



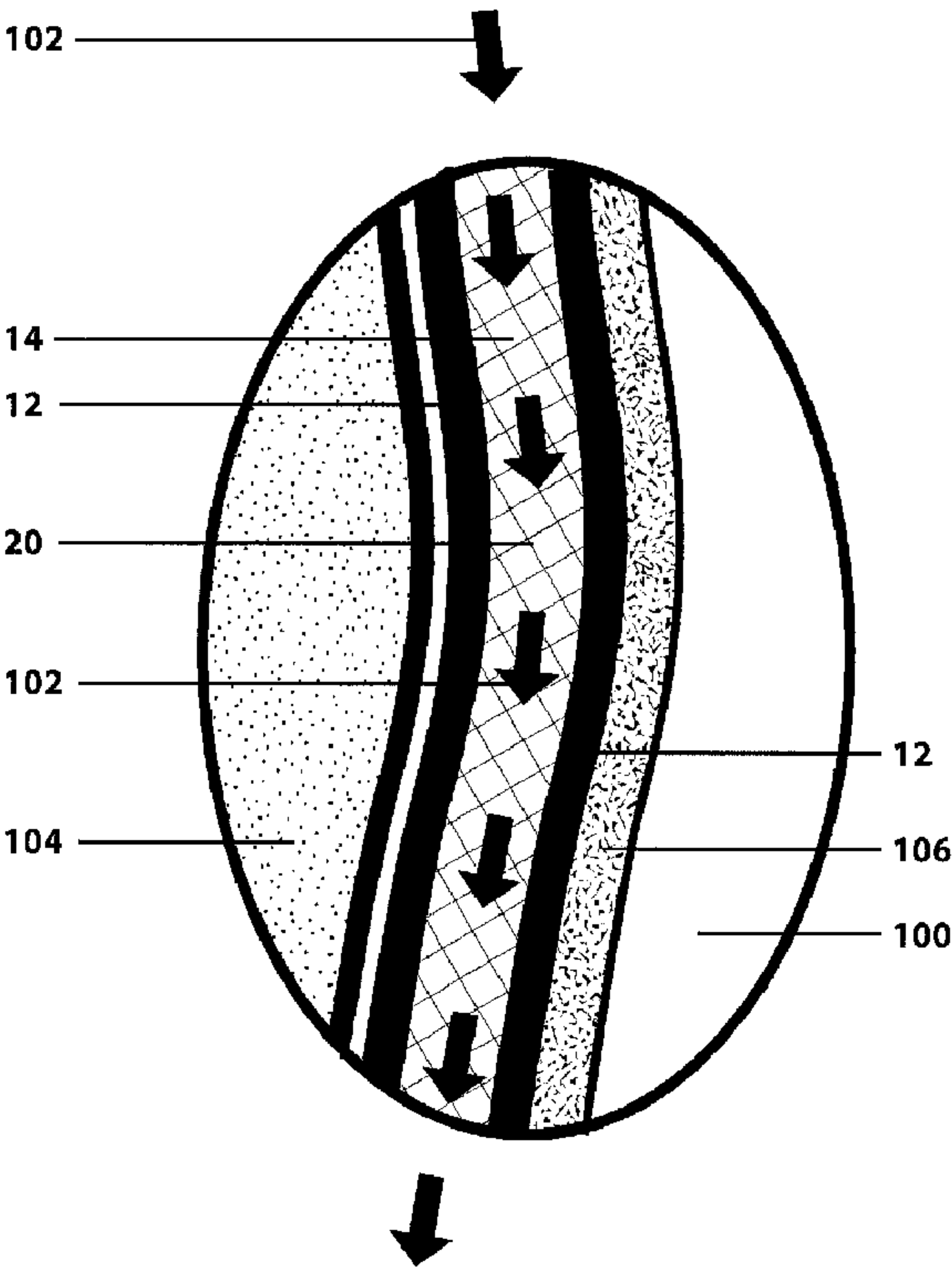
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(54) Titre : VETEMENT DE PLONGEE SOUS-MARINE CHAUFFE PAR LE SOUFFLE DE L'UTILISATEUR
(54) Title: SUB-SEA DIVE SUIT HEATED WITH A WEARER'S BREATH



(57) Abrégé/Abstract:
A sub-sea dive suit heated with a wearer's breath that has a non-compressible bladder defining a garment. The non-compressible bladder has an air cavity with an inlet and an outlet. The non-compressible bladder resists compression to allow a free flow of

(57) **Abrégé(suite)/Abstract(continued):**

breath through the air cavity from the inlet to the outlet notwithstanding an increase in ambient pressure due to immersion in water. A breath input device is connected to the inlet of the non-compressible bladder. An exhaust valve is connected to the outlet of the non-compressible bladder. The exhaust valve discharges breath externally of the garment.

ABSTRACT OF THE DISCLOSURE

A sub-sea dive suit heated with a wearer's breath that has a non-compressible bladder defining a garment. The non-compressible bladder has an air cavity with an inlet and an outlet. The non-compressible bladder resists compression to allow a free flow of breath
5 through the air cavity from the inlet to the outlet notwithstanding an increase in ambient pressure due to immersion in water. A breath input device is connected to the inlet of the non-compressible bladder. An exhaust valve is connected to the outlet of the non-compressible bladder. The exhaust valve discharges breath externally of the garment.

TITLE

[0001] Sub-sea dive suit heated with a wearer's breath

FIELD

5 [0002] There is described a dive suit in which a wearer exhales into the garment for the purpose of heating the garment.

BACKGROUND

[0003] United States Patent 6,415,453 (Anderson et al) entitled "Low temperature
10 thermal insulation garment utilizing the wearer's exhalant" discloses a survival suit that directs a wearer's breath into the suit for the purpose of heating the interior of the suit.

[0004] United States Patent 6,883,185 (Duncan) entitled "Survival suit" discloses a survival suit which is an improvement over Anderson et al, as it directs a wearer's breath
15 through bladders to control air movement within the suit.

SUMMARY

[0005] There is provided a sub-sea dive suit heated with a wearer's breath. A bladder serves to define the sub-sea dive suit. The bladder has an air cavity with at least one inlet and
20 at least one outlet. The bladder is filled with an air permeable and compression resistant filler material which resists compression while allowing a free flow of breath through the air cavity of the bladder from the at least one inlet to the at least one outlet notwithstanding an increase in ambient pressure due to immersion in water. A breath input device is connected to the inlet of the bladder. An exhaust valve is connected to the outlet of the bladder. The
25 exhaust valve discharges breath externally of the garment.

[0006] The sub-sea dive suit described above, uses exhaled air passing through the bladder as a buffer which keeps the cold water away from the body while at the same time providing some heat to warm the body. Without the air permeable and compression resistant
30 filler material, the increase in ambient pressure due to immersion in water would eventually restrict air flow as a diver descends.

[0007] Passing breath through the air cavity of the bladder can make it more difficult for

the diver to breathe. An explanation is given under the heading “Cautionary Warnings” as to how to avoid making breathing more difficult.

5 BRIEF DESCRIPTION OF THE DRAWINGS

[0008] These and other features will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to be in any way limiting, wherein:

[0009] FIG. 1 is a front elevation view of a sub-sea dive suit.

10 [0010] FIG. 2 is a detailed section view of the sub-sea dive suit of FIG. 1.

[0011] FIG. 3 is a detailed top plan view, in section, of a breath input device for the dive suit of FIG. 1.

DETAILED DESCRIPTION

15 [0012] A sub-sea dive suit, generally identified by reference numeral 10, will now be described with reference to FIG. 1 through FIG. 3.

Structure and Relationship of Parts:

20 [0013] Referring to FIG. 1, sub-sea dive suit 10 is defined by a bladder 12. Referring to FIG. 2, bladder 12 has an air cavity 14. Referring to FIG. 1, an inlet 16 and an outlet 18 are provided through which air enters and exits air cavity 14 of bladder 12. It will be appreciated that there may be more than one inlet 16 and more than one outlet 18. It is critical that bladder 12 be non-compressible, for otherwise the increase in ambient pressure due to
25 immersion in water will create choke points that prevent or restrict the flow of air. Referring to FIG. 2, in order to address this problem, air cavity 14 of bladder 12 is filled with an air permeable and compression resistant filler 20 which resists compression, while allowing a free flow of breath through air cavity 14 from inlet 16 to outlet 18, notwithstanding an increase in ambient pressure due to immersion in water. A suitable air permeable and
30 compression resistant filler 20 is loop knit fabric, as such fabrics are both air permeable and compression resistant. They are currently sold as “spacer fabrics” by such suppliers a

Gehring-Tricot Corporation.

[0014] Referring to FIG. 1, a breath input device 22 has an exhale tube 23 that is connected to inlet 16 of bladder 12. Referring to FIG. 3, breath input device 22 has a one way valve 24 that allows breath to pass from a mouthpiece 26 through inlet 16 into bladder 12, while preventing a reverse flow from bladder 12 back into mouthpiece 26. It is important that air cavity 14 be larger than inlet 16 to avoid any inflow restriction that would impede exhaled breath from entering bladder 12. As mouthpiece 26 is intended for sub-sea applications, breath input device 22 includes an air supply tube 28 through which air is drawn into breath input device 22 from an air supply tank (not shown). Breath input device has a second one way valve 30 that permits air to flow through air supply tube 28 when the wearer inhales and blocks air flow through air supply tube 28 when the wearer exhales.

[0015] Referring to FIG. 1, an exhaust valve 32 is connected to outlet 18 of bladder 12. Exhaust valve 32 discharges excess air externally of sub-sea dive suit 10. Exhaust valve 32 is a one way valve that is pressure activated to open when the pressure within bladder 12 exceeds pre-set limits. When exhaust valve 32 is closed, it prevents the entry of water. When exhaust valve 32 is open, the release of air prevents entry of water. Exhaust valve 32 will not be further described, as suitable exhaust valves are known in the art and are commercially available. One example of a commercially available exhaust valve are the exhaust valves manufactured in various sizes for various applications under the Trademark brand SI-TECH.

[0016] For reasons that will hereinafter be further explained, it is preferred that exhaust valve 32 be mounted at the end of a discharge tube 34 which is connected to outlet 18 of bladder 12.

Operation:

[0017] Referring to FIG. 3, a wearer places mouthpiece 26 of breath input device 22 into his or her mouth. As the wearer inhales, air is drawn along air supply tube 28 into mouthpiece 26. One way valve 30 open to permit air to flow through air supply tube 28 into

mouthpiece 26 and one way valve 24 closes to prevent air from being drawn from bladder 12 back into mouthpiece 26. When the wearer exhales one way valve 30 closes to block air flow back into air supply tube 28, and one way valve 24 opens to allow air to flow through inlet 16 of bladder 12 into air cavity 14. Referring to FIG. 2, air permeable and compression resistant filler 20 resists compression, while allowing a free flow of breath (shown by arrows 102) through air cavity 14 from inlet 16 to outlet 18, notwithstanding an increase in ambient pressure due to immersion in water 104. This serves a number of important functions. Firstly, air is an insulator which keeps the cold water away from the wearer's body 100. Secondly, the air is derived from exhaled breath that has some warmth to it, which assists in maintaining core body temperature. Although, typically, a diver will be wearing an insulating undergarment 106 under sub-sea dive suit 10. It will be appreciated that the closer to the wearer's body 100, bladder 12 is positioned the more effective will be the heat transfer to the wearer's body 100. Referring to FIG. 1, when the pressure within bladder 12 exceeds pre-set limits, exhaust valve 32 opens to discharge excess air externally of sub-sea dive suit 10.

Cautionary Warning

[0018] The inventor was told during the development process that it would not be possible to develop a sub-sea dive suit heated with a wearer's breath, such as sub-sea dive suit 10, as it would be too hard for a diver to breathe. Having been alerted to this potential problem, the inventor attached discharge tube 34 to outlet 18 and placed a remote end of discharge tube 34 at various positions. It was determined that the positioning of the remote end of discharge tube 34 had a significant impact on how easy or how difficult it was to breathe. As the remote end of discharge tube 34 is lowered farther below the connection of a dive regulator to mouthpiece 26, it becomes more difficult to breathe. Conversely, as the remote end of discharge tube 34 is raised farther above the connection of the dive regulator to mouthpiece 26, there is a "siphon effect" that tends to create a free flow of air through the dive regulator. Making it more difficult to breathe is viewed as undesirable. However, depleting the dive tanks by have a free flow of air passing through the dive regulator is also undesirable. It is recommended that the remote end of discharge tube 34 be positioned in the vicinity of the connection of the dive regulator with mouthpiece 26. Preferably, the remote

end is positioned at about the same horizontal plane as a mouthpiece 26 of the breath input device 22, as one wants to have the height of the water column acting upon the ingress of air and the egress of air approximately equal.

5 [0019] In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the element is present, unless the context clearly requires that there be one and only one of the elements.

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[0020] The scope of the claims should not be limited by the illustrated embodiments set forth as examples, but should be given the broadest interpretation consistent with a purposive construction of the claims in view of the description as a whole.

What is Claimed is:

1. A sub-sea dive suit heated with a wearer's breath, comprising:
 - 5 a bladder defining a garment, the bladder having an air cavity with at least one inlet and at least one outlet, the bladder being filled with an air permeable and compression resistant filler which resists compression while allowing a free flow of breath through the air cavity of the bladder from the at least one inlet to the at least one outlet notwithstanding an increase in ambient pressure due to immersion in water;
 - 10 a breath input device connected to the inlet of the bladder; and
 - an exhaust valve connected to the outlet of the bladder, the exhaust valve discharging breath externally of the garment.
2. The sub-sea dive suit of Claim 1, wherein a discharge tube is connected to the outlet of
 - 15 the bladder.
3. The sub-sea dive suit of Claim 2, wherein a remote end of the discharge tube is positioned at about the same horizontal plane as a mouthpiece of the breath input device.
- 20 4. The sub-sea dive suit of Claim 1, wherein the air cavity is larger than the inlet to avoid any inflow restriction.
5. The dive suit of Claim 1, wherein the breath input device has a one way valve that allows breath to pass from the breath input device through the inlet into the bladder and prevents a
 - 25 reverse flow from the bladder.
6. The dive suit of Claim 5, wherein the breath input device includes an air supply tube through which air is drawn into the breath input device, the breath input device having a second one way valve that permits air to flow through the air supply tube when the wearer
 - 30 inhales and blocks air flow through the air supply tube when the wearer exhales.

FIG. 1

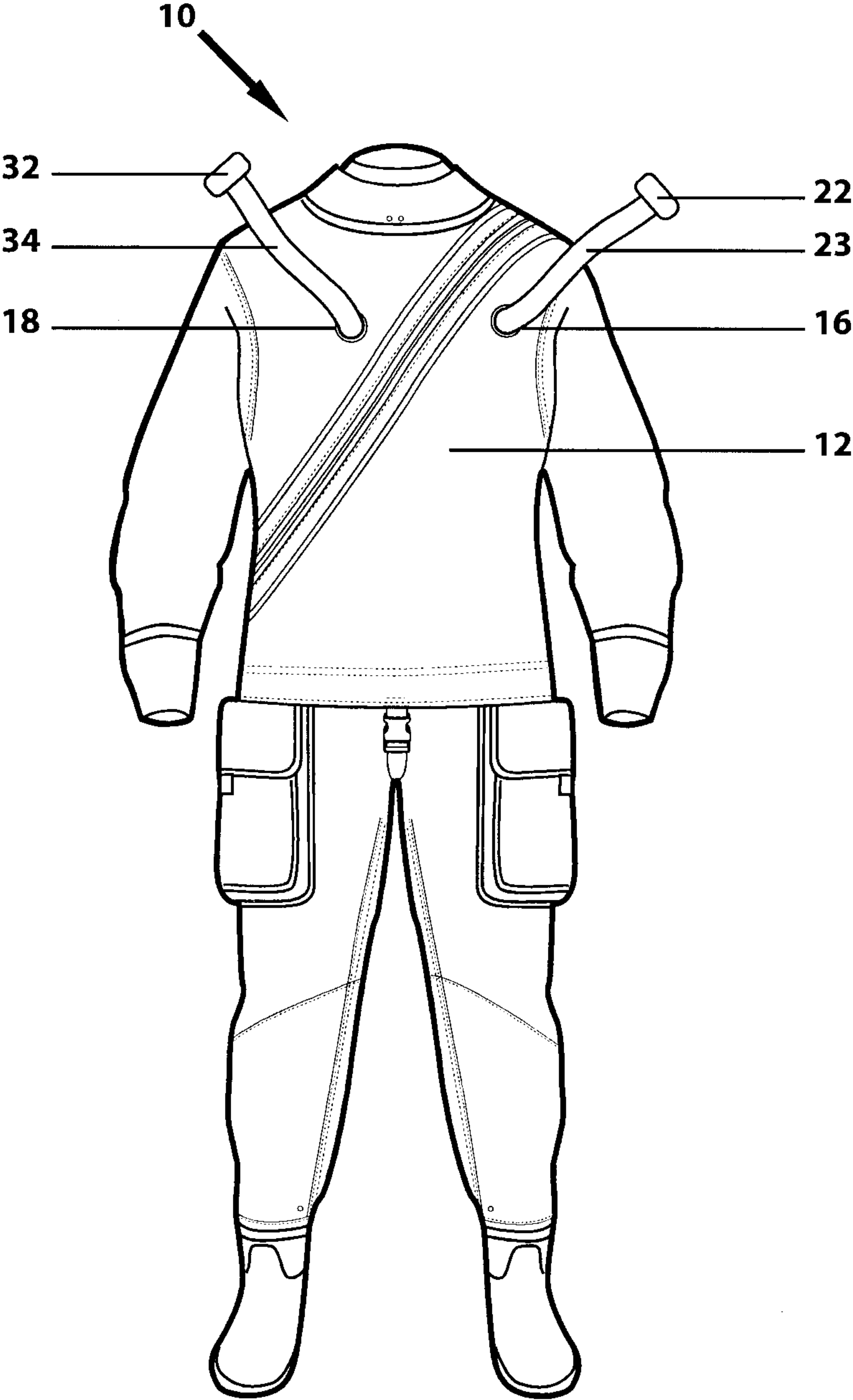


FIG. 2

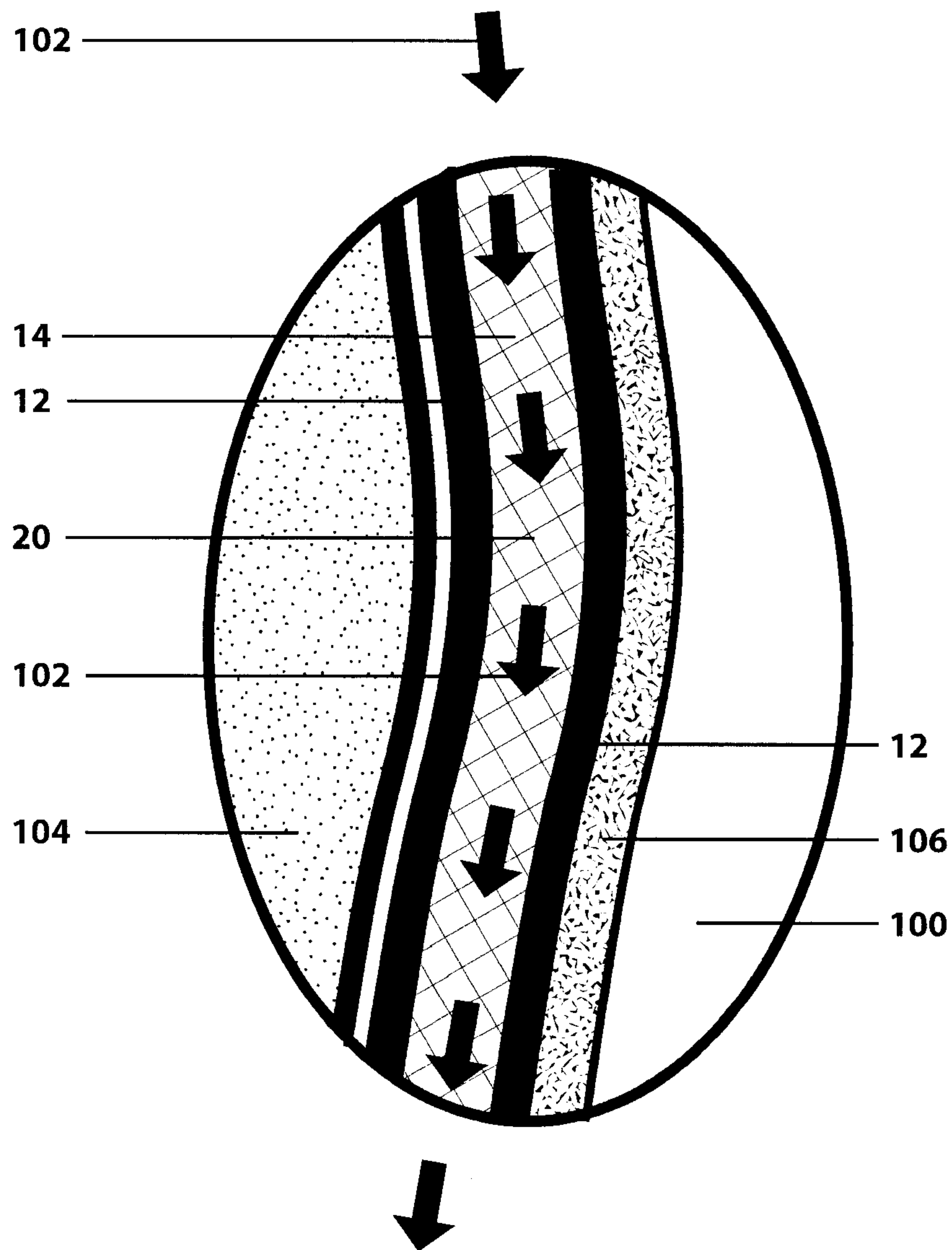


FIG. 3

