A self-ventilating, self-exhausting body-worn article having a plural number of conduits extending therethrough, the conduits each having an intake opening and one-way intake valve through which warmed interior air and perspiration moisture vapor is drawn into the conduit, one or more compressible members, such as a tube, bulb or bladder, and a one-way exhaust valve and exhaust opening through which the warmed air and vapor is expelled. The compressible members are compressed by the expansion of the chest, flexing or movement of body parts, or contact with outside objects to expel the warmed air and vapor, and when the compressive forces are removed, the compressible members expand to again draw warmed air and vapor into the compressible members through the intake openings to repeat the cycle.
SELF-VENTILATING BODY-WORN ARTICLES

BACKGROUND OF THE INVENTION

[0001] This invention relates generally to the field of articles of clothing, shoes, athletic equipment such as football helmets or shoulder pads, or other body-worn devices that comprise means to cool the wearer by removing body heat and exhausting it to the ambient air. More particularly, the invention relates to such body-worn articles where the body heat is removed by replacing or removing interior air elevated by body heat. Even more particularly, the invention relates to any such body-worn articles where the body heat is removed by withdrawing the elevated temperature interior air as well as moisture produced through perspiration, without recourse to powered mechanisms, and expelling both into the ambient atmosphere.

[0002] Many occupations require the wearing of heavy, stiff, thick or padded articles of clothing, shoes, protective equipment or other body-worn articles that readily trap body heat and perspiration moisture vapor produced by the wearer during exertion, such that the interior air becomes elevated in temperature and the wearer becomes overheated or uncomfortable. This condition is exacerbated during hot weather.

[0003] Many workers, for example, must wear vests or body suits containing multiple pockets or retainers for equipment, or workers such as soldiers or policemen may wear protective bullet-resistant vests. While of obvious utilitarian benefit to the wearer, these articles are especially uncomfortable in hot weather or when the wearer performs exerting tasks, as they tend to trap the body heat and perspiration produced by the wearer. Particularly in southern climates, this uncomfortable heat-trapping side effect sometimes results in a personal decision not to wear the article. Protective gear for certain sports, such as for example football helmets, shoulder pads or the like, also trap body heat and perspiration, increasing fatigue and stress on the body. Heavy work boots constructed of relatively thick leather or similar material, running shoes or other footwear also entrap body heat and perspiration produced by the feet.

[0004] Attempts have been made to solve the heat-trapping problem of body-worn articles by providing internal circulation systems within the article. Such devices are shown for example in U.S. Pat. No. 5,255,390 to Gross et al., U.S. Pat. No. 5,050,240 to Sayre U.S. Pat. No. 5,005,216 to Blackburn et al., U.S. Pat. No. 4,194,247 to Melander, U.S. Pat. No. 3,348,236 to Copeland, and U.S. Patent Application Publication No. 2003/0196254 to Forgha. These devices utilize an outside source of pressurized air or fluid to pass cool air or fluid into the internal conduits, which is then exhausted or recirculated after absorbing body heat from the wearer. Gioello in U.S. Pat. No. 4,451,934 shows a ribbed undergarment worn below a bullet-resistant vest, where the channels between the ribs allow for convection flow to reduce body heat entrapment. Gaithers, Jr., in U.S. Pat. No. 6,668,385 shows an undergarment with expandable pleats to form channels. Siple in U.S. Pat. No. 2,648,325, while directed at producing a body warming vest, is of interest in that it discloses a closed circulating system with no outside fluid source, where the temperature of the fluid is raised by chemical means and the circulation occurs as a function of the breathing or movement of the wearer, the expansion and contraction of the chest pressing against bulbs which force fluid flow in a single direction because of the presence of a single one-way valve in each conduit. This construction would not work for cooling the wearer, since there is not provided any means to exhaust and replace, or to cool the fluid, once it has absorbed body heat from the wearer.

[0005] In U.S. Pat. No. 6,454,749 to Lau et al., the problem of body heat entrapment was addressed in bulky personal care products, such as diapers or feminine hygiene products, by providing a bellows structure that forces ambient air into the personal care products, the bellows being activated by movement of the wearer. In my U.S. Pat. No. 6,128,784, the same problem was addressed by providing elongated compressible members, such as tubes, bulbs and bladders, alone or in combination, with each such compressible member having an inlet opening to the ambient and an outlet opening to the ambient. Cooler ambient air was drawn into the tubes, where it was warmed by the trapped body heat, and the heated air was then expelled back into the ambient. Air flow was a result of the natural movement or expansion/contraction cycles of the wearer’s body, such that the article of clothing was self-ventilating and no powered mechanical air movement means were required.

[0006] A shortcoming of the known devices directed at the problem of entrapped body heat in body-worn articles is that they are relatively complex, encompassing complex enclosed circulation systems or powered air or liquid delivery systems, or are relatively inefficient, in that static channels are provided which have limited to zero air flow, or ambient air is brought into the body-worn article, or ambient air is passed through a body-worn article. The inefficiency results from the fact that the known devices do not address removal of the interior air that is elevated by body heat, and even more particularly, do not address removal of moisture vapor produced by perspiration. Such vapor dramatically reduces the efficiency of the heat-exchanger-type devices by soaking the garment material and closing pores.

[0007] It is an object of this invention to provide a body-worn article, such as clothing in the form of a shirt, pants, vest, coat, raincoat, jacket, etc., shoes, helmets, pads or the like, which cools the wearer by removing body heat in the form of elevated interior air and moisture vapor produced by perspiration, where the air and vapor is drawn through conduits in the body-worn article and exhausted externally, cooler ambient air being drawn into the interior to replace the expelled air through normal garment openings at the neck, arms, waist, ankles, etc. or through openings disposed directly in the body-worn device for this purpose. It is a further object to provide such a device where the air and vapor is withdrawn from the interior and expelled from the device with no outside pressurization means or forced air pumping apparatus, such that the device is self-ventilating. It is a further object to provide such a device where the expansion and contraction of the chest of the wearer or other physical body movement is sufficient to cause the air warmed by body heat and moisture vapor to be exhausted into the outside atmosphere. It is a further object to provide such a device which contains multiple pairs of one-way check valves mounted in individual conduits, where the valve pairs are oriented such that flow through the conduit occurs in a single direction only, where the conduits may comprise tubes, bladders, bulbs or combinations thereof to provide the self-ventilation means to pass air through the
device. These and other objects not expressly stated will be accomplished as set forth in the disclosure below.

SUMMARY OF THE INVENTION

[0008] The invention is a self-ventilating body-worn device which may comprise an article of clothing, such as a shirt, vest, pants, outer garment, body suit or the like, footwear, helmets, protective pads or other devices, which cools the wearer by providing a means for withdrawing moisture vapor produced by perspiration and interior air elevated in temperature by body heat. The device is provided with air conduits, either positioned within the device or mounted on its interior side, which comprise tubes, bladders, bulbs or combinations thereof, where some of the components, or at least portions thereof, are compressible by the expansion of the chest of the wearer or from body movement, such that air within the compressible components is forced from the components and expelled from the conduits into the ambient atmosphere. The compressible components are constructed of material having a resilient memory, typically a plastic or rubber, and are designed with a wall structure and thickness such that when pressure is removed from the components the components expand back to their non-compressed configuration, thereby drawing air into the components and the conduits. Each of the conduits is arranged to communicate with an interior intake opening and an external exhaust opening, with the interior intake opening positioned to remove air and vapor from the area internal to the device. A one-way check valve, such as a plastic duck-billed slit valve or the like, is positioned adjacent the intake opening and oriented such that air flow can only occur into the conduit through the intake opening. Likewise, a one-way check valve is positioned adjacent the exhaust opening and oriented in the same direction as the other valve, so that air flow can only occur from the conduit out through the exhaust outlet. Multiple conduits may be connected to a manifold with an extension exhaust tube of sufficient length to be positioned external to any articles of clothing surrounding the self-ventilating device. In this manner, pressure against the compressible components forces warmed air and vapor within the conduits out the exhaust openings, while the subsequent expansion of the compressible components when the pressure is removed causes interior air and vapor to be drawn back into the conduits. This cycle is repeated with every expansion/contraction cycle of the chest or body movement, such that the device is self-ventilating with no need for a powered means to force the air through the device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is an illustration showing the invention embodied as an article of clothing.

[0010] FIG. 2 is a cross-sectional partial view showing the invention embodied as a running shoe.

[0011] FIG. 3 is a partially exposed, cross-sectional view showing the invention embodied as a football helmet.

[0012] FIG. 4 is a cross-sectional view of a compressible member comprising a tube, shown in the neutral position.

[0013] FIG. 5 is a cross-sectional view of the member of FIG. 4, shown in the compressed position such that air is expelled through the exhaust valve and opening.

[0014] FIG. 6 is a cross-sectional view of the member of FIG. 4, shown in the expanding position such that air is drawn in through the inlet opening and valve.

[0015] FIG. 7 is an alternative embodiment for the compressible member, where bulb members are employed.

[0016] FIG. 8 is another alternative embodiment for the compressible member, where a large bladder member is employed.

[0017] FIG. 9 shows an alternative embodiment of the invention, where the individual conduits are connected to a manifold.

DETAILED DESCRIPTION OF THE INVENTION

[0018] With reference to the drawings, the invention will now be described in detail with regard to the best mode and the preferred embodiment. The invention comprises a self-ventilating or automatic exhausting body-worn article, such as an article of clothing or other device to be worn on the body, such as a shirt, vest, pants, outer garment, body suit or the like, footwear, helmets, protective pads or other devices, which cools the wearer by providing a means for withdrawing or extracting moisture vapor produced by perspiration and interior air (defined as air between the body-worn article and the wearer’s skin) that has been elevated in temperature by body heat, and then exhausting the vapor and air externally to the body-worn device and into the atmosphere, with the cycle repeating. The operational force for the device is the movement of the wearer’s body, such as the expansion and contraction of the wearer’s chest from breathing or exertion, the bending or flexing of body parts or appendages, the flexing of the foot, or through forceful contact with external objects, such as when tackling another football player or striking the heel into the ground during running or walking, with no requirement for a powered or pressurized means to force air through the device. For simplicity, the invention will be described in the embodiments of a shirt, shoe and helmet, as illustrated, but it is to be understood that the invention can comprise any body-worn article of similar characteristics, including pants, shorts, vests, coats, jackets, body suits, etc. The invention may be provided as a cooling article that is worn underneath and in addition to other articles of clothing or bulky devices, such as a coat, shirt, vest (and in particular, bullet-proof vests), etc., or the invention may comprise the actual coat, shirt, vest, device, etc., where the operational components are built directly into or attached to the article of clothing or device in an integral manner. The invention works with optimum efficiency when it is positioned directly against the skin of the user or when separated from the user’s skin only by thin material which allows relatively unimpeded passage of body heat and perspiration moisture vapor.

[0019] As shown in FIG. 1, the invention comprises a plural number of self-ventilating, self-exhausting conduit means 20 affixed to some manner of webbing or other material such that the relative positions of the conduit means 20 are maintained when the device is worn on the body. As illustrated, the conduit means 20 are positioned within a shirt 10 having two arm openings 11, a torso opening 12, a head opening 13, an interior side 18 and an exterior side 19. The conduit means 20 may be incorporated within the body of the shirt 10 or may be affixed to the interior side of the shirt 10.
The self-ventilating, self-exhausting conduit means 20 comprise a relatively large number of ventilating means defined as compressible members 30, the compressible members 30 defining hollow bodies where the wall structure of the compressible members 30 is such that they may be relatively easily compressed, such as in this case by the expansion of the wearer’s chest during breathing. The compressible members 30 are preferably retained such that the interior walls 35 of the compressible members 30 are deflected inwardly relative to the exterior walls 36 of the compressible members 30. In addition, the material of construction, the interior wall 35 thickness and the overall shape of the compressible members 30 are chosen such that the compressible members 30 rebound to the neutral position when all compressive forces are removed, such that the interior space of the compressible members 30 is maximized. Preferably the compressible members 30 are composed of a plastic or rubber material.

In one embodiment, the compressible members 30 are compressible tubes 31 which extend through the body of the shirt 10. The tubes 31 may extend generally vertically as shown or any desired direction. They may be relatively straight as shown, or configured in more intricate patterns. Preferably near, adjacent or at each interior end of each tube 31 is an intake valve 41 and preferably near, adjacent or at each exterior end is an exhaust valve 42, which both comprise one-way valves which are self-closing and opened by air pressure, such as a one-way valve 41 of the type well known in the art. As shown in FIGS. 4, 5 and 6, the intake valve 41 and the exhaust valve 42 are positioned such that flow through the conduit means 20 and compressible member 30 is possible in only one direction. The end of the tube 31 adjacent or near the intake valve 41 is the intake opening 21 positioned internally on the interior side 18 of the body-worn device to extract or withdraw both interior air heated by body heat and perspiration moisture vapor from the area interior to the body-worn device, while the end of the tube 31 adjacent or near the exhaust valve 42 is the exhaust opening 22 disposed on the exterior side 19, through which air warmed by body heat and perspiration moisture vapor is exhausted.

The operation of the self-ventilating conduit means 20 begins with the compressible members 30 in the passive or neutral position, as shown by compressible tube 31 in FIG. 4. The interior within the tube 31 is maximized such that a good volume of air resides within the tube 31. When the wearer expands the chest or performs certain physical movements, the interior wall 35 of the tube 31 is compressed outwardly against the exterior wall 36 as shown in FIG. 5. This forces the warmed air and moisture vapor resident in the tube 31 out through exhaust valve 42 and exhaust opening 22 into the atmosphere, since intake valve 41 remains closed. When the compressive forces are removed, as shown in FIG. 6, the resilient nature of the interior wall 35 causes it to expand inwardly toward the wearer’s body, which draws another batch of warmed air and moisture vapor through the intake opening 21 and intake valve 41, refilling the compressible tube 31, since the exhaust valve 42 remains closed during this intake process. With every chest expansion or movement, the cycle repeats, with warmed air and perspiration vapor being exhausted to atmosphere. The exhausted warmed air is replaced by inflow of ambient air through the cloth itself or through the arm, torso and neck openings 11, 12 and 13.

Alternative configurations for the compressible members 34 are shown in FIG. 7, where the compressible members 30 comprise rounded bulbs 33 connected in series by connecting tubes 34, and in FIG. 8, where the compressible members 30 comprise relatively large bladders 32 joined by connecting tubes 34. The self-ventilating operation of the bulbs 33 and bladders 32 is the same as described above for the compressible tubes 31, in that the bulbs 33 and bladders 32 are composed of resilient material such that each is biased to expand back into the neutral configuration with maximum interior space after any compressive forces are removed.

Depending on the particular construction chosen for the invention, and depending on the types of clothing or devices which may be worn external to the invention, it may be necessary to provide extension means for the exhaust openings 22 to reach and communicate with the outside air. In a simple form, the conduit means 20 may simply extend some distance beyond the body-worn device. Alternatively, multiple conduit means 20 may be connected to common manifold bodies 50, as shown in FIG. 9, where each manifold 50 has an extension tube 51 which may be positioned with its opening communicating with the atmosphere.

An alternative embodiment is illustrated in FIG. 2, wherein the body-worn device is shown to comprise a shoe 80. A bladder 32 compressible member is disposed in the heel area of the shoe 80, with an intake opening 21 containing an intake valve 41 providing a passageway from the interior of the shoe 80 into the bladder 32 and with an outtake opening 42 containing an exhaust valve 42 providing a passageway from the bladder 32 into the ambient atmosphere. When the wearer presses the heel down during walking or running, the bladder 32 is compressed and its contents expelled through the exhaust valve 42 to the exterior of the shoe 80, the intake valve 41 preventing flow into the interior of the shoe 80. When the heel is raised the bladder 32 expands and warmed interior air and perspiration moisture vapor is drawn from the interior of the shoe 80 into the bladder 32, with the cycle continuing with each step. It is contemplated that the location and type of the compressible members 30 may be varied without departing from the scope of the invention, such as for example placing tubes 31, bladders 32 or bulbs 33 within the flexing arch area, exhausting the warm air and vapor to the sides or out the top of the shoe 80, etc. Likewise, the invention may be utilized with various types of footwear, such as running shoes, walking shoes, dress shoes, work boots, athletic shoes, etc.

In another alternative embodiment, the invention may be utilized in other body-worn devices not normally considered to be articles of clothing, such as for example athletic equipment. As shown in FIG. 3, the invention is illustrated as a football helmet 90, where the conduit means 20 comprise tube members 31 disposed within padding 91. Each tube 31 extends from an intake opening 21 through the padding 91 and to an exhaust opening 22. Intake valves 41 are disposed near, adjacent or at the intake openings 41 and exhaust valves 42 are disposed near, adjacent or at the exhaust openings 22. Upon contact with another object, such as the ground or another football player, the padding 91 and tubes 31 are compressed, expelling the warmed air and vapor through the exhaust valves 42. When the compressive
force is removed, the tubes 31 expand and warm air and moisture vapor is drawn through the intake valves 41 from the interior of the helmet 90.

[0027] It is contemplated that equivalents and substitutions to certain elements set forth above may be obvious to those skilled in the art, and therefore the true scope and definition of the invention is to be as set forth in the following claims.

I claim:
1. A self-ventilating, self-exhausting body-worn article having an interior side facing a wearer and an exterior side, wherein said body-worn article draws warmed interior air and perspiration moisture vapor through said interior side and expels said warmed interior air and perspiration moisture vapor through said exterior side and into the atmosphere, said body-worn article comprising conduit means each comprising an intake opening open to said interior side of the body-worn article, at least one compressible member which is compressible by body movement, an exhaust opening open to said exterior side of the body-worn article, a one-way intake valve which allows warmed interior air and perspiration moisture vapor from said interior side of the body-worn article to be drawn in only one direction through said intake opening and into said at least one compressible member, and a one-way exhaust valve which allows said warmed interior air and perspiration moisture vapor to be expelled from said at least one compressible member and out through said exhaust opening into the atmosphere, where said warmed interior air and perspiration moisture vapor is expelled through said exhaust valve when said at least one compressible member is compressed by body movement and where said at least one compressible member expands to refill with new warmed interior air and perspiration moisture vapor drawn through said intake valve when said compressible member is not compressed by body movement.

6. The article of claim 1, where said body-worn article comprises an article of clothing.
7. The article of claim 1, where said body-worn article comprises a shoe.
8. The article of claim 1, where said body-worn article comprises a helmet.
9. A self-ventilating, self-exhausting body-worn article comprising means to withdraw warmed interior air and perspiration moisture vapor and means to expel said warmed interior air and perspiration moisture vapor into the ambient atmosphere;

wherein said withdrawal means comprises at least one compressible member, an intake opening through which said warmed interior air and perspiration moisture vapor is withdrawn, a one-way intake valve, an exhaust opening and a one-way exhaust valve, such that warmed interior air and perspiration moisture vapor flows in only one direction;

wherein said compressible member is body actuated, such that repetitive movement of a body part in contact with the body-worn article results in compression and expansion of said compressible member, which causes suction of said warmed interior air and perspiration moisture vapor through said intake opening and said intake valve and expulsion of said warmed interior air and perspiration moisture vapor through said exhaust valve and said exhaust opening.

10. The article of claim 9, where said at least one compressible member comprises a tube.
11. The article of claim 9, where said at least one compressible member comprises a bulb.
12. The article of claim 9, where said at least one compressible member comprises a bladder.
13. The article of claim 9, further comprising a manifold body, and wherein said at least one compressible member is connected to said manifold body.
14. The article of claim 9, where said body-worn article comprises an article of clothing.
15. The article of claim 9, where said body-worn article comprises a shoe.
16. The article of claim 9, where said body-worn article comprises a helmet.

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