A cooler accessory for use with a hard hat or other head-protecting gear having a protective shell with a rim, the accessory including a housing that is attachable to the protective shell, flexible and pliable tubing that extends from the rigid housing in a manner that allows for user control over position and orientation of the tubing, and airflow supply means (e.g., an electric fan assembly) for supplying a flow of air that passes through the tubing and exits therefrom. During use, a portion of the tubing is disposed below the rim of the protective shell for directing the flow of air supplied by the airflow supply means under the rim for injection toward space adjacent the user’s body, thereby cooling the user’s body. Preferably, the tubing is positioned such that airflow is injected into an air gap between the user’s head and the protective shell and over the user’s head, thereby actively cooling the user’s head. In another aspect, parts of the active cooling device (e.g., the housing or portions thereof) can be integrally formed with the protective shell and rim of the hard hat or other type of head-protection gear.
FAN-BASED COOLER FOR HEAD-PROTECTION GEAR

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates broadly to hard hats for protecting the heads of users in dangerous environments, such as construction sites, mines, industrial environments (e.g., chemical plants, assembly plants, steel mills, lumber mills), forestry and other tree cutting and pruning environments, military helmets, motorcycle helmets, helmets for alpine skiing and/or snowboarding, and other head-protection gear that employ a rigid head-protecting shell. More particularly, the invention relates to mechanisms for allowing the user's face to be secured to (or part of) the protective shell of a hard hat and to operate to cool the user.


[0004] Environments involving high temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, or strenuous physical activities have a high potential for inducing heat stress in individuals who work in such environments. Such environments include iron and steel foundries, brick-firing and ceramic plants, glass products facilities, rubber products facilities, electrical utilities (particularly boiler rooms), bakeries, confectioneries, commercial kitchens, laundries, food canneries, chemical plants, mining sites, smelters and steam tunnels.

[0005] Outdoor operations conducted in hot weather, such as construction, forestry and lumber mills, refining, asbestos removal, and hazardous waste site activities, especially those that require workers to wear semi-permeable or impermeable clothing are also likely to cause heat stress among exposed workers.

[0006] In many of these environments, workers wear hard hats that protect the users' heads from falling debris and other potential hazards. However, in hot weather, hard hats provide a “greenhouse” effect where the humidity caused by body perspiration about the head and neck builds up under the hard hat, thereby thwarting the body's own evaporative cooling system. Some leading hard hat manufacturers have introduced small air vents similar to the concept disclosed in U.S. Pat. No. 6,170,090 to Minor. However, these small vents provide minimal to no cooling effect. There have been many hard hat designs that actively cool the user by blowing air over the head. Such a design takes advantage of the body’s own evaporative cooling system and enhances it with the cooling properties of wind chill. See U.S. Pat. No. Re. 36,242 to Apisdorf, U.S. Pat. No. 3,813,696 to Yeager, U.S. Pat. No. 3,881,198 to Waters, U.S. Pat. No. 3,881,478 to Rosendahl et al., U.S. Pat. No. 4,680,815 to Hirsch et al., U.S. Pat. No. 4,893,356 to Waters, U.S. Pat. No. 5,561,862 to Flores, Sr., U.S. Pat. No. 6,122,773 to Katz, and U.S. Pat. No. 6,760,925 to Maxwell. However, these designs are disadvantageous in that they require modification (e.g., thru-holes) to the protective shell of the hard hat and thus risk compromising the structural integrity of the protective shell. Some standards bodies such as the American National Standards Institute (ANSI) also forbid modification of the hard hat by drilling holes. Moreover, the designs suffer from other limitations including high costs, the inability to remove the active cooling mechanism from the hard hat, the inability to secure the active cooling mechanism to hard hats of varying size, the use of materials that are unsuitable for rugged high-impact environments, and the lack of effective user control over the active cooling function.

[0007] Thus, there remains a need in the art to provide an active cooling device for use with a hard hat that does not require modification to the protective shell of the hard hat (and thus does not risk compromising the structural integrity of the hard hat). Moreover, there remains a need in the art for such an active cooling device that is inexpensive, preferably removable from the hard hat, capable of being added to hard hats of varying size, uses materials that are suitable for rugged high-impact environments, and affords effective user control over the active cooling function.

SUMMARY OF THE INVENTION

[0008] It is therefore an object of the invention to provide an active cooling device for use with a hard hat that does not require modification to the protective shell of the hard hat (and thus does not risk compromising the structural integrity of the hard hat).

[0009] It is another object of the invention to provide such an active cooling device that is inexpensive.

[0010] It is a further object of the invention to provide such an active cooling device that is removable from the hard hat.

[0011] It is also an object of the invention to provide such an active cooling device that is capable of being added to hard hats of varying size.

[0012] It is an additional object of the invention to provide such an active cooling device that is realized from materials that are suitable for rugged high-impact environments.

[0013] It is still another object of the invention to provide such an active cooling device that affords effective user control over the cool function of the device.

[0014] In accord with these objects, which will be discussed in detail below, an active cooler accessory is provided for use with a hard hat or other head-protecting gear having a protective shell with a rim. The accessory includes a housing that is attachable to the protective shell, flexible and pliable tubing that extends from the housing in a manner that allows for user control over position and orientation of the tubing, and airflow supply means (e.g., an electric fan assembly) for supplying a flow of air that passes through the tubing and exits therefrom. During use, a portion of the tubing is disposed below the rim of the protective shell for directing the flow of air supplied by the airflow supply means under the rim for injection toward space adjacent the user’s body; thereby cooling the user’s body. Preferably, the tubing is positioned such that airflow is injected into an air gap between the user’s head and the protective shell and over the user’s head, thereby actively cooling the user’s head. Preferably, the housing supports a battery compartment and at least one user-manipulated switch and associated control circuitry that operate to selectively couple at least one battery held within the battery compartment to the electric fan assembly in response to user manipulation of the at least one switch.

[0015] It will be appreciated that the cooling airflow provided by the accessory device can be directed such that
it flows over the user’s head, which works in conjunction with the body’s own evaporative cooling system to significantly reduce the heat and humidity experienced by the user and thus results in a significant increase in the comfort of the user. Such cooling also reduces the exposure to work related heat exhaustion, potential serious heatstroke and reduced productivity.

[0016] According to one embodiment of the invention, a first switch (e.g., 3-position switch) cooperates with control circuitry to operate in each one of the following modes: i) a first mode wherein airflow supply means is powered off; ii) a second mode wherein the airflow supply means is automatically cycled on/off for predetermined on/off time periods; and iii) a third mode wherein the airflow supply means is continuously powered on. A second switch (e.g., larger size push button switch) cooperates with the control circuitry to operate in a fourth mode wherein the airflow supply means is automatically powered on for a predetermined time period, with the fourth mode overriding the operations of the first and second modes.

[0017] According to another embodiment of the invention, the housing supports one or more connectors that connect to external power sources (e.g., external AC/DC power converter (outlet charger), external DC/DC power converter (automobile cigarette lighter charger), external solar-cell power converter) for charging the battery(ies) that are held in the battery compartment of the housing, and possibly for powering the airflow supply means of the device for use.

[0018] According to yet another embodiment of the invention, the housing includes a curved base that generally follows the contour of an exterior portion of the protective shell with a flexible insert cushion fixed thereto. The tubing is extendable along its length. These features allow the accessory to be secured to hard hats of varying size and shape.

[0019] In another aspect of the present invention, parts of the active cooling device (e.g., the housing or portions thereof) can be integrally formed with the protective shell and rim of the hard hat.

[0020] Additional objects and advantages of the invention will become apparent to those skilled in the art upon reference to the detailed description taken in conjunction with the provided figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] FIG. 1 is a perspective view of a cooling accessory secured to a hard hat in accordance with the present invention.

[0022] FIG. 2A is a perspective view of the cooling accessory of FIG. 1.

[0023] FIG. 2B is an exploded view of the cooling accessory of FIG. 1.

[0024] FIG. 3 is a side view of the cooling accessory of FIG. 1.

[0025] FIG. 4 is an internal view of the electric fan assembly of the accessory of FIG. 1 and the airflow generated thereby for cooling purposes.

[0026] FIG. 5 is a blown-up view of a recessed compartment in the housing of the accessory of FIG. 1, which supports a user control switch and two connector ports for connection to external power sources.

[0027] FIG. 6 is a schematic diagram of exemplary control circuitry that is supported by the housing of FIG. 1 and provides for smart activation of the electric fan assembly in accordance with user input.

[0028] FIG. 7 is a perspective view of the accessory of FIG. 1, with an external solar-cell power source mounted onto its housing.

[0029] FIGS. 8A-8C are different views of the accessory of FIG. 1, showing exemplary dimensions for different parts of the accessory.

[0030] FIG. 8D is a view of the accessory of FIG. 7, showing exemplary dimensions for the external solar-cell power generator.

[0031] FIGS. 9A and 9B are different perspectives of an alternate embodiment of the present invention wherein parts of the active cooling device are integrally formed with the protective shell and rim of a hard hat.

[0032] FIG. 10 is a side view of another embodiment of a cooling accessory that is secured to a hard hat in accordance with the present invention.

DETAILED DESCRIPTION

[0033] The term “hard hat” as used herein is meant to include not only the specific designs shown, but also include other types of head-protecting safety hats for dangerous environments such as construction sites, mines, industrial environments (e.g., chemical plants, assembly plants, steel mills, lumber mills), forestry and other tree cutting and pruning environments, miner’s hats, protective hats for industrial applications, protective hats for lumbering and tree pruning applications, military helmets, motorcycle helmets, helmets for alpine skiing and/or snowboarding, and other head-protection gear that employ a rigid head-protecting shell.

[0034] Turning now to FIG. 1, an exemplary hard hat 10 includes a molded, hard plastic protective shell 12 with a rim 14 surrounding a dome-shaped head cover portion 16 that defines a head-receiving cavity 18 therein. A head support harness (not shown) is affixed to the interior surface of the dome-shaped head cover portion 16 and is disposed within the head-receiving cavity 18. The head-support harness interfaces to the user’s head and supports the shell 12 above the user’s head such that an air gap exists therebetween. A cooling accessory 21 is affixed to the exterior surface of the shell 12, preferably to the rear portion of the shell 12 as shown.

[0035] As best shown in FIGS. 2A, 2B and 3, the cooling accessory 21 includes a rigid plastic housing 23 preferably realized from three distinct housing parts 23A, 23B, 23C (FIG. 2B). The housing part 25C has a curved base 25 that generally follows the contour of the domed-shaped portion 16 of the protective shell 12. In the preferred embodiment, the housing parts 23A, 23B, 23C are realized from a lightweight material suitable for high-impact applications such as an acrylonitrile-butadiene-styrene (ABS) copolymers or polypropylene or other suitable plastic suitable for high impact applications, carbon fiber, Kevlar, or other high impact material.
As best shown in the exploded view of FIG. 2B, a flexible insert 27 of elastomeric material (such as rubber or neoprene) is fixed to the base 25 preferably with an adhesive layer. One or more hook-and-loop fastener pads (not shown) may be adhesively affixed to the insert 27 preferably by the user and then secured to the protective shell 12 to locate the accessory 21 on the exterior surface of the protective shell 12 and then remove it if desired. Alternatively, the base 25 and/or the insert 27 may be adhesively fixed to the protective shell 12. The insert 27 provides a cushion for mounting the housing 23 onto the exterior surface of the protective shell 12 in a manner that accommodates protective shells with varying shapes and sizes (e.g., varying radii of curvature). This allows the accessory 21 to be mounted on hard hats with varying shapes and sizes. Rubber trim 28 may surround the edge of the curved base 25 in order to hide a gap that may exist between the curved base 25 and the protective shell 12. The rubber trim 28 also keeps dust and debris away from the curved base 25 and the interface between the base 25 and the protective shell 12.

As best shown in FIG. 2B and FIG. 4, the housing part 23A defines an opening 29 that leads to an air duct 31 within the housing part 23B of a grille 33 covers the opening 29. An electric fan assembly 35, comprising a fan blade 37 driven by an electric motor 39, is mounted axially within the air duct 31. A hose 41 is coupled to the bottom of the housing part 23C in fluid communication with air duct 31. The electric fan assembly 35, when powered on, operates to draw air into the opening 29 and through the air duct 31 and hose 41 where it exits from the end port 43 of the hose. The grille 33 may be removable by the user such that the user can access the fan blade 37 (and possibly the electric motor 39) for cleaning and maintenance as required. In the preferred embodiment, the air duct 31 and the electric fan assembly 35 are adapted to produce airflow through and out the hose 41 in a range between 14 to 16 cfm. The hose 41 is realized from a flexible and pliable construction that enables the user to adjust the position and orientation of the end port 43 in order to control the direction of the airflow that exits therefrom as desired. Moreover, the construction of the hose 41 preferably allows for extension of the hose 31 along its length to further provide greater flexibility in user positioning of the end port 43. In the preferred embodiment, the hose 41 is constructed of corrugated rubber, silicone or poly-elastomeric material and has a length that can vary between 50 mm and 170 mm. The user extends the hose 41 by applying an axial pulling force (e.g., away from the housing) to a desired section of the hose 41. The user shortens the hose 41 by applying an axial pushing force (e.g., toward the housing) to a desired section of hose. The lengthwise extendibility of the hose 41 also allows the device to be used on hard hats with different rim sizes (e.g., no-brim hard hats, short-brim hard hats, long-brim hats, and possibly Western-style hard hats).

During use, the air duct 31 is positioned substantially orthogonal relative to the plane defined by the rim 14 as best shown in FIG. 1. In this manner, the air duct 31 and electric fan assembly 35 are typically disposed in a substantially vertical position during use. A portion of the flexible hose 41 is positioned under the rim 14 such that the airflow produced by the electric fan assembly 35 flows under the rim 14 of the hard hat 10. The end port 43 of the hose is positioned such that airflow exiting therefrom is directed to flow towards or around a part of the user’s body for cooling purposes. Preferably, the end port 43 of the hose is positioned such the exiting airflow is injected upward from the rear of the hard hat 10 into the air gap between the user’s head and the protective shell 12 and up over the head where it is then exhausted below the front of the hard hat 10. In this configuration, the airflow passes over the back, top and front of the user’s head, which provides a maximal cooling effect. Note that the tube 41 generally has a u-shape along its length in order to guide the airflow under the rim 14 of the hard hat 10 and eject it upward into the air gap between the user’s head and the protective shell 12. Alternatively, the end port of the hose can be positioned such that the airflow is directed towards or around other parts of the head (e.g., the base of the head), the neck, or other part(s) of the body.

The housing 23 includes a battery compartment 38 (not shown) that holds one or more batteries that supply electrical power to the electric motor 39 of the fan assembly 35. The housing part 23C also supports a printed circuit board (FIG. 6) mounted therein that includes a microcontroller 51 and associated circuitry. The microcontroller 51 interfaces to switching circuitry 53 that selectively closes and opens one or more current paths that allow the battery(ies) 38 to power on and off the electric motor 39 of the fan assembly 35. The microcontroller 51 also interfaces to a set of one or more user-operated switches (e.g., two switches 45A and 45B—see FIG. 6) that are supported by the housing 23. The one or more user-operated switches allow the user to control the operation of the electric motor 39 to thereby activate the cooling fan function provided by the device.

In the preferred embodiment, two switches 45A and 45B are used. As best shown in FIG. 5, the first switch 45A is a three-position switch that is disposed in a recessed compartment 47 of the housing and accessible by a removable cover 49 (FIG. 1). In this configuration, the first switch 45A is protected from direct impact forces (which can be experienced if the hard hat 10 is dropped or otherwise impacted) as well as from direct environmental factors (e.g., rain, snow, dust, etc). The second switch 45B, which is preferably realized as an ergonomically designed larger-size button switch preferably with a diameter greater than 15 mm (and most preferably in a range between 20 mm and 30 mm in a range as best shown in FIGS. 1-3 and 8B, is disposed on the exterior of the housing 23 for quick user access. In this configuration, the second switch 45B is specifically designed to withstand a degree of direct impact forces (which can be experienced if the hard hat 10 is dropped or otherwise impacted) as well as a degree of direct environmental factors (e.g., rain, snow, dust, etc). The second switch 45B also preferably provides tactile feedback that enables the user to operate the switch 45B with work gloves that are commonly used in such dangerous environments. In the preferred embodiment, the second switch 4
The first switch 45A cooperates with the microcontroller 51 to carry out three different operations modes as follows:

i) “○” position—Off Mode: the switching circuitry 53 is controlled so that electric motor 39 is powered off—the transistor Q1 is switched OFF so that the ground current path is inactive;

ii) “A” position—Intermittent Mode: the switching circuitry 53 is controlled so that the electric motor is automatically cycled on/off for predetermined on/off time periods (e.g., on for one minute and then off for four minutes)—the transistor Q1 is automatically cycled on/off for predetermined on/off time periods so that the ground current path is cycled on/off;

iii) “●” position—Continuous Mode: the switching circuitry 53 is controlled so that electric motor 39 is continuously powered ON—the transistor Q1 is switched ON so that the ground current path is continuously active.

Preferably, the power capacity of the battery(ies) held in the battery compartment, the power consumption characteristics of the electric motor 39 and the associated control circuitry, and the predetermined ON/OFF time periods of the Intermittent mode are adapted such that the electric motor 39 can operate in the Intermittent mode for an 8 to 10 hour time period. In this configuration, the Intermittent mode is advantageous because the device can be used to cool the user for an entire workday (or a substantial part of a long work day) on a single battery charge. The Intermittent mode has other advantages. More particularly, during the OFF time periods, heat and moisture will typically build up under the protective shell 12 and cause the user to perspire. In the ON mode, the air blown over the head will enhance the evaporative-cooling provided by such perspiration for an improved cooling effect.

The second switch 45B cooperates with the microcontroller 51 to carry out a “Fast-Blast” mode wherein the switching circuitry 53 is controlled to power ON the electric motor 39 for a predetermined time period (e.g., two minutes)—the transistor Q1 is automatically cycled on for the predetermined time period so that the ground current path is activated for the predetermined time period. In such operations, the “Fast-Blast” mode overrides the “OFF” and “Intermittent” modes such that the “Fast-Blast” mode takes precedence over the control of the switching circuitry 53 (e.g., transistor Q1) and governs the operation of the electric motor 39. In the preferred embodiment, the “Fast-Blast” switch 45B.

Referring back to FIG. 5, the housing part 23B preferably includes a first connector port 51A for connecting to an external AC/DC power converter (outlet charger) or to an external DC/DC power converter (automobile cigarette lighter charger) (not shown) and a second connector port 51B for connecting to an external solar-cell power generator 53 (FIG. 7). Alternatively, these two external power sources may be connected to the same connector. The connector port(s) are preferably located in the same recess as the first switch 45A as shown for protection against direct impact and environmental factors. The printed circuit board supported within the housing also includes charging circuitry, operably coupled between the connector port(s) and the battery(ies) held in the battery compartment, that operates to charge the battery(ies) using the electrical power signal(s) supplied thereto by the external power source. The external power sources (e.g., the solar-cell power generator 53) may also be used in conjunction with the battery(ies) to supply power to the electric motor 39 of the electric fan assembly during use. Alternatively, the external power sources (e.g., the solar-cell power generator 53) may be as a substitute for the battery(ies) to thereby supply power to the electric motor 39 of the electric fan assembly during use, without charging the batteries. In preferred embodiment, the external solar-cell power generator 53 is part of a unitary construction 23A that is removable secured to the top of the housing part 23C about the opening 29 where it is positioned above the curved base 25 as shown in FIG. 7. A wire (not shown) connects the solar-cell power generator 53 to the second connector port 51B for charging/powering the device.

The dimensions of an exemplary embodiment of the cooling accessory of the present invention is shown in FIGS. 8A-8C. The overall height of the housing 23 is on the order of 112 mm. The diameter of the housing part 23C that defines the air duct 31 is on the order of 64 mm in diameter. The width of the curved base 25 is on the order of 82 mm. In another exemplary embodiment shown in FIG. 8D, the housing part 23A is extended above the curved base 25 for mounting an external solar-cell power generator 53 thereon as shown in FIG. 7. In this embodiment, the external solar-cell power generator 53 is on the order of 94 inches wide and 54 inches in length.

In an alternate embodiment shown in FIGS. 9A and 9B, the housing 23B (or parts thereof) of the active cooling device 21B is integrally formed (preferably by injection molding) with the protective shell 12B and rim 14B of a hard hat 10B. In this alternate embodiment, means for securing the housing of the cooling device to the hard hat are omitted and the active cooling device 21B includes the same functional elements and structural elements as the accessory 21 as described above, and operates in the same manner as the accessory 21 as set forth above.

In yet another alternate embodiment shown in FIG. 10, the opening 29B defined by the housing parts 23A and 23C of the active cooling device 21B is angled downward at an angle α+90° relative to the central axis of the air duct 31B as it extends away from the top of the curved base portion 25. In the illustrative embodiment shown, the angle α is on the order of 20°. It is contemplated that the angle a may have another value between 0° and 30°, or possibly a larger angle value. Moreover, in this alternate embodiment, the lower housing 23B and the hose 41B are realized as a single unitary plastic part that is formed by injection molding of plastic. The active cooling device 21B includes the same functional elements and structural elements as the accessory 21 as described above, and operates in the same manner as the accessory 21 as set forth above.

Advantageously, the cooling airflow provided by the active cooling device of the present invention can be directed such that it flows over the user’s head, which significantly reduces the heat and humidity experienced by the user and greatly enhances the body’s evaporative cooling mechanism (perspiration) and thus results in a significant increase in the comfort of the user. Such cooling also
reduces the exposure to work related heat exhaustion, potential serious heatstroke while improving worker concentration and productivity. Moreover, such cooling is consistent with the Occupational Safety & Health Administration’s guidelines for methods for controlling and preventing heat related illness. The housing also provides crush absorption to absorb shock. Finally, the device’s low cost and durable construction affords exceptional return on investment.

[0052] In alternate embodiments, the housing of the device may be realized from a lightweight, low-cost foam material (or possibly some other material). Such foam material provides additional crush absorption to absorb shock beyond that provided by a rigid plastic housing.

[0053] There have been described and illustrated herein several embodiments of a fan-based cooler accessory for a hard hat and related methods of operation. While particular embodiments of the invention have been described, it is not intended that the invention be limited thereto, as it is intended that the invention be as broad in scope as the art will allow and that the specification be read likewise. Thus, while particular configurations and materials have been disclosed, it will be appreciated that other configurations and materials can be used as well. Moreover, while the device described above employs an electric fan assembly to actively generating a supply of airflow, other air moving mechanisms (such as an air blower, centrifuged fan or air pump) can also be used. Also, while particular mechanisms for securing the device to the hard hat have been disclosed, other fixation mechanisms that do not rely on drilling, such as suction cups, permanent adhesive, etc. can be used. In some applications, fixation means (e.g., screws, rivets) that employ holes drilled through the protective shell of the hard hat may be used. In addition, while particular control schemes and electronic control circuitry have been disclosed, it will be understood that other control schemes and other electronic control circuitry can be used. It will therefore be appreciated by those skilled in the art that yet other modifications could be made to the provided invention without deviating from its spirit and scope as claimed.

What is claimed is:

1. A device for use with head-protection gear that includes a protective shell with a rim, the device comprising:
   a housing that is attachable to the protective shell;
   flexible and pliable tubing that extends from the housing in a manner that enables a user to adjust position and orientation of the tubing in order to control the direction of the airflow that exits therefrom; and
   airflow supply means, supported by the housing, for supplying a flow of air that passes through the tubing and exits therefrom;

2. A device according to claim 1, wherein:
   the tubing is positioned such that flow of air supplied by the airflow supply means is injected into an air gap between the user’s head and the protective shell and over the user’s head.

3. A device according to claim 1, wherein:
   the length of the tubing is extendible.

4. A device according to claim 1, wherein:
   the housing defines an interior air duct that extends from an opening to the tubing, wherein the airflow supply means is mounted axially within the interior air duct.

5. A device according to claim 3, further comprising:
   a removable grill that covers the opening.

6. A device according to claim 1, further comprising:
   a battery compartment that is supported by the housing and holds at least one battery for powering the airflow supply means and
   at least one user-manipulated switch and associated control circuitry that are supported by the housing and operate to selectively couple the at least one battery to the airflow supply means in response to user manipulation of the at least one switch.

7. A device according to claim 6, further comprising:
   a first user-manipulated switch cooperates with associated control circuitry to operate in the following modes:
   i) a first mode wherein airflow supply means is powered off; and
   ii) a second mode wherein the airflow supply means is automatically cycled on/off for predetermined on/off time periods.

8. A device according to claim 7, wherein:
   the first user-manipulated switch cooperates with associated control circuitry to operate in a third mode wherein the airflow supply means is continuously powered on.

9. A device according to claim 8, wherein:
   the first user-manipulated switch comprises a 3-position switch that is disposed on a recessed surface of the housing and covered by a movable door.

10. A device according to claim 7, further comprising:
    a second user-manipulated switch cooperates with associated control circuitry to operate in a fourth mode wherein the airflow supply means is automatically powered on for a predetermined time period, said fourth mode overriding the operations of the first and second modes.

11. A device according to claim 10, wherein:
    the second user-manipulated switch comprises a button switch that is disposed on the exterior of the housing.

12. A device according to claim 11, wherein:
    the button switch provides an ergonomic design that facilitates finger manipulation by user’s wearing gloves.

13. A device according to claim 6, wherein:
    the control circuitry comprises a microcontroller that interfaces to switching circuitry that selectively opens and closes a current path between the at least one battery held in the battery compartment and the airflow supply means, the operation of the microcontroller dictated by user manipulation of the at least one switch.

14. A device according to claim 6, further comprising:
    a connector that is supported by the housing and connects to an external power source, the external power source
selected from the group including an AC/DC power converter, a DC/DC power converter, and a solar-cell power source.

15. A device according to claim 14, wherein:

the connector interfaces to charging circuitry that charges the at least battery held in the battery compartment with electrical energy supplied by the external power source connected thereto.

16. A device according to claim 14, wherein:

the connector interfaces to control circuitry for selectively powering on the airflow supply means with electrical energy supplied by the external power source applied thereto.

17. A device according to claim 14, further comprising:

means for mounting the solar-cell power source on the housing.

18. A device according to claim 1, wherein:

the housing includes a curved base that generally follows the contour of a portion of the exterior surface of the protective shell.

19. A device according to claim 18, further comprising:

an insert of flexible elastomeric material fixed to the curved base, wherein the insert provides a cushion for mounting the housing onto the exterior surface of the protective shell in a manner that accommodates protective shells with varying shapes and sizes.

20. A device according to claim 19, further comprising:

means for detachably securing the curved base to the exterior surface of the protective shell.

21. A device according to claim 1, wherein:

said housing is realized from a rigid plastic material.

22. A device according to claim 1, wherein:

the airflow supply means comprises one of an electric fan assembly, an air blower, a centrifuge fan, and an air pump.

23. A device according to claim 1, wherein:

the head-protection gear is a hard hat.

24. A device according to claim 1, wherein:

the head-protection gear is one of a military helmet, motorcycle helmet, a helmet for alpine skiing and/or snowboarding.

25. A method of cooling a user wearing head-protection gear that has a protective shell with a rim, the method comprising:

attaching a device to the protective shell, the device including a housing, flexible and pliable tubing that extends from the housing in a manner that enables a user to adjust position and orientation of the tubing in order to control the direction of the airflow that exits therethrough, and airflow supply means supported by the housing for supplying a flow of air that passes through the tubing and exits therethrough;

adjusting the position of the tubing such that a portion of the tubing is disposed below the rim of the protective shell for directing the flow of air supplied by the airflow supply means under the rim for injection towards space adjacent the user’s head, thereby cooling the user’s body; and

activating the airflow supply means to produce a flow of air that is directed under the rim and injected toward space adjacent the user’s head, thereby cooling the user’s body the user’s head.

26. A method according to claim 25, further comprising:

manipulating the tubing to adjust its length.

27. A method according to claim 25, further comprising:

providing the device with a battery compartment; and

loading the battery compartment with at least one battery for powering the airflow supply means.

28. A method according to claim 27, further comprising:

providing the device with at least one user-manipulated switch and associated control circuitry that operate to selectively couple the at least one battery to the airflow supply means in response to user manipulation of the at least one switch;

manipulating the at least one switch for activation of the electric fan assembly.

29. A method according to claim 28, further comprising:

providing the device with a first user-manipulated switch that cooperates with associated control circuitry to operate in the following modes:

i) a first mode wherein the airflow supply means is powered off; and

ii) a second mode wherein the airflow supply means is automatically cycled on/off for predetermined on/off time periods.

30. A method according to claim 29, wherein:

the first user-manipulated switch cooperates with associated control circuitry to operate in a third mode wherein the airflow supply means is continuously powered on.

31. A method according to claim 29, wherein:

the first user-manipulated switch comprises a 3-position switch that is disposed on a recessed surface of the housing and covered by a movable door.

32. A method according to claim 29, further comprising:

providing the device with a second user-manipulated switch that cooperates with associated control circuitry to operate in a fourth mode wherein the airflow supply means is automatically powered on for a predetermined time period, said fourth mode overriding the operations of the first and second modes.

33. A method according to claim 32, wherein:

the second user-manipulated switch comprises a button switch that is disposed on the exterior of the housing.

34. A method according to claim 28, wherein:

the control circuitry comprises a microcontroller that interfaces to switching circuitry that selectively opens and closes a current path between the at least one battery held in the battery compartment and the airflow supply means, the operation of the microcontroller dictated by user manipulation of the at least one switch.

35. A method according to claim 27, further comprising:

providing the device with a connector that is supported by the housing and connects to an external power source, the external power source selected from the group
including an AC/DC power converter, a DC/DC power converter, and a solar-cell power source.

36. A method according to claim 35, wherein:
the connector interfaces to charging circuitry that charges
the at least battery held in the battery compartment with
electrical energy supplied by the external power source
connected thereto.

37. A method according to claim 35, wherein:
the connector interfaces to control circuitry for selectively
powering on the airflow supply means with electrical
energy supplied by the external power source applied
thereto.

38. A method according to claim 35, further comprising:
connecting the solar-cell power source to the connector.

39. A method according to claim 35, further comprising:
mounting the solar-cell power source onto the housing of
the device.

40. A method according to claim 25, further comprising:
providing the housing of the device with a curved base
that generally follows the contour of a portion of the
exterior surface of the protective shell; and
detachably mounting the curved base to an exterior sur-
faced of the protective shell.

41. A method according to claim 40, further comprising:
providing the housing of the device with an insert of
flexible elastomeric material fixed to the curved base,
wherein the insert provides a cushion for mounting the
housing onto the exterior surface of the protective shell
in a manner that accommodates protective shells with
varying shapes and sizes.

42. A method according to claim 40, wherein:
the device is detachably mounted on the rear portion of
the protective shell.

43. A method according to claim 42, wherein:
the tubing of the device is positioned such that airflow is
injected into an air gap between the user’s head and the
protective shell and over the user’s head, thereby
cooling the user’s head.

44. A method according to claim 25, wherein:
the airflow supply means comprises one of an electric fan
assembly, an air blower, a centrifuge fan, and an air
pump.

45. A method according to claim 25, wherein:
the head-protection gear is a hard hat.

46. A method according to claim 25, wherein:
the head-protection gear is one of a military helmet,
motorcycle helmet, a helmet for alpine skiing and/or
snowboarding.

47. A head-protection apparatus comprising:
a protective shell with a rim;
a housing with portions that are attachable to, or integrally
formed with, the protective shell;
flexible and pliable tubing that extends from the rigid
housing in a manner that enables a user to adjust
position and orientation of the tubing in order to control
the direction of the airflow that exits therefrom; and
airflow supply means supported by the housing for sup-
plying a flow of air that passes through the tubing and
exits therefrom;

wherein, during use, a portion of the tubing is disposed
below the rim of the protective shell for directing the
flow of air supplied by the electric fan assembly under
the rim for injection toward space adjacent the user’s
body, thereby cooling the user’s body.

48. A head-protection apparatus according to claim 47,
wherein:
the tubing is positioned such that flow of air supplied by
the airflow supply means is injected into an air gap
between the user’s head and the protective shell and
over the user’s head.

49. A head-protection apparatus according to claim 47,
wherein:
the length of the tubing is extendible.

50. A head-protection apparatus according to claim 47,
wherein:
the housing defines an interior air duct that extends from
an opening to the tubing, wherein the airflow supply
means is mounted axially within the interior air duct.

51. A head-protection apparatus according to claim 47,
further comprising:
a battery compartment that is supported by the housing
and holds at least one battery for powering the airflow
 supply means; and
at least one user-manipulated switch and associated con-
trol circuitry that are supported by the housing and
operate to selectively couple the at least one battery to
the airflow supply means in response to user manipu-
lation of the at least one switch.

52. A head-protection apparatus according to claim 47,
wherein:
said housing is realized from a rigid plastic material.

53. A head-protection apparatus according to claim 47,
wherein:
the airflow supply means comprises one of an electric fan
assembly, an air blower, a centrifuge fan, and an air
pump.

54. A head-protection apparatus according to claim 47,
which is realized as a hard hat.

55. A head-protection apparatus according to claim 47,
which is realized as one of a military helmet, motorcycle
helmet, a helmet for alpine skiing and/or snowboarding.

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