



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.11.2015 Bulletin 2015/45

(51) Int Cl.:
A41D 13/002 (2006.01)

(21) Application number: **14194761.4**

(22) Date of filing: **25.11.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **Yue, Steven**
Taipei City 114 (TW)

(72) Inventor: **Yue, Steven**
Taipei City 114 (TW)

(74) Representative: **Cordina, Kevin John**
Olswang LLP
90 High Holborn
London WC1V 6XX (GB)

(30) Priority: **02.05.2014 TW 103115829**
20.08.2014 TW 103214874

(54) **Heat-dissipating garment**

(57) A heat-dissipating garment includes a clothing main body (1) that has a front portion (13), a rear portion (14), and a pair of side portions (15). The clothing main body (1) is formed with at least two first channels (17) respectively at the front and rear portions (13, 14), two second channels (3) respectively at the side portions (15), and a third channel (6) connected to upper ends

respectively of the first and second channels (17, 18) and in spatial communication therewith. Two first airflowguides (2) are disposed respectively in the first channels (17). Two second airflowguides (3) are disposed respectively in the second channels (18). Two fans (4) correspond respectively to lower openings (31) of the second airflow guides (3) for producing airflow.

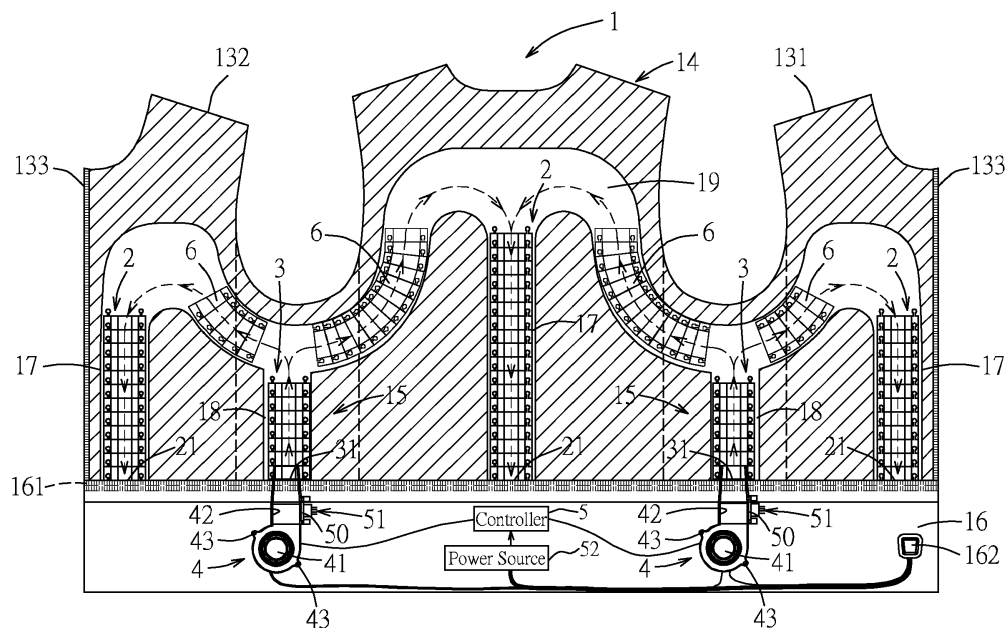


FIG.1

Description

[0001] The present invention relates to a heat-dissipating garment.

[0002] In order to be environmentally friendly, a conventional heat-dissipating garment, such as a cooling suit disclosed in U.S. Patent No. 7,272,946, is configured for allowing a wear comfortable feeling with a low power consumption and a simple structure. The cooling suit includes a cloth part having an upper portion made of a highly air-permeable material, and having those portions other than the upper portion which are made of a substantially air-impermeable material. Formed at a reverse surface of the cloth part are airflow passages between the cloth part and an undergarment. Provided at a lower portion of the cloth part are air outlets for extracting air-streams within the airflow passages to the exterior. Provided at those positions of the reverse side of the cloth part, which correspond to the air outlets, are fans for forcibly causing the air-streams within the airflow passages. Outside air is introduced into the airflow passages by the fans through the upper portion of the cloth part, and the air-streams flow within the airflow passages in a manner substantially parallel to the wearer's body surface, so that the wearer's body is cooled.

[0003] An object of the present invention is to provide a heat-dissipating garment with a different heat-dissipating configuration.

[0004] Accordingly, a heat-dissipating garment of the present invention includes a clothing main body, at least two first airflow guides, two second airflow guides, two fans and a controller.

[0005] The clothing main body includes an outer layer and a lining. The clothing main body has a front portion, a rear portion, and a pair of side portions that are respectively connected between the front portion and the rear portion and between the front portion and the rear portion. The clothing main body is formed with at least two upright-extending first channels, two upright-extending second channels and a transversely-extending third channel. The first channels are formed respectively at the front portion and the rear portion between the outer layer and the lining. The second channels are formed respectively at the side portions between the outer layer and the lining. The third channel is connected to upper ends respectively of the first and second channels, and is in spatial communication with the first and second channels.

[0006] The first airflow guides are disposed respectively in the first channels, and have respective lower openings. The second airflow guides are disposed respectively in the second channels and have respective lower openings. The fans correspond respectively to the lower openings of the second airflow guides and produce airflow that flows through the lower openings of the second airflow guides into the second airflow guides toward the third channel, that flows through the third channel toward the first airflow guides, and that is discharged from the clothing main body through the lower openings of the first

airflow guides. The controller is electrically connected to the fans to control rotational speed of the fans.

[0007] Other features and advantages of the present invention will become apparent in the following detailed description of the embodiments with reference to the accompanying drawings, of which:

Figure 1 is a schematic sectional view of a first embodiment of a heat-dissipating garment of the present invention;

Figure 2 is a fragmentary sectional side view of the first embodiment of the heat-dissipating garment for illustrating an outer layer, a lining and a plurality of protruding members;

Figure 3 is a circuit block diagram of the first embodiment of the heat-dissipating garment;

Figure 4 is a schematic sectional front view of the first embodiment for illustrating a front portion of the heat-dissipating garment;

Figure 5 is a schematic sectional rear view of the first embodiment for illustrating a rear portion of the heat-dissipating garment;

Figure 6 is a schematic sectional side view of the first embodiment for illustrating one of a pair of side portions of the heat-dissipating garment;

Figure 7 is a schematic perspective view of a duct component of the first embodiment;

Figure 8 is a schematic perspective view of an engaging member of the first embodiment for engaging an external pipe;

Figure 9 is a schematic perspective view of the first embodiment for illustrating the engaging member engaging the external pipe;

Figure 10 is a fragmentary schematic view of the first embodiment for illustrating how the engaging member is disengaged from the external pipe;

Figure 11 is a schematic sectional view of the first embodiment for illustrating the heat-dissipating garment is connected to an air purifying device.

Figure 12 is a schematic sectional view of a second embodiment of a heat-dissipating garment of the present invention;

Figure 13 is a fragmentary schematic perspective view of an air flow guide of the second embodiment;

Figure 14 is a fragmentary sectional side view of the second embodiment for illustrating the air flow guide attached to a lining; and

Figure 15 is a schematic sectional front view of a third embodiment of a heat-dissipating garment of the present invention for illustrating a front portion of the heat-dissipating garment.

[0008] Before the present invention is described in greater detail, it should be noted that like elements are denoted by the same reference numerals throughout the disclosure.

[0009] Referring to Figures 1 to 3, a first embodiment of a heat-dissipating garment according to the present

invention is shown to include at least a clothing main body 1, three first air flow guides 2, two second air flow guides 3, two fans 4 and a controller 5.

[0010] The clothing main body 1 includes an outer layer 11 and a lining 12. The clothing main body 1 has a front portion 13, a rear portion 14, a pair of side portions 15 and a lower portion 16. The front portion 13 has a front-left part 131 and a front-right part 132. One of the side portions 15 is connected between the front-left part 131 and the rear portion 14, and the other one of the side portions 15 is connected between the front-right part 132 and the rear portion 14. The lower portion 16 is connected among the front-left part 131, the front-right part 132, the rear portion 14 and the side portions 15. The lining 12 is generally made of a fabric with moisture-absorbing and fast-drying characteristics.

[0011] The clothing main body 1 is formed with three upright-extending first channels 17, two upright-extending second channels 18, and a transversely-extending third channel 19. The first channels 17 are formed respectively at the front-left part 131, the front-right part 132 and the rear portion 14 between the outer layer 11 and the lining 12. The second channels 18 are formed respectively at the side portions 15 between the outer layer 11 and the lining 12. The third channel 19 is formed between the outer layer 11 and the lining 12, is connected to upper ends respectively of the first and second channels 17, 18, and is in spatial communication with the first and second channels 17, 18.

[0012] While the first and second channels 17, 18 extend vertically in this embodiment, they may extend inclinedly in other embodiments, and the present invention should not be limited in this respect.

[0013] The first airflow guides 2 are disposed respectively in the first channels 17, and have respective lower openings 21. The second airflow guides 3 are disposed respectively in the second channels 18, and have respective lower openings 31. The fans 4 are disposed in the lower portion 16 of the clothing main body 1. The fans 4 correspond respectively to the lower openings 31 of the second airflow guides 3 in position. Each of the fans 4 has an airflow access 41 exposed out of the outer layer 11 of the clothing main body 1, and an air pipe 42 connected to a corresponding one of the lower openings 31 of the second airflow guides 3. The airflow access 41 allows airflow to flow through the air pipe 42 and the lower opening 31 into the second airflow guide 3 toward the third channel 19. Then, the airflow directed into the third channel 19 flows through the third channel 19 toward the first airflow guides 2 in the first channels 17, and is discharged from the clothing main body 1 through the lower openings 21 of the first airflow guides 2.

[0014] Referring to Figures 1, and 4 to 6, the layout of the third channel 19 is configured in a manner that, when a wearer wears the heat-dissipating garment of this embodiment, the third channel 19 extends along the body parts that are likely to perspire heavily, such as the chest, the back, the armpits, etc.. Accordingly, the perspiration

excreted through the skin will be absorbed by the lining 12 and infiltrates into the third channel 19 through the lining 12. The moisture and heat generated by the wearer will be carried by the airflow produced by the fans 4 to flow through the third channel 19 toward the first airflow guides 2 so as to be discharged from the clothing main body 1 through the lower openings 21 of the first airflow guides 2, thereby achieving heat-dissipation.

[0015] To enhance the effectiveness of heat-dissipation, the first embodiment of the heat-dissipating garment further includes four third airflow guides 6 that are disposed in the third channel 19 and that have respective airflow inlets 61 and airflow outlets 62. In particular, two of the third airflow guides 6 extend in the third channel 19 respectively from the side portions 15 to the front-right portion 132 and the front-left portion 131, respectively. The remaining two of the third airflow guides 6 extend in the third channel 19 respectively from the side portions 15 to the rear portion 14. Specifically, the airflow inlets 61 of two of the third airflow guides 6 flank the upper end of one of the second channels 18, which corresponds to one of the armpits of the wearer in position, and the airflow inlets 61 of the other two of the third airflow guides 6 flank the upper end of the other one of the second channels 18, which corresponds to the other one of the armpits of the wearer in position. Further, the airflow outlets 62 of the third airflow guides 6 correspond to the chest and the back of the wearer. With such configuration, the third channel 19 corresponding to the abovementioned body parts that sweat heavily may not be blocked, and, the airflow within the garment may flow smoothly, thereby achieving better heat-dissipation.

[0016] Moreover, as shown in Figures 1 and 7, each of the first, second and third airflow guides 2, 3, 6 of the first embodiment is a duct constituted by a plurality of duct components 7 that are separably connected to one another in succession. Each of the duct components 7 includes a duct body 71, and a pair of connecting components 72 disposed at opposite sides of the duct body 71. Each of the connecting components 72 has a male structure 73 on one side, and a female structure 74 on the other side for matching and connecting to the male structure 73 of another connecting component 72. Therefore, the first, second and third airflow guides 2, 3, 6 may respectively have desired lengths and shapes by interconnecting a desired number of the duct components 7 with the desired shapes.

[0017] The controller 5 in this embodiment is disposed in the lower portion 16 of the clothing main body 1. The controller 5 is electrically connected to the fans 4 for controlling rotational speed of the fans 4. A power source 52, such as a rechargeable battery, maybe further provided in the lower portion 16 for supply of electricity to the fans 4 and the controller 5.

[0018] Referring further to Figures 1 and 4, the first embodiment of the heat-dissipating garment further includes a first connecting member 133 that is disposed at the front-left part 131 and the front-right part 132 for in-

terconnecting separably the front-left part 131 and the front-right part 132. The first embodiment of the heat-dissipating garment further includes a second connecting member 161 that is disposed among the front-left part 131, the front-right part 132, the rear portion 14, the side portions 15 and the lower portion 16 for connecting separably the lower portion 16 to the front-left part 131, the front-right part 132, the rear portion 14 and the side portions 15 such that the lower portion 16, where the fans 4, the controller 5 and the power source 52 are disposed, may be separated from the clothing main body 1 to ensure safety in case that the heat-dissipating garment is washed. Each of the first and second connecting members 133, 161 in this embodiment may be a zipper, a hook-and-loop fastener or other connecting elements as long as the same effect can be achieved.

[0019] Referring to Figure 2, the clothing main body 1 in this embodiment further includes a plurality of protruding members 10 that are disposed in the first, second and third channels 17, 18, 19 and that protrude from inner surfaces respectively of the outer layer 11 and the lining 12 which face each other. The protruding members 10 are configured for spacing the outer layer 11 and the lining 12 apart so as to prevent blocking of the first, second and third channels 17, 18, 19.

[0020] To further enhance the effectiveness of heat dissipation, the first embodiment of the heat-dissipating garment as shown in Figure 1 may also include two cooling chips 50 that are disposed respectively on the air pipes 42 of the fans 4 and that are controlled by the controller 5. Particularly, each of the cooling chips 50 has a cold side that is attached to an outer surface of the air pipe 42 of a respective one of the fans 4 so as to lower the temperature of the airflow from the respective airflow access 42 toward the corresponding second airflow guide 3. The power source 52 is connected electrically to the cooling chips 50 for providing electric power to the cooling chips 50. The controller 5 is connected electrically to the cooling chips 50 for controlling temperature of the cold sides.

[0021] Moreover, each of the cooling chips 50 has a hot side opposite to the cold side. When the cooling chip 50 is in operation, current flow brings the heat from cold side to the hot side, so that the cold side gets cooler while the hot side gets hotter. Therefore, in order to improve the performance of the cooling chips 50, the heat-dissipating garment further includes two heat sinks 51 that are attached respectively to the hot sides of the cooling chips 50. As a result, the hot sides may remain at ambient temperature such that the heat keeps flowing from the cold sides to the hot sides, and the temperature at the cold sides may be kept low.

[0022] The heat-dissipating garment may further include a user operating unit 162 that is mounted on the lower portion 16 of the clothing main body 1 as shown in Figure 1 and that allows manual control of the controller 5. The user operating unit 162 has, for example, two operating panels (not shown) for controlling respectively

the temperature of the cold sides of the cooling chips 50 and the rotational speed of the fans 4. By controlling cooperatively the two factors mentioned above, the wearer may conveniently obtain a desired temperature. Furthermore, the heat-dissipating garment may include optionally a remote controller 100, as shown in Figure 3, for controlling remotely the controller 5 to enable operations of the fans 4 and the cooling chips 50, respectively. For example, the remote controller 100 may be a smart phone with remote-control function or a universal remote controller.

[0023] Referring to Figures 1 and 8 to 10, the first embodiment of the heat-dissipating garment may further include two engaging members 9 that are mounted respectively to the fans 4. Each of the engaging members 9 is adapted to engage an external pipe 200 that provides cool air. Specifically, each engaging member 9 includes an engaging ring 91, and is formed with a pair of through holes 92 at diametrically opposite sides of the engaging ring 91. The through holes 92 of the engaging member 9 are to be registered with two connecting holes 43 formed on a periphery of the airflow access 41 of the respective fan 4, such that the engaging member 9 is fastened removably to the respective fan 4 while an opening 910 of the engaging ring 91 is registered with the airflow access 41 of the respective fan 4. Each engaging member 9 further includes three resilient plates 93 that protrude from an inner surface of the engaging ring 91 into the opening 910.

[0024] When an engaging portion 201 of the external pipe 200 is inserted into the opening 910 of the engaging ring 91, the resilient plates 93 are first pressed by the engaging portion 201 of the external pipe 200 and then snap respectively into three grooves 202 that are formed at an outer surface of the engaging portion 201, so that the engaging portion 201 engages removably the engaging member 9. Accordingly, cold airflow generated by a cold air generating apparatus (e.g., an air conditioner) may be directed to the fans 4 through the external pipes 200, and may be further be guided in sequence sequentially to the second, third and first airflow guides 3, 6, 2 by propulsion of the fans 4. As a result, effectiveness of heat dissipation of the heat-dissipating garment is improved.

[0025] The external pipe 200 can be removed from the engaging member 9 by simply rotating the engaging portion 201 of the external pipe 200 in a direction as indicated by an arrow in Figure 10. Accordingly, the resilient plates 93 are urged to exit the grooves 202 of the engaging portion 201, and thus, the engaging portion 201 is disengaged from the engaging ring 91.

[0026] Referring to Figure 11, the first embodiment of the heat-dissipating garment may further include three airflow exhausting pipes 101 and a main pipe 102. Each of the airflow exhausting pipes 101 has one end 1011 that corresponds to and is in spatial communication with the lower opening 21 of a respective one of the first airflow guides 2, and the other end 1012 that is in spatial

communication with one end 1021 of the main pipe 102. The other end 1022 of the main pipe 102 is configured for connecting to an air purifying device 300. The airflow discharged from the lower openings 21 of the first airflow guides 2 flows through the airflow exhausting pipes 101 and the main pipe 102 into the air purifying device 300, and is purified by and discharged from the air purifying device 300. With such configuration, the wearer who works in an unventilated space (e.g., a factory) may not be affected by the discharged heat, and an air quality in the unventilated space may be improved.

[0027] Referring to Figure 12, a second embodiment of the heat-dissipating garment of the present invention is shown to be similar to the first embodiment. The difference resides in that each of the first, second and third airflow guides 2', 3', 6' in this embodiment has a different structure, is formed in one-piece, and is flexible. Referring further to Figures 13 and 14, each of the first, second and third airflow guides 2', 3', 6' includes a base plate 81, plural pairs of wing components 82, and plural pairs of protruding plates 83. Specifically, the base plate 81 is attached to the lining 12 of the heat-dissipating garment, and has two opposite edges extending along a corresponding one of the first, second and third channels 17, 18, 19. As for each pair of the protruding plates 83, the protruding plates 83 protrude respectively from the edges of the base plate 81 toward the outer layer 11. The protruding plates 83 are arranged along the two opposite edges of the base plate 81, and cooperate with the base plate 81 and the outer layer 11 to define an air passageway 84 thereamong. As for each pair of the wing components 82, the wing components 82 extend respectively from the edges of the base plate 81 away from the air passageway 84, and are sewn onto the lining 12.

[0028] Similarly, the airflow generated by the fans 4 may be guided to the third channel 19 through the second airflow guides 3', and may carry the moisture and heat excreted by the wearer, particularly on the chest, the back or the armpits, to exit the clothing main body 1 through the third and first airflow guides 6', 2', thereby achieving heat-dissipation.

[0029] Referring to Figure 15, a third embodiment of the heat-dissipating garment of the present invention is shown to be similar to the first embodiment. The difference resides in that the heat-dissipating garment is a vest formed into a single piece. In particular, the front portion 13' of the clothing main body 1' in this embodiment cannot be separated into two parts, and is formed, between the outer layer 11 and the lining 12, with only one upright-extending first channel 17. Therefore, the front portion 13' is provided with only one first airflow guide 2 that is disposed in the first channel 17.

[0030] To conclude, some advantages of the heat-dissipating garment according to the present invention are as follows:

1. When the heat-dissipating garment of the present invention is worn by the wearer, the third channel 19

extends along the body parts that are likely to perspire heavily, such as the chest, the back, the armpits, etc.. As a result, more effective heat dissipation may be achieved for those body parts.

2. The configurations of the first, second and third airflow guides 2, 2', 3, 3', 6, 6' disposed within the first, second and third channels 17, 18, 19 may improve transmission efficiency of the airflow, thereby improving effectiveness of heat dissipation.

3. By virtue of the cooling chips 50, the heat sinks 51 and the external pipe 200, the effectiveness of heat dissipation may be further enhanced.

4. By virtue of the airflow exhausting pipes 101 and the main pipe 102 that are connected between the first airflow guides 2, 2' and the air purifying device 300, discharged heat may be purified such that air quality may be improved.

Claims

1. A heat-dissipating garment **characterized by:**

a clothing main body (1) including an outer layer (11) and a lining (12), and having a front portion (13), a rear portion (14), and a pair of side portions (15) that are respectively connected between said front portion (13) and said rear portion (14) and between said front portion (13) and said rear portion (14), said clothing main body (1) being formed with

at least two upright-extending first channels (17) that are formed respectively at said front portion (13) and said rear portion (14) between said outer layer (11) and said lining (12),

two upright-extending second channels (18) that are formed respectively at said side portions (15) between said outer layer (11) and said lining (12), and

a transversely-extending third channel (19) that is connected to upper ends respectively of said first and second channels (17, 18) and that is in spatial communication with said first and second channels (17, 18) ;

at least two first airflow guides (2) disposed respectively in said first channels (17) and having respective lower openings (21);

two second airflow guides (3) disposed respectively in said second channels (18) and having respective lower openings (31);

two fans (4) corresponding respectively to said lower openings (31) of said second airflow guides (3) for producing airflow that flows through said lower openings (31) of said second airflow guides (3) into said second airflow guides (3) toward said third channel (19), that flows through said third channel (19) toward said first airflow guides (2), and that is discharged from

- said clothing main body (1) through said lower openings (21) of said first airflow guides (2); and a controller (5) electrically connected to said fans (4) to control rotational speed of said fans (4).
2. The heat-dissipating garment as claimed in Claim 1, **characterized in that** said front portion (13) of said clothing main body (1) has a front-right part (132) and a front-left part (131), and said side portions (15) are respectively connected between said front-right part (132) and said rear portion (14) and between said front-left part (131) and said rear portion (14), wherein said heat-dissipating garment is **characterized by** three of said upright-extending first channels (17) formed respectively at said front-right part (132), said front-left part (131) and said rear portion (14), and three of said first airflow guides (2) disposed respectively in said first channels (17).
 3. The heat-dissipating garment as claimed in Claim 2, characterized in that said clothing main body (1) further has a lower portion (16) that is connected among said front-right part (132), said front-left part (131), said rear portion (14) and said side portions (15), and said fans (4) and said controller (5) are disposed in said lower portion (16).
 4. The heat-dissipating garment as claimed in Claim 3, further **characterized by** a connecting member (161) that is disposed among said front-left part (131), said front-right part (132), said rear portion (14), said side portions (15) and said lower portion (16) for connecting separably said lower portion (16) to said front-left part (131), said front-right part (132), said rear portion (14) and said side portions (15).
 5. The heat-dissipating garment as claimed in Claim 2, further **characterized by** a connecting member (133) that is disposed at said front-left part (131) and said front-right part (132) for interconnecting separably said front-left part (131) and said front-right part (132).
 6. The heat-dissipating garment as claimed in Claim 1, further **characterized by** two cooling chips (50) disposed respectively on said fans (4), wherein each of said cooling chips (50) has a cold side that is attached to a respective one of said fans (4), and said controller (5) is connected electrically to said cooling chips (50) for providing electric power to said cooling chips (50) and for controlling temperature of said cold sides.
 7. The heat-dissipating garment as claimed in Claim 6, **characterized in that** each of said cooling chips (50) further has a hot side opposite to said cold side, and said heat-dissipating garment being further **characterized by** two heat sinks (51) that are attached respectively to said hot sides.
 8. The heat-dissipating garment as claimed in Claim 6, further **characterized by** a remote controller (100) for controlling remotely said controller (5) to enable operations of said fans (4) and said cooling chips (50), respectively.
 9. The heat-dissipating garment as claimed in Claim 1, characterized in that said clothing main body (1) further includes a plurality of protruding members (10) that are disposed in said first, second and third channels (17, 18, 19) and that protrude from inner surfaces respectively of said outer layer (11) and said lining (12) that face each other.
 10. The heat-dissipating garment as claimed in Claim 1, further **characterized by** four third airflow guides (6) which are disposed in said third channels (19), two of which flank said upper end of one of said second channels (18), and the other two of which flank said upper end of the other one of said second channels (18).
 11. The heat-dissipating garment as claimed in Claim 10, **characterized in that** each of said first, second and third airflow guides (2, 3, 6) is a duct constituted by a plurality of duct components (7) that are separably connected to one another in succession.
 12. The heat-dissipating garment as claimed in Claim 10, **characterized in that** each of said first, second and third airflow guides (2, 3, 6) includes:
 - a base plate (81) attached to said lining (12) and having two opposite edges extending along a corresponding one of said first, second and third channels (17, 18, 19);
 - at least two protruding plates (83) protruding respectively from said edges of said base plate (81) toward said outer layer (11), and cooperating with said base plate (81) and said outer layer (11) to define an air passageway (84); and
 - at least two wing components (82) extending respectively from said edges of said base plate (81) away from said air passageway (84), and being sewn onto said lining (12).
 13. The heat-dissipating garment as claimed in Claim 1, further **characterized by** two engaging members (9) which are mounted respectively to said fans (4), each of said engaging members being adapted to engage an external pipe (200) providing cool air, such that the cool air is directed into said second airflow guides (3) by said fans (4).
 14. The heat-dissipating garment as claimed in Claim 1,

further **characterized by** at least two airflow exhausting pipes (101) and a main pipe (102), wherein each of said airflow exhausting pipes (101) has one end (1011) that corresponds to and is in spatial communication with said lower opening (21) of a respective one of said first airflow guides (2), and the other end (1012) that is in spatial communication with one end (1021) of said main pipe (102), the other end (1022) of said main pipe (102) being configured for connecting to an air purifying device (300).

15. The heat-dissipating garment as claimed in Claim 1, **characterized in that** said clothing main body (1) further has a lower portion (16) that is connected among said front portion (13), said rear portion (14) and said side portions (15), and said fans (4) and said controller (5) are disposed in said lower portion (16).

20

25

30

35

40

45

50

55

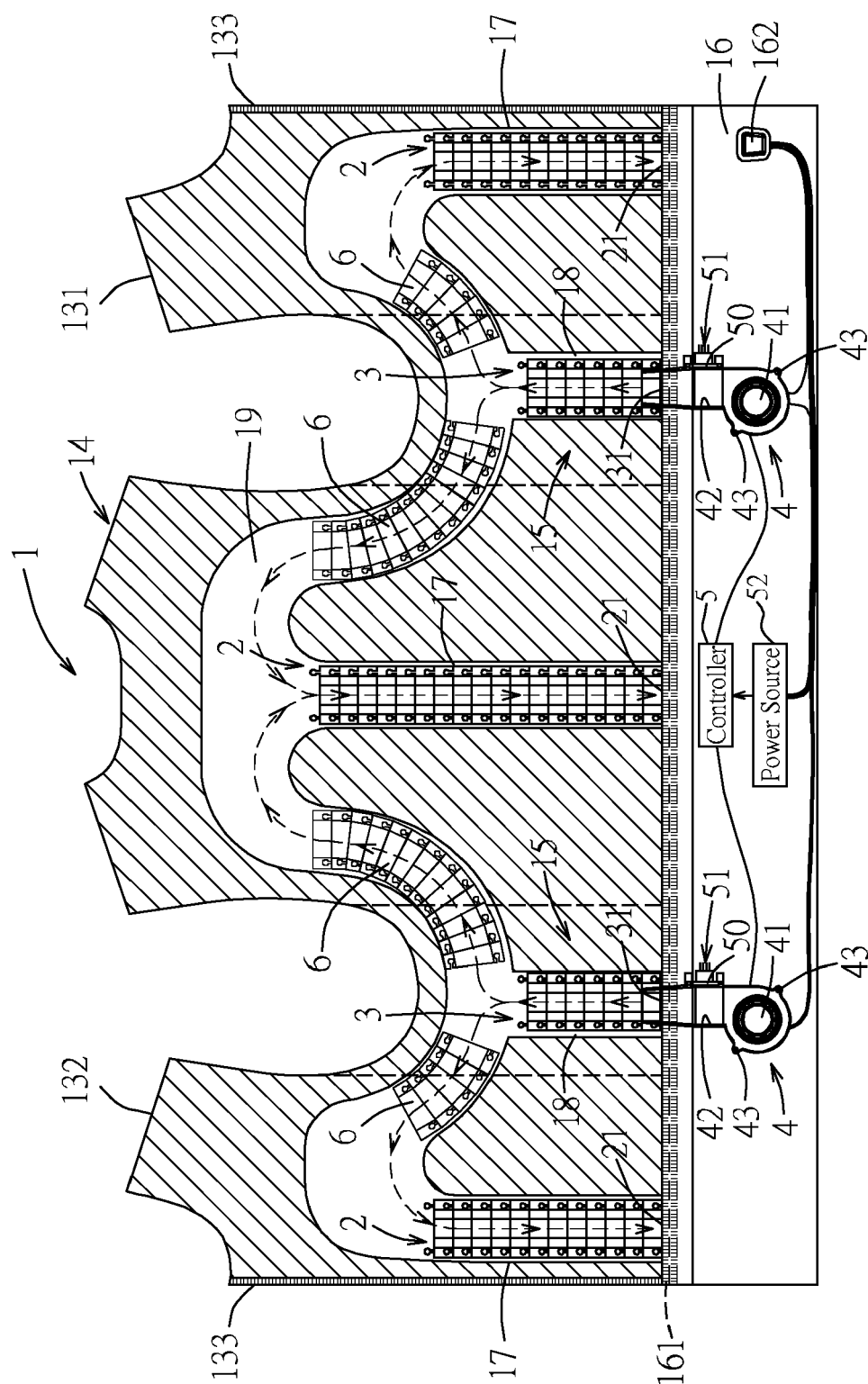


FIG. 1

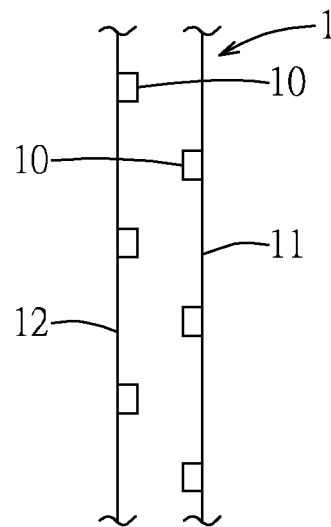


FIG. 2

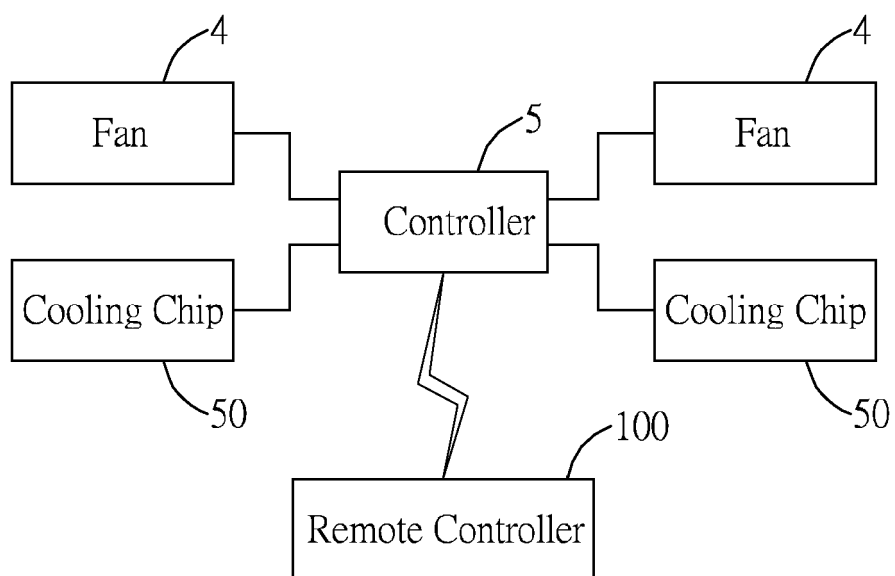


FIG. 3

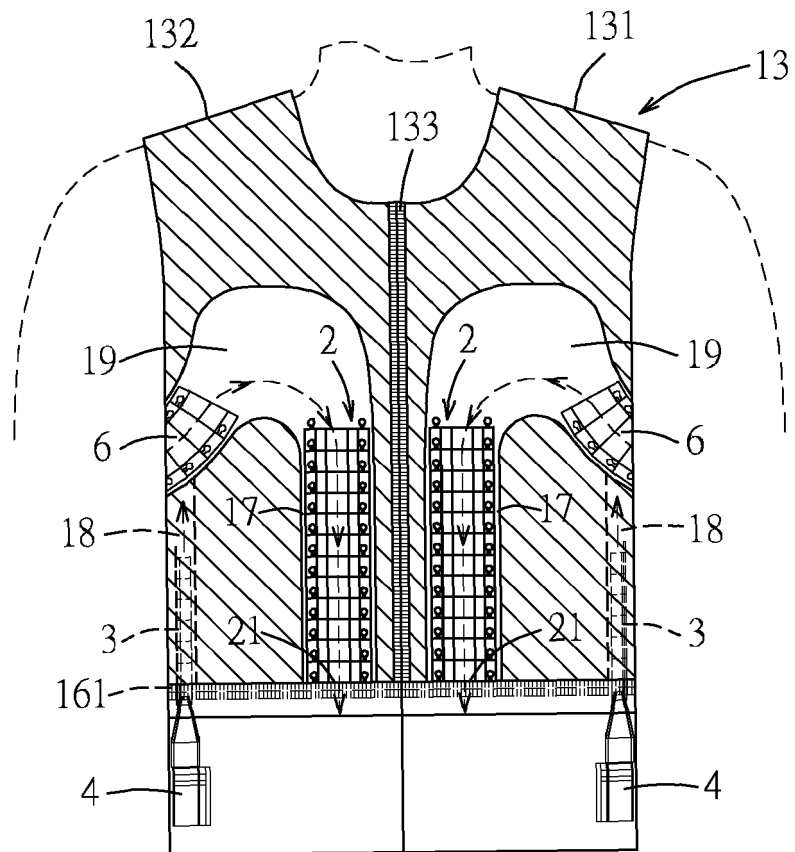


FIG.4

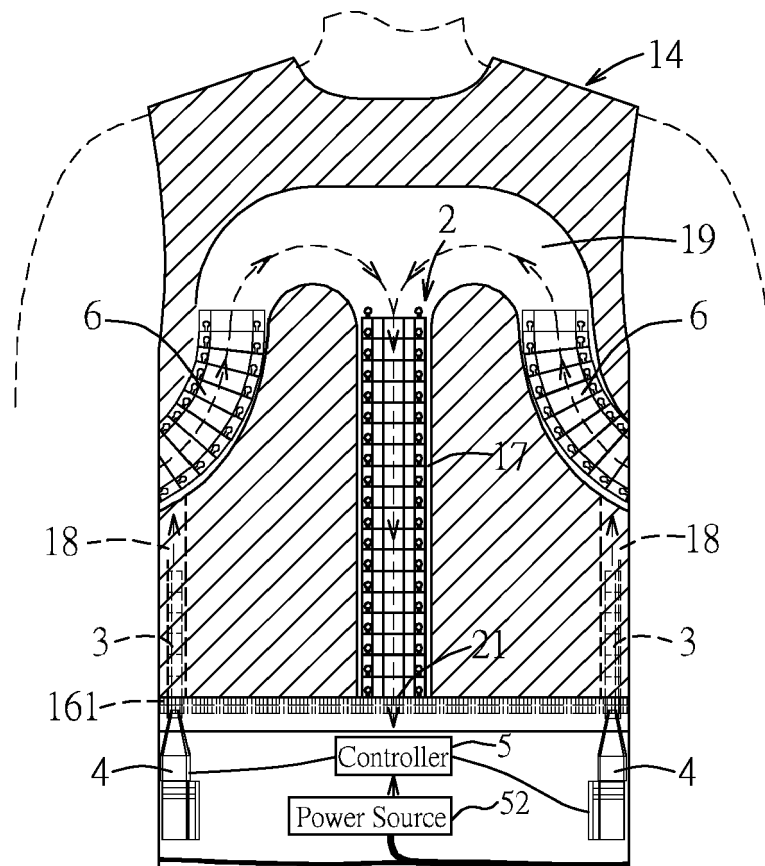


FIG.5

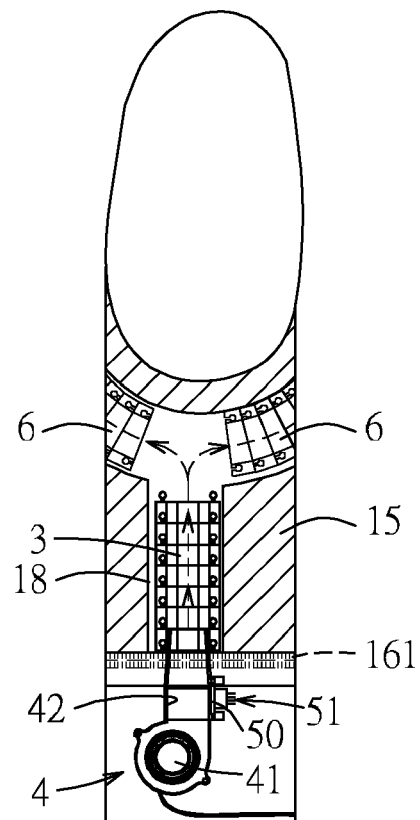


FIG.6

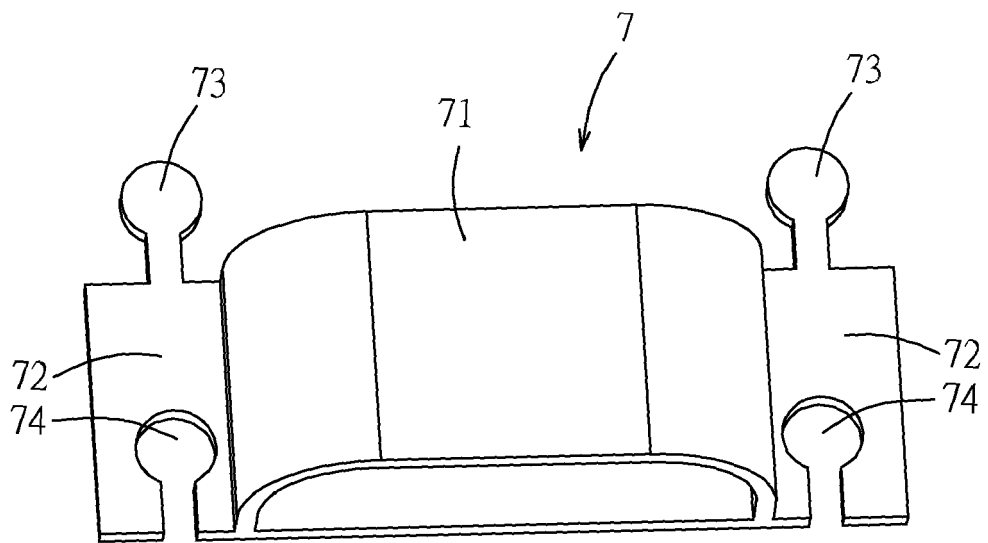


FIG. 7

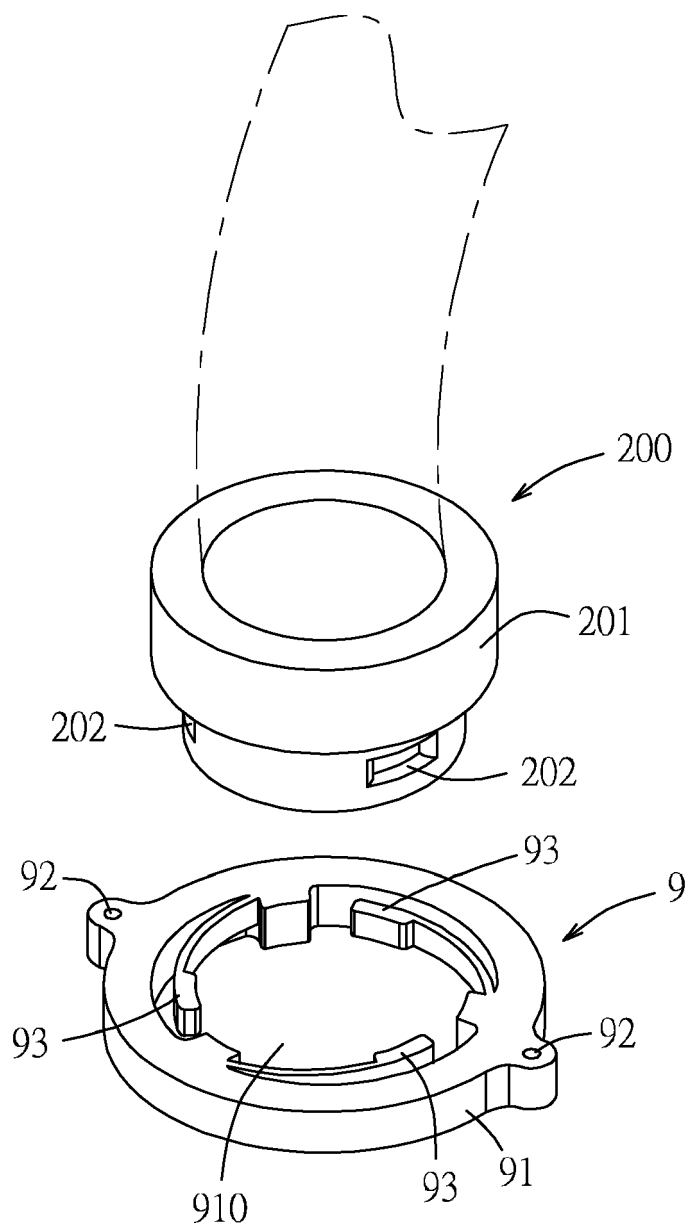


FIG.8

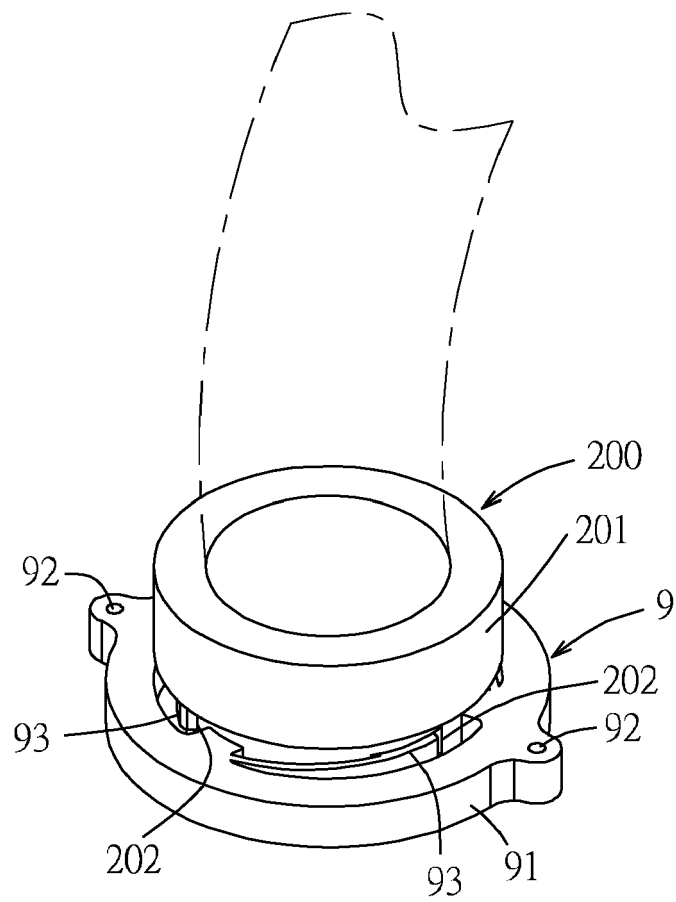


FIG.9

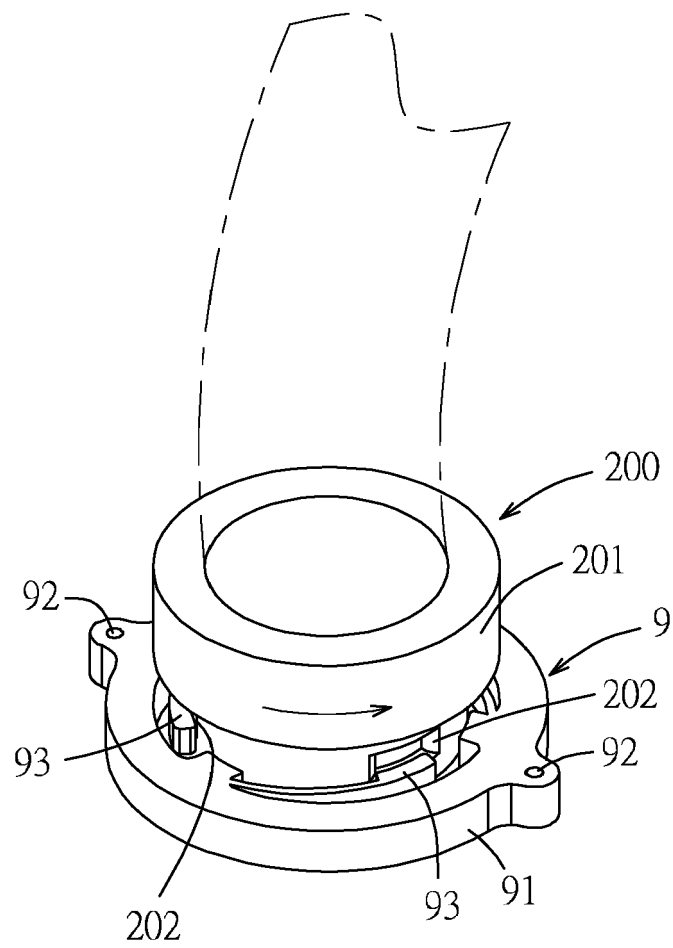


FIG.10

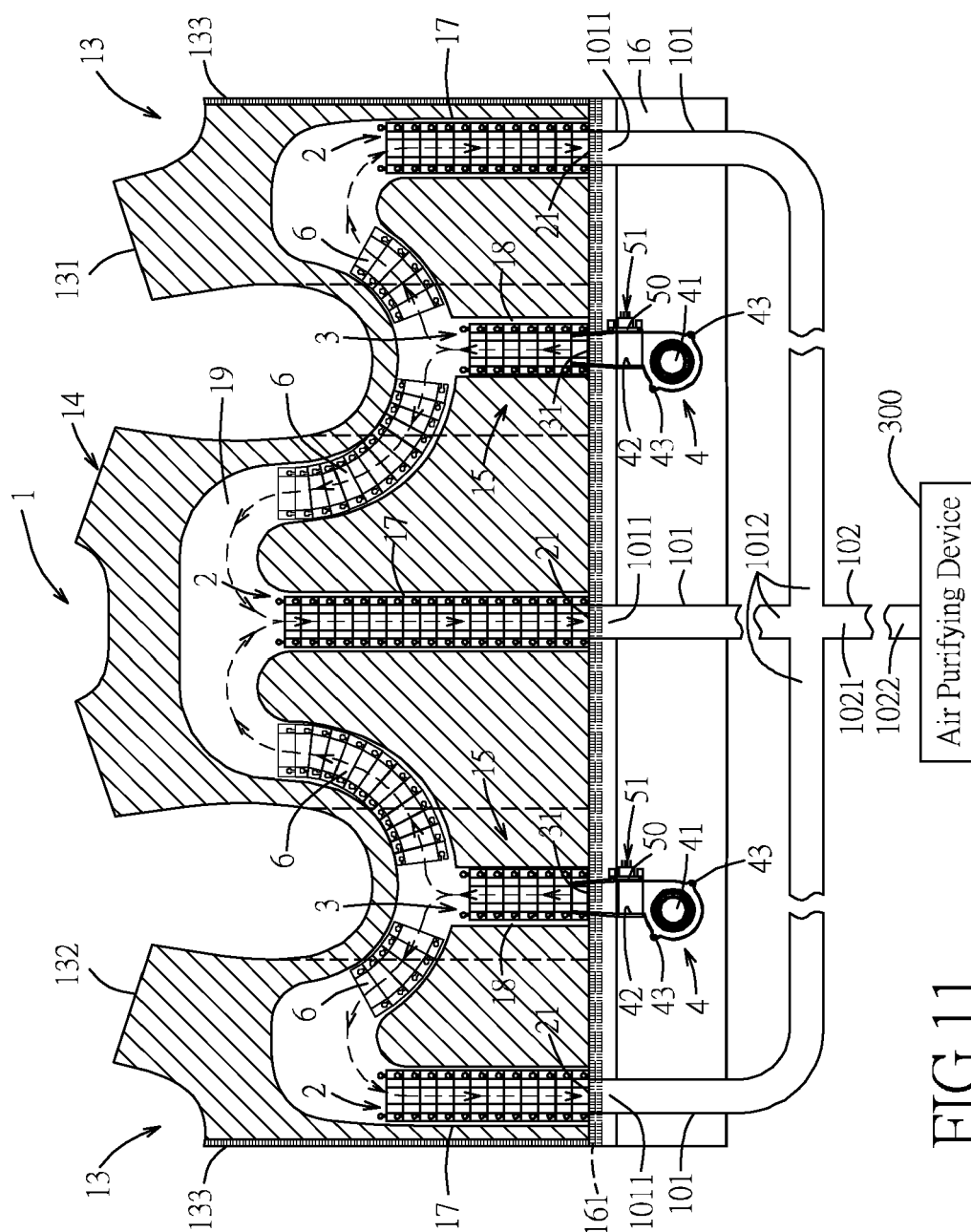


FIG.11

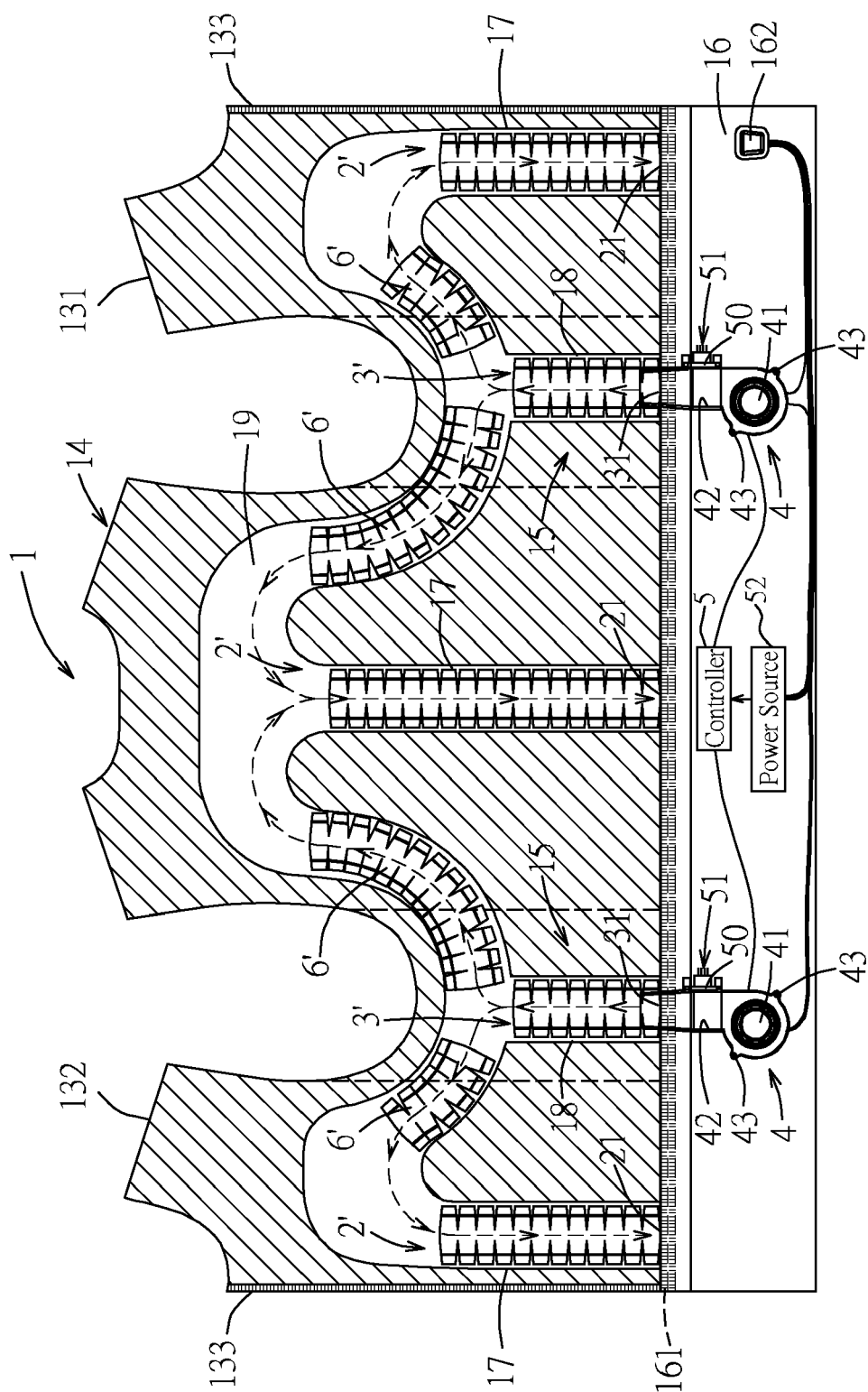


FIG.12

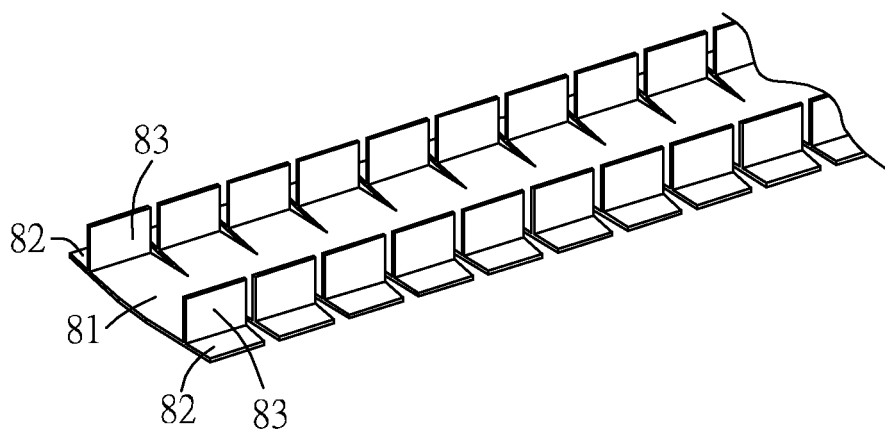


FIG.13

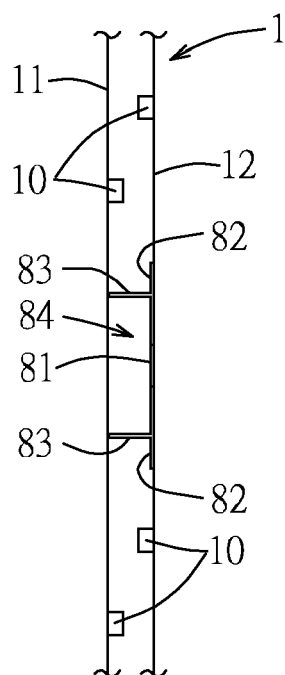


FIG.14

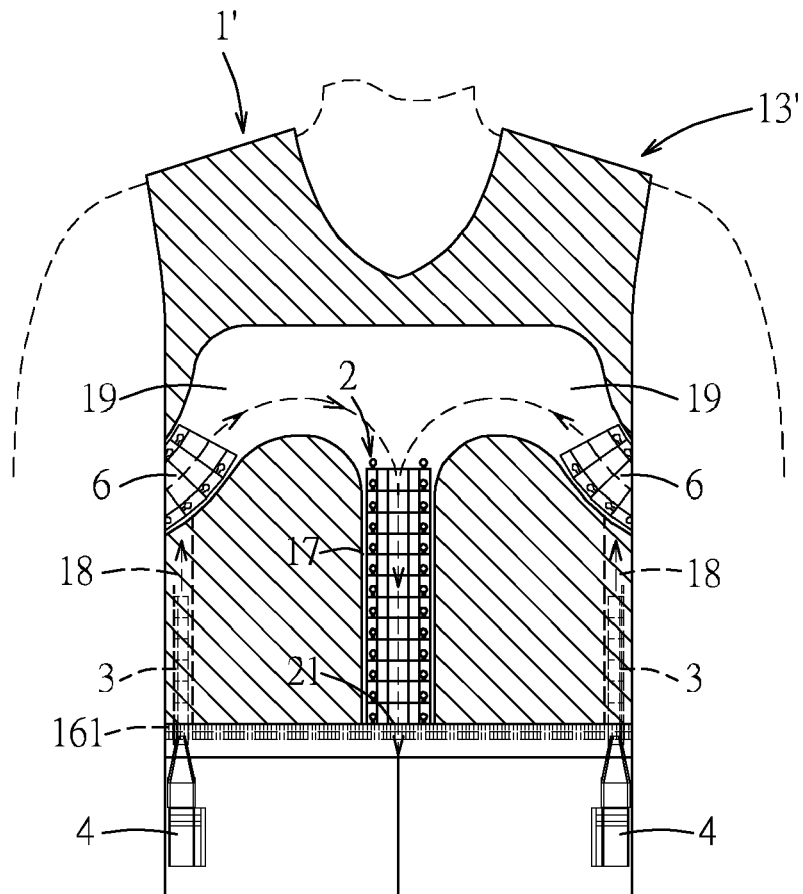


FIG.15



EUROPEAN SEARCH REPORT

Application Number
EP 14 19 4761

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 1 464 242 A1 (UNIV CLEMSON [US]) 6 October 2004 (2004-10-06) * paragraphs [0035], [0036]; figures 1-7 *	1-15	INV. A41D13/002
Y,D	US 7 272 946 B2 (ICHIGAYA HIROSHI [JP]) 25 September 2007 (2007-09-25) * column 4, line 29 - line 33; figure 1 *	1-15	
A	US 2014/069617 A1 (SHELTON BILLY A [US] ET AL) 13 March 2014 (2014-03-13) * figure 1 *	1-15	
A	US 2011/005236 A1 (CHANG TONG-BOU [TW] ET AL) 13 January 2011 (2011-01-13) * figure 1 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			A41D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 18 August 2015	Examiner van Voorst, Frank
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 19 4761

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-08-2015

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1464242	A1	06-10-2004	CN 1533722 A	06-10-2004
			EP 1464242 A1	06-10-2004
			JP 2004308101 A	04-11-2004
			US 2004198122 A1	07-10-2004

US 7272946	B2	25-09-2007	AU 2002318653 A1	02-02-2004
			CA 2491180 A1	22-01-2004
			CN 1638656 A	13-07-2005
			EP 1552759 A1	13-07-2005
			US 2006080987 A1	20-04-2006
			WO 2004006699 A1	22-01-2004

US 2014069617	A1	13-03-2014	NONE	

US 2011005236	A1	13-01-2011	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 7272946 B [0002]