United States Patent [19]

Laxo

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[54] **CONTROLLED TEMPERATURE GARMENT**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy,** Washington, D.C.

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[52] **U.S. Cl.** **165/39,** 165/46, 165/101, 62/259

[51] **Int. Cl.** **B60h 1/00**

[58] **Field of Search** 165/46, 39, 101; 62/259; 126/204

[56] **References Cited**

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Attorney—R. S. Sciascia and Charles D. B. Curry

[57] **ABSTRACT**

A controlled temperature garment using the counter flow heat exchanger principle to maintain an equal temperature distribution along the inner surface of the garment. Three layers of material are bonded together in such a manner as to provide flow channels along the garment. The garment comprises distribution, turning and collection chambers at each end of the channels; and a fluid discharge and collecting manifold to control the flow of the temperature controlling fluid.

10 Claims, 9 Drawing Figures

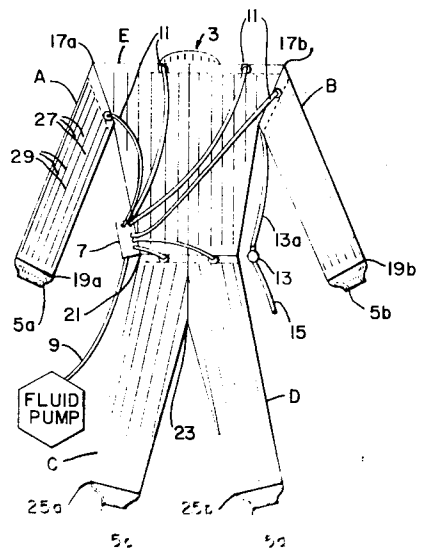


FIG_1

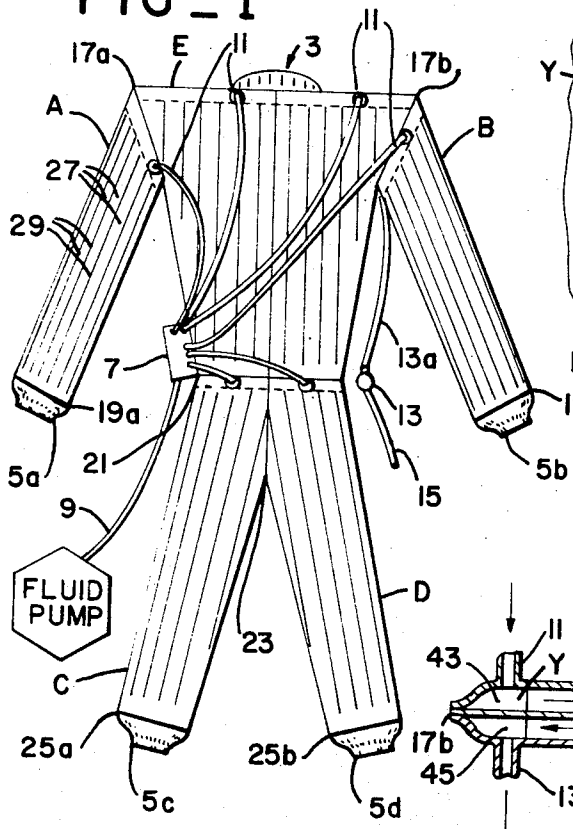


FIG_2

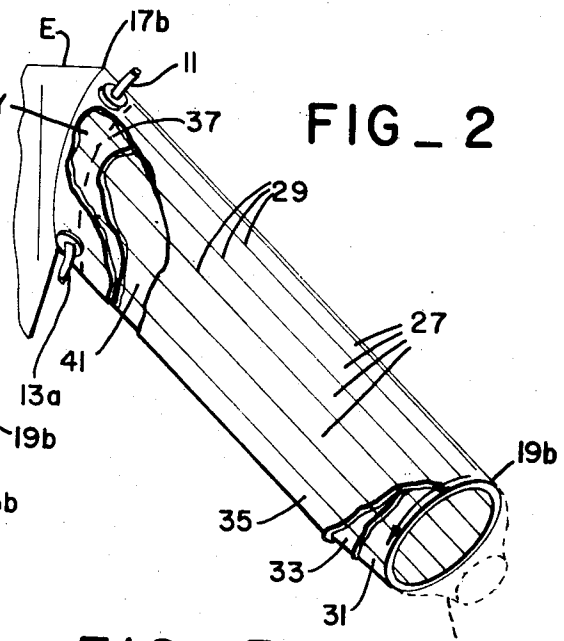


FIG_3

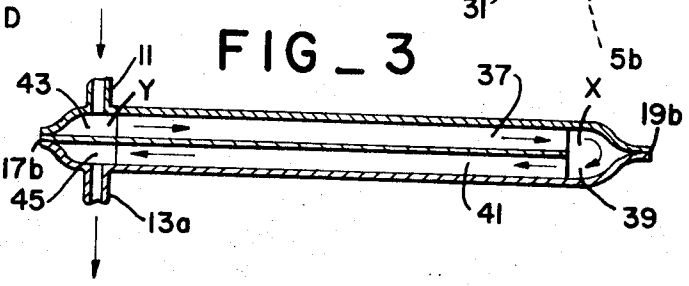
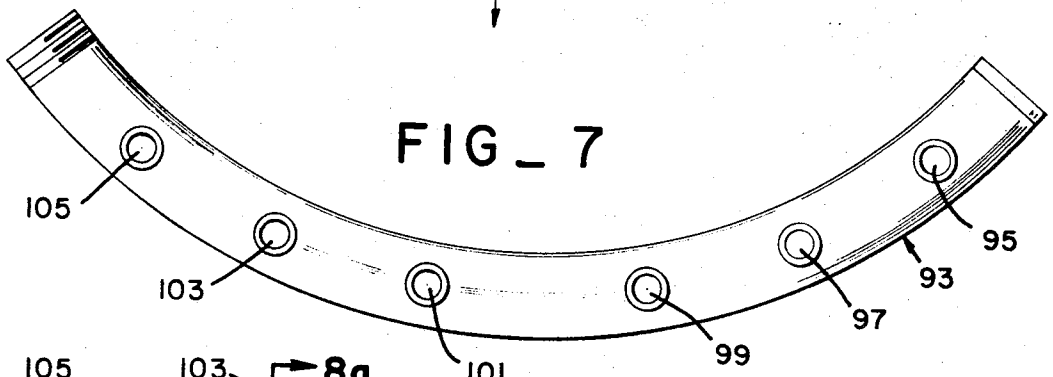


FIG_7



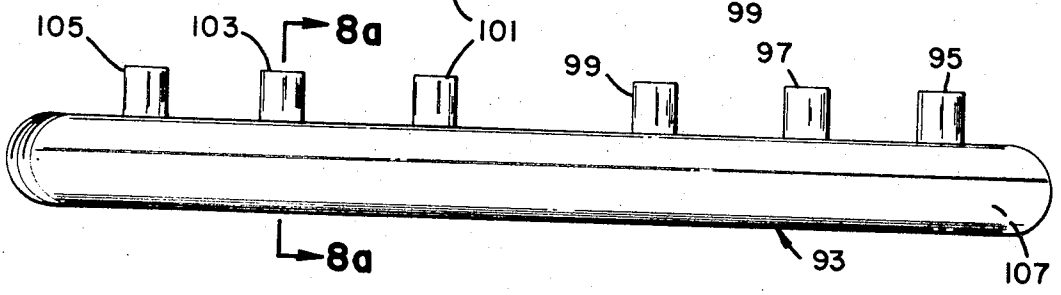


FIG_8

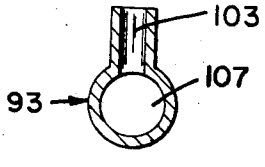
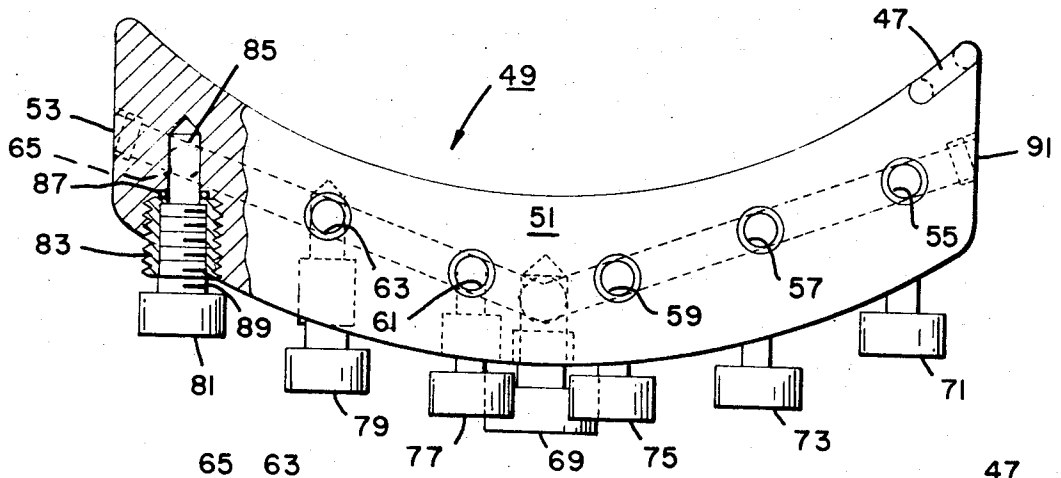


FIG_8a

FIG_4



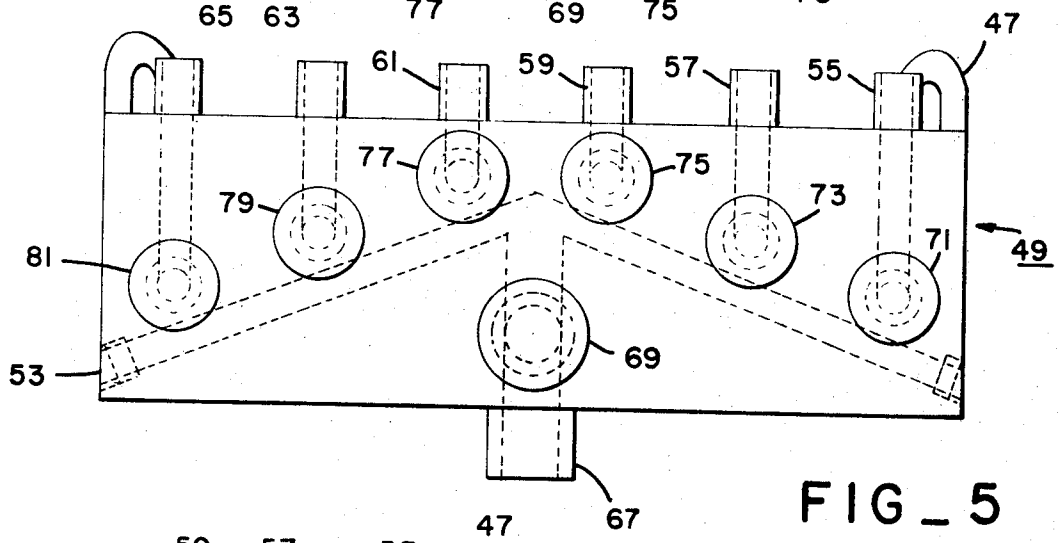


FIG_5

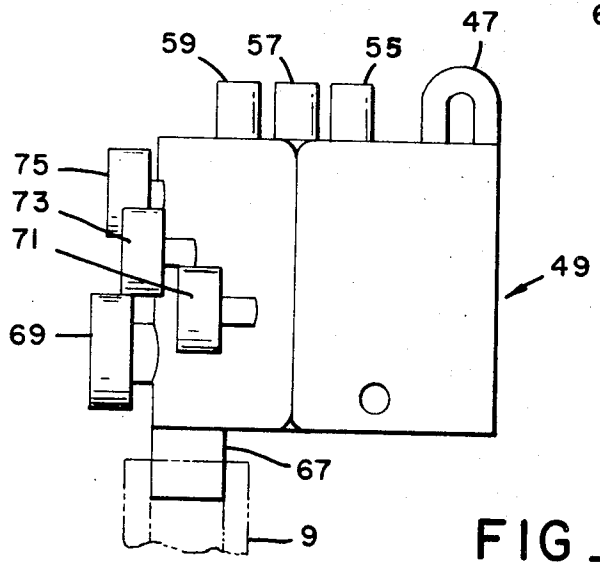


FIG_6

CONTROLLED TEMPERATURE GARMENT

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a controlled temperature garment to provide protection against extreme temperatures and more particularly to a garment which uses the counter flow heat exchanger principle to maintain an equal temperature distribution in the protective garment.

2. Description of the Prior Art

The prior devices for protecting divers working in a coldwater environment were rubber suits with a perforated tube in each of the extremities of the suit. The function of the perforated tube was to distribute hot water to the interior of the suit. Divers using the suits have suffered burns at the tube perforators due to extreme water temperatures required and the lack of mixing distribution at these locations.

SUMMARY OF THE INVENTION

The present unique invention will overcome the difficulties inherent in the aforementioned prior temperature control garments. The particular advantage of the unique system, which is the subject matter of the present invention, is that the wearer is not directly exposed to the temperature controlling fluid. Moreover, the wearer is protected from extreme temperature spots. That is, the temperature is more evenly distributed throughout the garment. The wearer also can control the temperature distribution within the garment by adjusting the various controls on the unique distribution flow control.

STATEMENT OF THE OBJECTS OF INVENTION

A primary object of the present invention is to provide a garment which will protect the wearer from extreme temperatures.

Another object of the present invention is to provide a garment which will provide even temperature distribution throughout the garment.

Another object of the present invention is to provide a temperature controllable garment which protects the wearer from extreme temperature hot spots.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sketch of the controlled temperature garment;

FIG. 2 is a detailed sketch of the arm shoulder portion of the controlled temperature garment;

FIG. 3 is a side view of the inner and outer surface of the garment lining;

FIG. 4 is a top view of the distribution manifold;

FIG. 5 is a side view of the manifold of FIG. 4;

FIG. 6 is an end view of the manifold of FIG. 4;

FIG. 7 is a top view of the discharge collecting manifold;

FIG. 8 is a side view of the collecting manifold of FIG. 7; and

FIG. 8A is an end sectional view of the collecting manifold of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 wherein the controlled temperature suit 1 includes a plurality of longitudinal flow channels 27 over the entire suit area. Each of the flow channels 27 is formed by a plurality of longitudinally extending flow dividing seams 29. The flow channels 27 of suit 1 are further divided into arm sections A and B; leg sections C and D; and continuous body section E. The body section E is isolated and divided from the arm sections A and B by flow dividing sealed shoulder seams 17*a* and 17*b*. Arm sections A and B are sealed at the wrist by seals 19*a* and 19*b*. Cuffs 5*a* and 5*b* are attached to seals 19*a* and 19*b* to seal off the interior of suit 1 against the surrounding atmosphere. The waist section sealing seam 21 divides body section E from leg sections C and D. A neck seal 3 is provided to seal the interior of body section E from the surrounding atmosphere. Leg sections C and D are separated by a sealed crotch seam 23. The ankle portions are sealed by sealing seams 25*a* and 25*b*. The ankle portions of each leg section C and D are provided with sealing cuffs 5*c* and 5*d*, respectively. A complete description of the structure and function of the flow channels will be hereinafter described in detail in conjunction with FIGS. 2 and 3. Referring again to FIG. 1, the flow of the fluid, such as hot or cold water or any other similar fluid which is well known in the art, is controlled by the flow distribution control and manifold 7. The supply of the temperature controlling fluid may be supplied by any fluid pumping device P which is well known in the art. The fluid passes from pump P through supply umbilical hose 9 to the inlet of flow distribution and control manifold where it is distributed to the various sections of the suit through the plurality of distribution lines 11. The temperature controlling fluid is discharged through a plurality of discharge lines 13*a* attached in a similar manner to distribution lines 11 to discharge manifold 13. The fluid is then directed through return umbilical 15 to be discharged in the surrounding environment for an open cycle system or returned to the umbilical supply hose 9 for a closed cycle system. A description of the flow distribution and control manifold in conjunction with the discharge system will be hereinafter explained.

The construction of the arm section A shown in FIG. 2, as well as the side view of the unique dual chamber ducting system shown in FIG. 3, is identical for all other sections and hence a description of one section will be deemed to apply to all sections. Referring now to FIG. 2, a plurality longitudinal channels 27 are formed by a plurality of flow dividing seams 29 located on either side of each channel. The arm section B comprises three layers of material; inner layer 31; middle layer 33; and outer layer 35. The plurality channels 27 are formed by bonding inner layer 31 and outer layer 35 to middle layer 33 along seams 29. The outer surfaces of outer layer 35 may be made of an insulation or asbestos type material to facilitate its use as a fire protection suit. Likewise, the outer layer could be used as a wet suit if made of a rubber material. The inner surface of inner layer 31, directly exposed to the wearer, should

be made of a suitable material which is comfortable to the wearer. The outer layer **35**, middle layer **33**, and inner layer **31** of arm section B are bonded at seam **17***b* to isolate the fluid flow from body section E, as shown in FIGS. **2** and **3**. Outer layer **35** is also bonded to inner layer **31** at **19***b*, as shown in FIG. **3**. The bonding of outer layer **35** and inner layer **31** should be bonded only to point Y so that a circumferentially extending distribution chamber **43** and collecting chamber **41** open onto the plurality of outer and inner chambers, respectively. However, it should be noted that middle layer **33** is shorter in length than outer layer **35** and inner layer **31** and is not bonded to point **19***b*, thereby forming a turning chamber **39** extending circumferentially at the wrist portion of arm section A, as shown by arrow *x*. Cuff seal **5***b* is attached to sealed seam or point **19***b*.

Referring specifically to FIG. **3** wherein a single counterflow heat exchanger is identical for all chambers, a description of one will be deemed to apply to every other chamber. The temperature controlling fluid, line referred to as "fluid," enters at an extreme temperature either hot or cold from the distribution line line **11** into distribution chamber **43** where it is directed to the plurality of flow channels and, in our case, outer flow channel **37**. The fluid is guided under pressure to turning chamber **39** wherein depending upon the environment the fluid gives up or gathers more heat as it passes along the outer channel **37** on its way to turning chamber **39**. When the fluid reaches turning chamber **39** it is directed into inner flow chamber **41** and again depending upon the environment it either picks up or delivers heat to the wearer. The fluid in the inner channel **41** also protects the wearer from direct contact with the extreme temperatures of the entering fluid until the temperature is more evenly distributed. Thus the wearer is protected from extreme hot spots. The fluid in the inner channel **41** travels to collecting chamber **45** where the fluid is discharged into discharge line **13a** which subsequently enters discharge manifold **13** to be further discharged to the surrounding environment as described above. The wearer can control the rate of fluid flow to each section of the suit by the use of the disclosed flow distribution and control manifold, as shown in FIGS. **1, 4, 5** and **6**. The manifold may be constructed of aluminum or other lightweight material which is compatible with the fluid being used. The manifold may be attached to the waist of the suit by an attachment device **47**.

Referring to FIGS. **4, 5**, and **6** wherein the control manifold **49** comprises a hollow body **51** with distribution manifold **53**, the distribution manifold has six individual distribution tubes **55, 57, 59, 61, 63** and **65**. The fluid supply tube **67**, which is attached to supply umbilical **9**, is controlled by supply flow control knob **69**; six distributor flow control knobs **71, 73, 75, 77, 79** and **81** wherein the fluid distribution can be controlled individually to each section of the suit when supply flow control knob **69** is opened. Each control unit includes a retainer seal **83** and is threaded into body **49**. The flow control valve **85** is a needle metering valve with an O ring seal **87** to control the amount of fluid flow. The shaft **89** of the flow control valve **85** is threaded and attached to the respective control knobs so that the wearer may control the flow of fluid to the respective sections of the suit. It should be noted that there are two distribution tubes and lines to body section E. Each end of manifold **53** is enclosed by a removable plug **91**.

The fluid discharge collecting manifold **93** shown in FIGS. **7, 8**, and **8A** comprise six discharge tubes **95, 97, 99, 101, 103**, and **105** attached to discharge cylinder which is attached to return umbilical **15**, as shown in FIG. **1**. This unit may be used with a closed or open system. A lightweight material, which is compatible with the fluid, should be used.

In conclusion, the materials of construction will be determined by the environment in which the garment is to be used and the type of fluid to be pumped through the system. Moreover, it is desirable that the outer layer be an insulating material to limit the heat transfer to or from the environment.

What is claimed is:

1. A controlled temperature garment including a temperature control flow distribution means and pumping means with a temperature controlling fluid, said garment comprising in combination:

a. first arm section;
b. second arm section;
c. first leg section;
d. second leg section;
e. body section each of said sections (a) through (e) having a plurality of vertically stacked channels, one on top of one another and side by side each other;
f. said flow distribution means directing said temperature controlling fluid to each channel of said plurality of vertically stacked channels of said sections; and
g. said fluid being independently controllable to each of said sections by said flow distribution means.

2. The device recited in claim **1** wherein each of said sections comprises a plurality of longitudinally extending channels formed by a plurality of intermittently spaced bonded flow dividing seams to form a fluid flow directing chamber to direct said fluid from said fluid distribution means to each of said sections.

3. The device recited in claim **2** wherein each of said chambers comprises:

a. distribution chamber;
b. an outer flow channel;
c. turning chamber;
d. inner flow channel;
e. collecting chamber;
f. discharge means; and
g. said fluid being directed into said distribution chamber from distribution means wherein said distribution chamber opens onto a plurality of said outer flow channels in each of said sections wherein said fluid is directed from said outer flow channel into said turning chamber; wherein said fluid is further directed from said chamber through a plurality of said inner flow channels to said collecting chamber; wherein said fluid is discharged into discharge means.

4. The device recited in claim **3** wherein each of a plurality of said fluid conducting chambers for each of said sections is formed by three vertically stacked layers of material comprising:

a. inner layer;
b. middle layer;
c. outer layer;
d. said inner layer, middle layer, and outer layer being partially bonded together longitudinally to form a plurality of said chambers and a plurality in-

termittently spaced longitudinally extending seams wherein the unbonded portion of said middle layer and said outer layer between said seams define said outer flow channel; wherein the unbonded portion of said middle layer and said inner layer between said seams define said inner flow channel; wherein said middle layer material is shorter in the longitudinal direction at one end of said middle material than said outer layer and said inner layer; wherein said outer layer and inner layer are bonded together at said one end to form said turning chamber; wherein the three layers are unbonded together at the end opposite said bonded end to form a distribution chamber between said outer layer and said middle layer and a collecting chamber between said middle layer and said inner layer.

5. The device recited in claim **4** wherein said fluid enters at an extreme temperature and is guided from said distribution chamber to the plurality of said outer flow chambers in each section either giving up or gathering more heat depending upon the environment outside said first layer as it passes along the outer layer and is further directed into said inner flow channel by route of said turning chamber and depending upon the environment said fluid picks up or gives up heat to said inner layer of said material and is thereby discharged into a discharge means.

6. The device recited in claim **3** wherein said flow distribution means includes a supply means, distribution lines and pump means said distribution means comprising:

a. fluid supply control means connected to said supply means;

b. supply manifold operatively connected to supply control means to control the amount of fluid flow into said manifold;

c. plurality of distribution tubes operatively connected to said supply manifold;

d. plurality of distribution flow control means operatively connected to said distribution tubes to distribute the fluid to said distribution tubes; and

e. said distribution tubes being operatively connected to each of said sections through said distribution lines thereby directing said fluid to each of said section being dependent upon the setting of said distribution control means and said supply control means.

7. The device recited in claim **6** wherein said distribution control means and supply control means are needle valves extending into said distribution means and said manifold.

8. The device recited in claim **5** wherein said discharge means includes a plurality of discharge lines and discharge tubing, said discharge means comprising:

a. discharge manifold;

b. plurality of discharge flow channels operatively connected to said manifold;

c. said channels being operatively connected to said garment by a plurality of discharge lines; and

d. said discharge manifold being operatively connected to said discharge tube.

9. The device recited in claim **8** wherein said discharge tube is connected as a closed loop system.

10. The device recited in claim **8** wherein said discharge tube discharges a temperature controlling fluid into the outside environment.

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