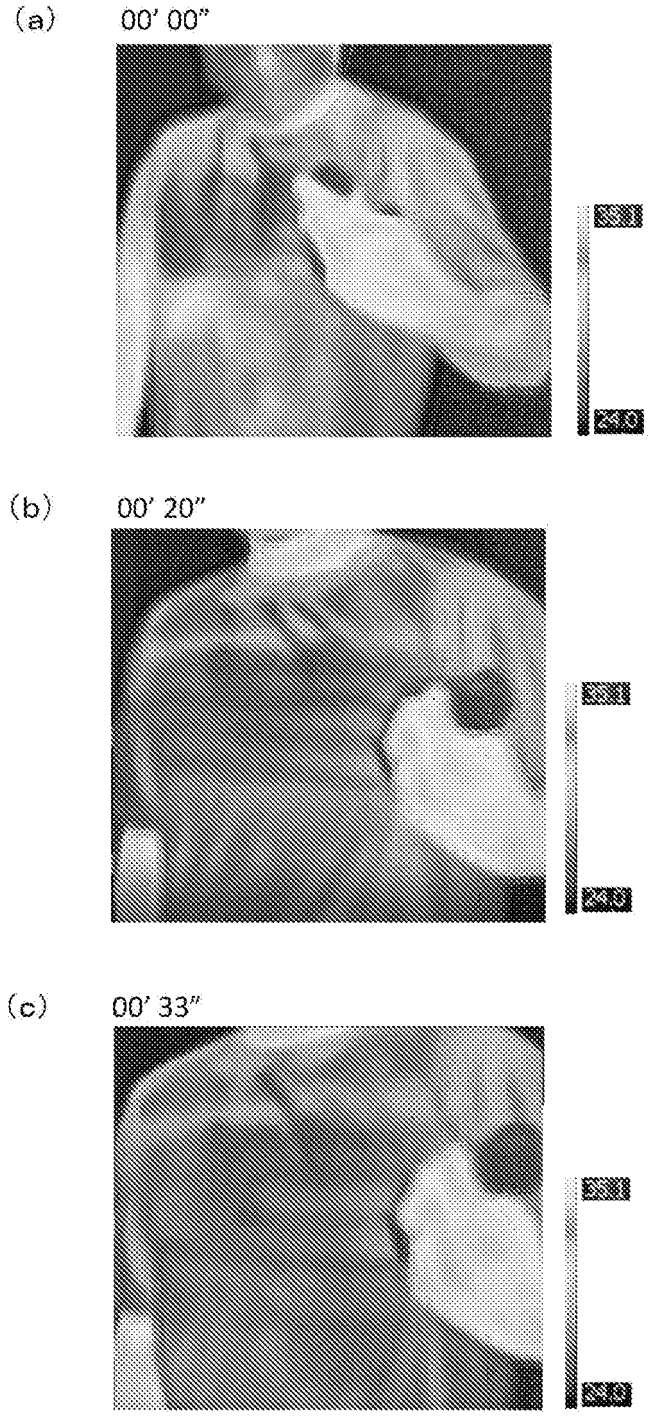
[Figure 3]



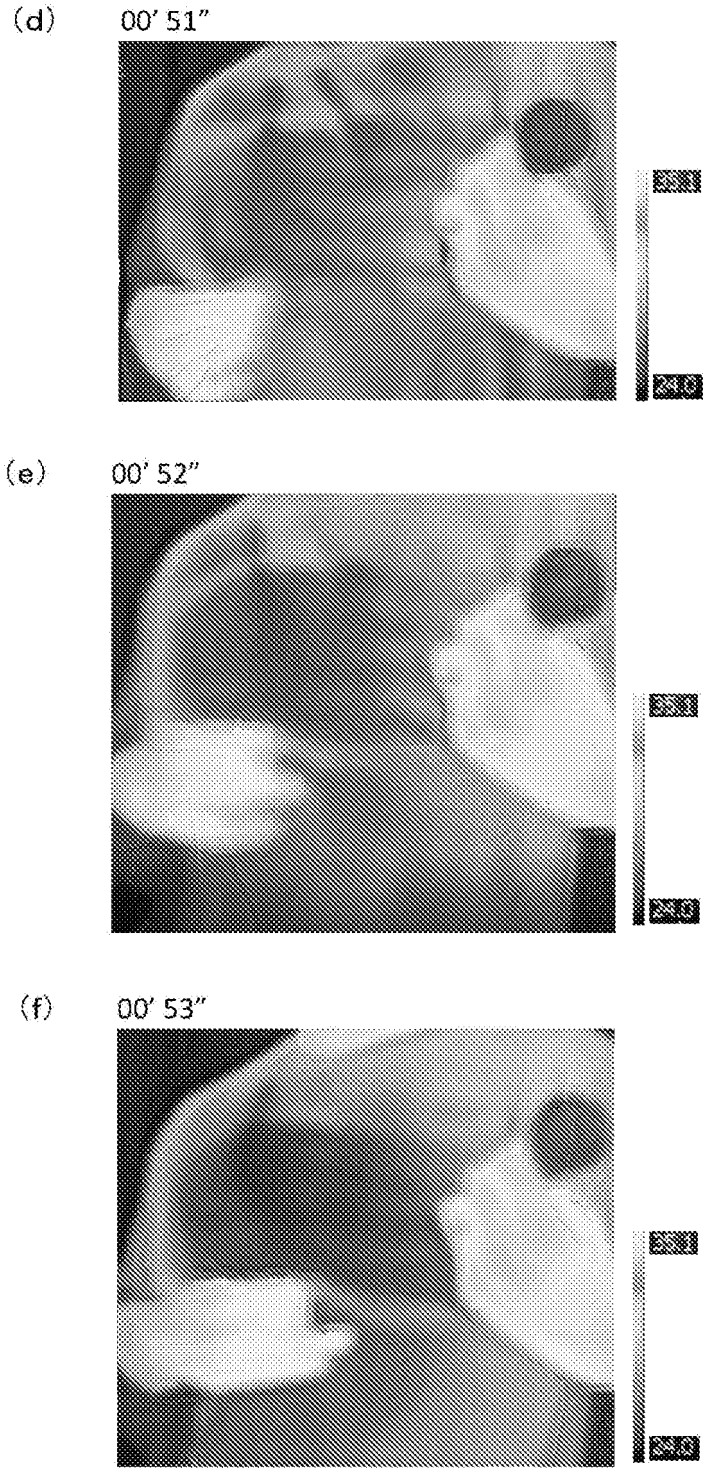
[Figure 4]



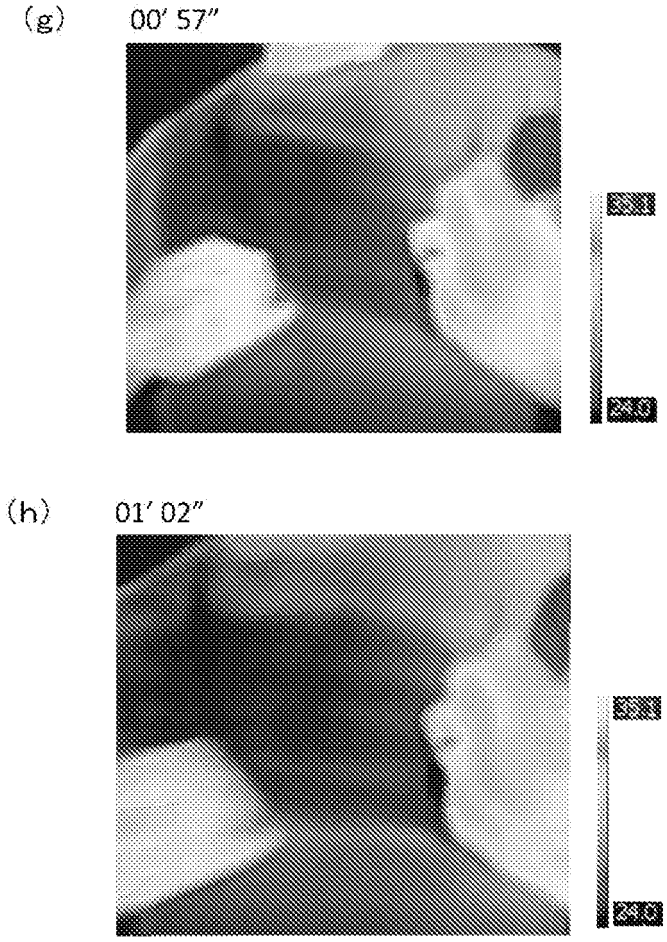
[Figure 5]



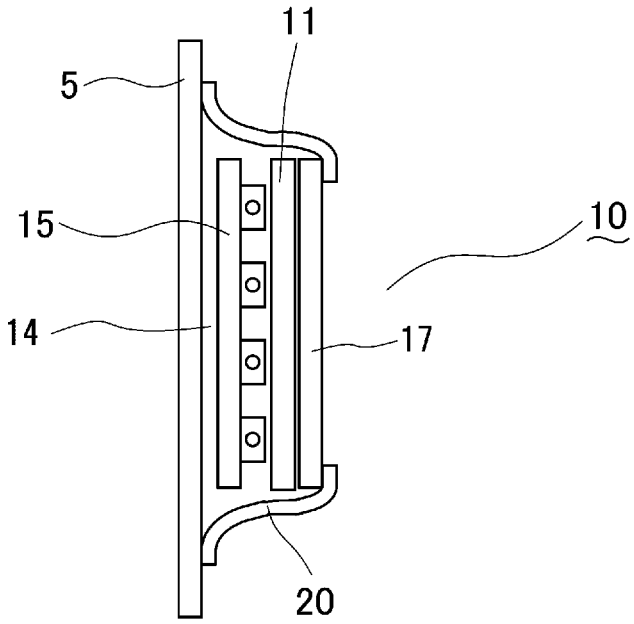
[Figure 6]



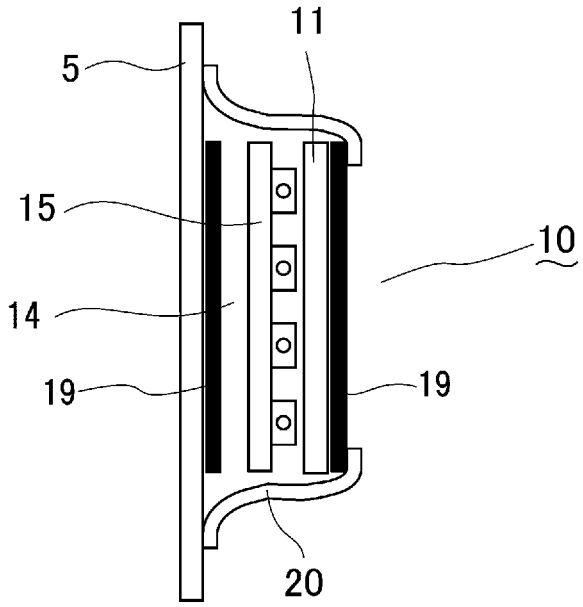
[Figure 7]



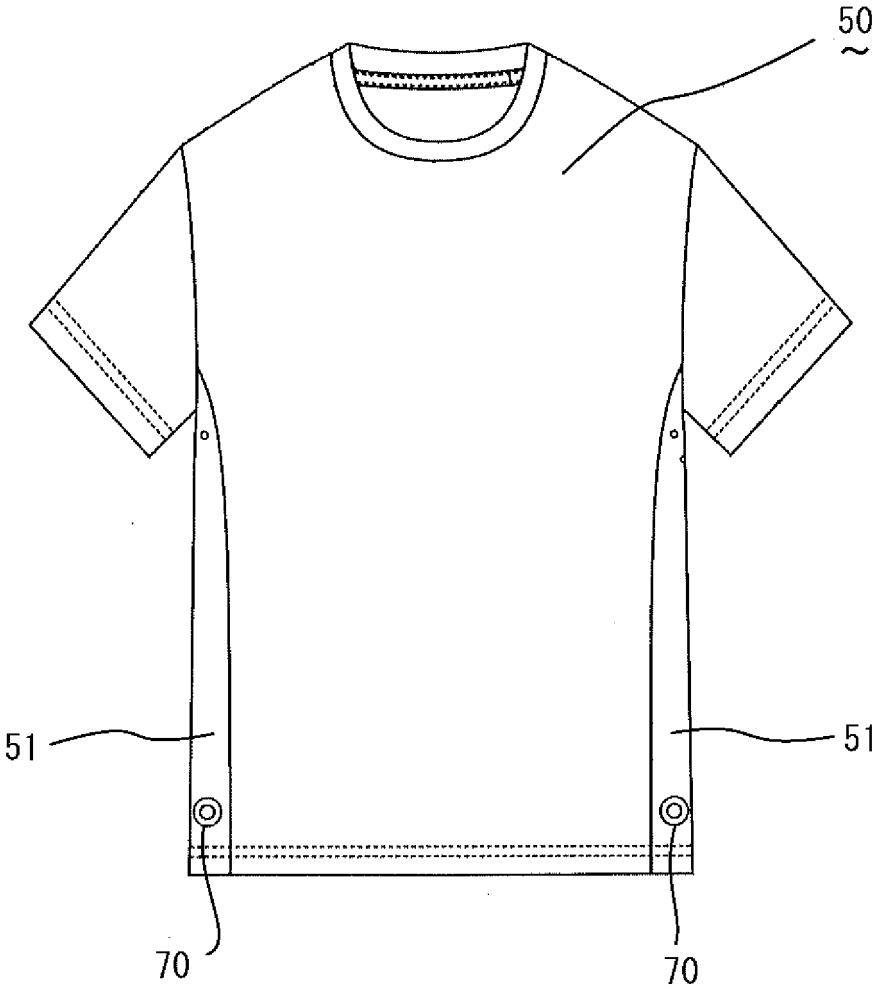
[Figure 8]



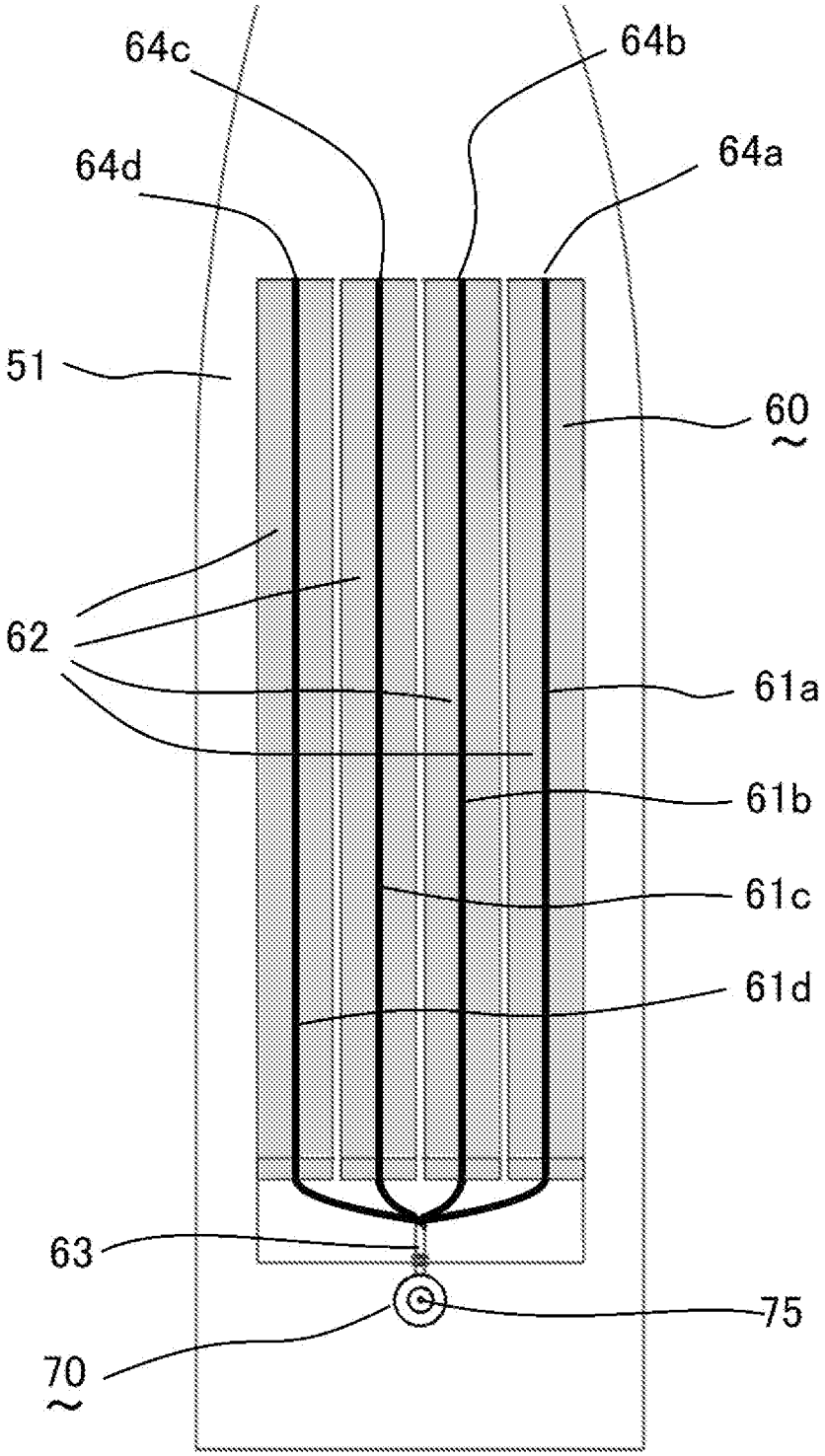
[Figure 9]



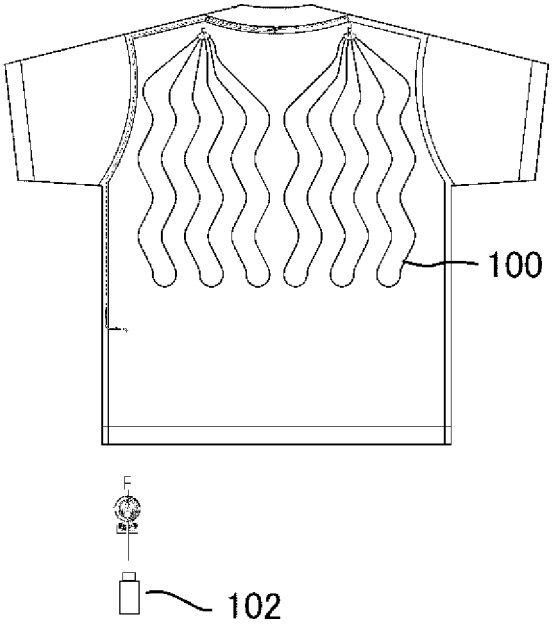
[Figure 10]



[Figure 11]



[Figure 12]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/027932

A. CLASSIFICATION OF SUBJECT MATTER

A41D 13/005(2006.01)i
FI: A41D13/005 106

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)

A41D13/005

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/0031428 A1 (PAULL, Leslie Owen) 11 February 2010 (2010-02-11) paragraphs [0017], [0018], [0021], [0028], [0030], [0031], [0038], [0042], fig. 1-6	1, 3, 7
Y		2, 5-6, 8-13
A		4
Y	JP 2019-218666 A (SANESU KK) 26 December 2019 (2019-12-26) paragraphs [0022], [0023]	2, 5-6, 8-13
Y	WO 2020/263090 A1 (TIESNITSCH BEHEER B. V.) 30 December 2020 (2020-12-30) p. 1, line 32 to p. 2, line 3, p. 9, lines 6-14	5-6, 11-12

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Date of the actual completion of the international search	Date of mailing of the international search report
06 September 2022	**20 September 2022**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/027932

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
US 2010/0031428 A1	11 February 2010	WO 2010/017036 A1	
JP 2019-218666 A	26 December 2019	(Family: none)	
WO 2020/263090 A1	30 December 2020	CN 114173595 A	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2019218666 A **[0004]**
- JP 2021058676 A **[0024]**