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(54) **SUPPORT STRUCTURE FOR FORCED AIR COOLING VEST**

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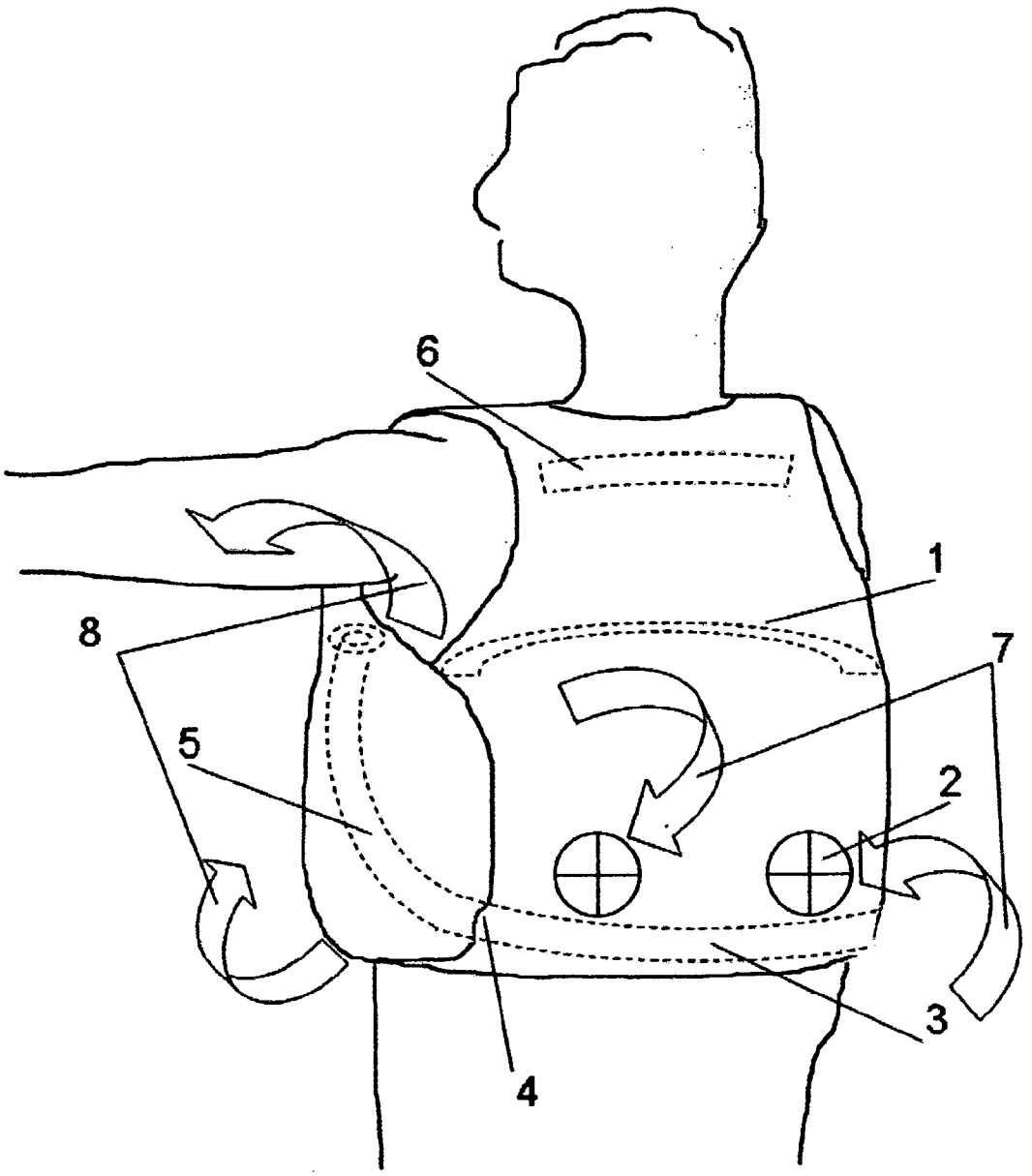
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(57) **ABSTRACT**

A fan or blower operated cooling vest with a structure that creates a plenum under a garment and allows the flow of air under the arms. Plenum uses any garment and the surface of the body to conduct the flow of air.



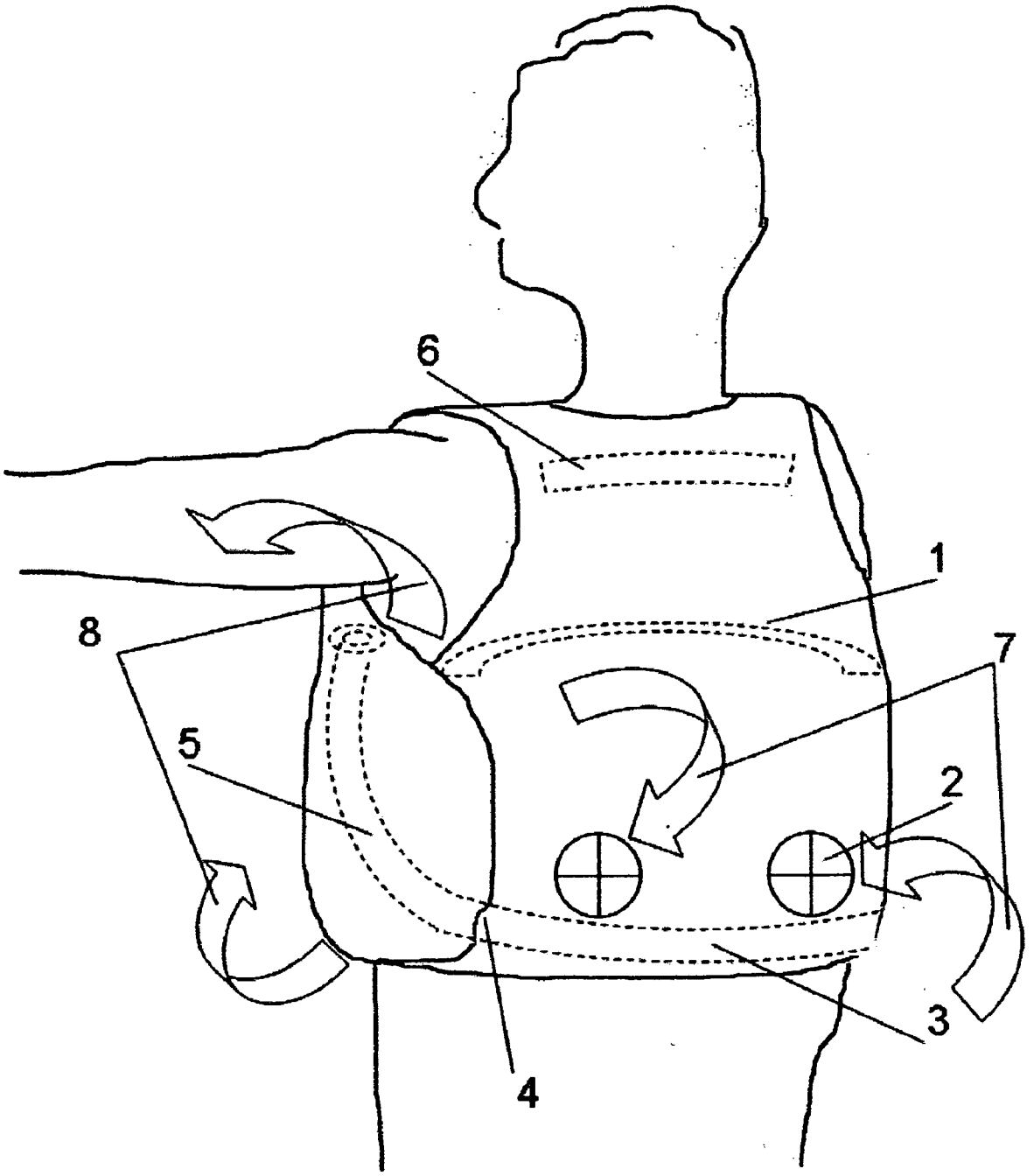


Fig. 1

SUPPORT STRUCTURE FOR FORCED AIR COOLING VEST

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] None

FEDERALLY SPONSORED RESEARCH

[0002] None

SEQUENCE LISTING

[0003] None

FIELD OF THE INVENTION

[0004] The present invention provides a means to deliver forced air by a fan or blower device to effect the evaporation of moisture from an individual and thus cool them while they are wearing heavy protective equipment. The present device provides a means to create a plenum between the body and a garment.

DESCRIPTION OF THE PRIOR ART

[0005] U.S. Pat. No. 5,217,408 by Kaine issued on Jun. 8 1993 discusses a cooling vest that has a fan and a cowling to contain the pumped air. The present invention eliminates the need for a cowling or hinged segments. The vest requires no cowling because it is designed to function under existing protective clothing such as a foundry jacket. Kaine fails to disclose a structure to deliver air through a plenum to the front of the vest by going under the arms and thus significantly reduces the effectiveness of the vest by eliminating the evaporative cooling of the sides of the individual. Kaine fails to disclose a method to take advantage of the effect of the movement of the torso and arms in increasing the flow of air around the individual. Kaine fails to account for the lateral side to side motion of the individual. The structure he teaches would prevent or limit such motion.

[0006] U.S. Pat. No. 6,874,332 by Forgach issued on Apr. 5, 2005 teaches a protective vest cooling system. Forgach teaches a protective vest for being worn over the body of the user and an elongated housing generally disposed inside the protective vest. The elongated housing has holes for the transfer of blown air. The present invention does not require a protective vest or elongated housing nor does it depend on an inserted plenum to carry the air or holes in the plenum. Forgach does not teach the flow of air under the arms as an important method of cooling the person.

[0007] U.S. Pat. No. 6,260,201 by Rankin issued on Jul. 17, 2001 teaches a vest with a plurality of tubular members with each member having a peripheral wall having a plurality of openings therein. The present invention eliminates the need for a tubing member with a plurality of openings or a connector tube or any fluidly connected tubular members. Rankin does not teach the support of outer protective clothing or the importance of flow of air under the arms. Rankin teaches the necessity of a supply tube to tubular members while the present invention requires no supply tube. The structural tubes in the present invention may be solid rods where the tubes in Rankin require the conduction of air.

SUMMARY OF THE INVENTION

[0008] The utility of cooling vests is well established and they are presently used widely. The present invention concerns cooling vests that use forced air to cool the individual by evaporation. The difficulty of delivering air to evaporate moisture on the skin has limited the adoption of this type of vest. The primary difficulty is the delivery of air under a protective coat. The difficulty is that the coat suppresses any air flow unless it is under elevated pressure. Our tests have shown that a minimum of 10 psi is required for an effective evaporative cooling vest under protective clothing. The present invention solves this problem by supporting an existing jacket off the body with a support mechanism and the elimination of any shell and uses the created space as an air plenum where the flow of low pressure air is possible.

[0009] The invention is designed to effect the movement of air around the individual and cool by evaporation. The present invention removes the weight of the vest from the shoulders and eliminates the need to duct air across the shoulders to cool the front of the torso of the individual. A structure is provided to create a plenum and to use this structure to support the weight on the hips of the wearer. The structure substantially entwines the waist and delivers the majority of the weight to the hips. The vest provides two blowers that draw air in the lower back area and force the air up the back of the person. Instead of moving air over the shoulders where the necessity of supporting a broad plenum on the shoulder would be required; the present invention directs the air under the arms and along the sides of the individual. It does this by means of a structure that holds any protective coat or fabric away from the body in the back and sides and front of the body. The vest directs the air from the back to the front of the chest along the sides and under the arms. The vest benefits from added evaporated cooling due to the nature of the movement of the arms effecting the clothing resting on the structure. The arms by their natural movement on clothing act as bellows without valves. The effect is to increase and decrease pressure as the arms are raised or lowered when the vest is operating. As the rear blowers in the back of the vest create a relatively increased pressure area in the back that will tend to inflate the overlaying jacket; the movement of the arms periodically increases and decreases this pressure gradient and moves air along folds of the fabric on the sides of the vest. As the air pressure is changed the trapped air in the folds of the fabric move and because the garment moves in a dynamic manner on the body as well with movement of the arms and torso, the trapped air moves in an almost random pattern from the elevated pressure area to the lower pressure area. The consequent movement of this air increases the evaporative cooling by the vest of the individual. Further by placing the air plenum under the arms by means of a structure formed in this case by the fixture of a **1** inch ridged tube around the waist to hold any coat or jacket off the body; the plenum allows air to flow where normally the arm resting on the side of the torso would prevent it. The structure allows movement at the waist of the person; particularly bending the torso side to side. This same tube structure acts as a gasket at the waist to prevent the flow of air out around the waist band and maintains a slight pressure gradient between the slightly pressurized back and the front of the vest where it exhausts. By means of a sliding and overlapping fabric side panel the vest can be made to fit many size people and still maintain air flow integrity around the waist. The tubing

simply slides into a channel sewn into the cloth on the front side of the vest and a flap seals the vest over the tubing and overlapping the back portion of the vest. The tubing as it is laid out then moves from the back waist to the front of the vest. The tubing rests along the waist and side and turns upward each end of the tubing coming up the chest dividing the chest into thirds and ending by the breast pocket. This supports the weight of a heavy coat or in some cases body armor in the form of a bullet proof vest off the chest and allows the flow of air from the back under the arms and up the front sides of the chest to the ends of the tubing and then escapes at the neck or down and out the waist. By this method a large volume of air can be pumped under very low pressure from the back of the vest to the front of the vest and thus evaporate the moisture from the major portion of the body. The same effect may be accomplished with a batten arrangement if a seal is provided at the waist. The structure then supports the outer garment off the individual without the difficulties of a plenum over the shoulder. Supporting the structure off the individual allows low pressure blowers to move sufficient air around the individual to effect cooling. A further advantage is the tubing resting on the waist transfers most of the weight of the vest to the hips rather than to the shoulders and effectively makes the vest much more comfortable. The stiffness of the tubing holds the battery, the blowers, and the fabric away from the body and rests the weight on the hips. The use of the tubing around the waist on the back further protects the blower from any damage by allowing it to be inset.

[0010] The separation of the outer clothing from direct contact with the wearer has a further advantage in that it prevents the conduction of heat to the individual. As for example one could take a few layers of cloth such as in the aluminized jackets used in foundries and place it on a hot iron. When one places the hand firmly on the fabric, heat is rapidly conducted to the hand. If even a static air space is provided the conduction is radically slowed down. The heat must then be radiated to the hand with only limited conduction through the gas or air. The effect of the vest is likewise by means of the suspension of the coat or jacket away from the body of the wearer. Radiant or conductive heat in the present invention is absorbed by the outer coat and conducted to the inner liner of the coat but then due to the structure in the vest the heat transfer is inhibited by the gas space that separates the coat from the person. Since this gas space is strongly ventilated the conduction of heat via the air or gas is virtually eliminated. The heat transferred to the body is limited to the later radiant heat that is emitted by the hot coat interior that is not blocked or shadowed by the moving gas. Every molecule of gas that is heated by the interior radiant heating of the coat blocks that much heat from the body. The air flow by the blowers also adds to the evaporative cooling of the individual.

[0011] The support structure that supports the jacket away from the body by means of a tube around the back and under the arms and up the chest on two side further allows the installation of a front zipper or Velcro opening allowing easy donning of the vest. The vest may be simply slipped on like a normal jacket rather than slipped over the head like many vests.

[0012] A batten is any stiff material that may be attached to or inserted into a softer material to hold it in shape. Thus a batten could be made of the material itself if it were tightly attached in layers over a portion of the surface so as to be stiff and shape holding.

[0013] A tubing structure can be inflated with air on not. A tubing structure need not be necessarily round. A tubing structure could be sewn into a vest with the vest material itself if it is an air flow resistant material that is effectively sealed and filled with a gas. A tubing structure could also be effected by the use of simple padding that is used in the vest to thicken a portion and provide stiffness. Thus two sewn lines can provide a stiff tubing structure if the pocket created is stuffed with sufficient wadding. A tubing structure may be self supporting without any fabric material such as a vest.

[0014] A plenum is a space that can conduct a gas. In the vest the plenum is created by holding the jacket or coat away from the body making the body one of the surfaces of the plenum and any coat or garment another plenum surface.

[0015] A garment is any piece of non ridged material intended to cover the body whether it be covered by another material or not.

[0016] A blower is any means of forcing a volume of air into a plenum

[0017] Further objects and advantages of my invention will become apparent from a consideration of the drawings and or ensuing description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. **1** is a perspective of the vest showing the intakes for the blowers and the location of the tubing structure that holds the outer garment away from the body. FIG. **1** number **1** shows a batten bowed out to support a garment away for the body. Number **2** is the right side blower intake. Number **3** is the lower waist tubing structure that holds a garment away from the body to create a plenum and can act as a gasket to limit flow of air from the blower number **2** out from the bottom of a garment. Number **4** shows the tubing structure going around the side waist of the person and turning up. Number **5** shows the tubing garment support structure coming up the front left chest area of the person to the breast pocket area. Number **6** shows a latitudinal tube structure formed by stuffing wadding between two sewn lines of fabric as an alternative tubing structure method. Number **7** shows airflow in through a blower and number **8** shows airflow out from a created plenum

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0019] The preferred embodiment is a mesh vest that uses the covering of another jacket as the outer cover for a plenum that conducts the flow of air around the body. The vest is mesh on the top two thirds and the bottom is made of an impermeable layer that extends down to the lower waist to seal it should the outer jacket ride up. In the back of the vest at the bottom of the vest are two blowers that produce a volume of air at a pressure of about 0.89 in. of H2O. The blowers are operated by a battery arrangement in a pocket accessible in the front. The batteries are rechargeable. The vest and the covering coat are supported by a tubing network that begins on one side of the upper breast pocket area in the front and comes down the front and at the waist bends and proceeds along the waist to rest along the buttocks to the

other waist and up the other front chest quarter to again stop at the breast pocket area. The tubing is steel reinforced pvc tubing 1.3 inches in diameter. It is stiff and crush resistant. The vest also incorporates a ¼ pvc rod that is sewn in across the back from arm pit to arm pit so that when worn the arms press the bow or batten ends inward and springs the batten outward to support the upper portion of the outer coat away from the body to provide a plenum. A plenum being a passageway for the flow of air. The sides of the vest are adjustable to allow the vest to fit a majority of people. The sides are adjustable with Velcro flaps that overlap yet maintain a seal to limit the escape of conducted air in the vest. As the vest is enlarged the tube in the front slides down to allow the expansion of the waist and to maintain a seal along the waist and side. Conversely, as the vest sides are adjusted for a smaller person the flaps are overlapped more and the tubing to adjust for a smaller waist is slid up the front to above the breast pocket area.

[0020] The vest also incorporates a system that utilizes the tubing system in the vest and to allow the injection of compressed air to adiabatically cool the individual should this additional cooling be needed. Alternatively a fire suppression system using CO2 is offered with the vest and uses the same system of tubing. A raised latitudinal pad is built along the back near the neck as an additional part of the tubing structure although it is not contiguous with the other structural parts. It is anticipated that a protective jacket could be built incorporating the supporting tubular structure.

[0021] The vest maintains the option of various filter arrangements on the intake of the blower. Such filters could be dust filters but what is in the future envisioned is a swamp cooler arrangement that will allow the injection of a mist that may be pumped with the blower around the individual to enhance cooling in dry climates.

[0022] It is intended that further embodiments incorporating the spirit of the invention to one skilled in the art fall within the scope of this invention.

I claim:

1. A method of cooling a person said method comprising: supporting a garment over the body of said individual, creating a plenum between said body and said garment, forcing air into said plenum, said air evaporating moisture from said body, thus cooling said person.

2. A method of creating a plenum around a person comprising a tube structure and a garment, said tube structure holds said garment off said person thus creating plenum between said person and said garment.

3. A structure to create a plenum under clothing comprising a tube that supports said clothing apart from the body, said structure supporting the clothing away from the body, a sealing means to limit the escape of air along portions of said plenum.

4. A structure as in claim 3 where said tube is a batten.

5. A cooling apparatus comprising:

a) a tubing structure that supports a garment away from the body,

b) a blower that blows air into the space created by said tubing structure and said garment.

6. A cooling vest as in claim 5 where said tubing is a batten.

7. A method as in claim 1 where said garment is a jacket.

8. A structure as in claim 3 where said sealing means is said tube.

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