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(54) **THERMOELECTRIC CRASH HELMET COOLING SYSTEM WITH NO MECHANICALLY MOVING COMPONENTS OR FLUIDS**

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(52) **U.S. Cl.** **2/411**; 2/171.3; 454/338; 62/3.2; 165/185

(57) **ABSTRACT**

An apparatus and method for cooling the interior of an aviation crash helmet without incorporation of any mechanically moving components or fluids. The said system can cool or warm the head of the user through the use of thermoelectric cooling elements, solid state fans or electro-aerodynamic pumps, heat exchangers, and a customized ventilation system. None of the components in the present invention contain mechanically moving parts, fluids, or chemicals. The preferred embodiment was designed for aircraft crash helmets, but this invention can be incorporated into any existing crash helmet which can accommodate incorporating thermoelectric pumping modules and provide a steady power supply to the said components. This present invention can be incorporated into any existing crash helmet through customization of helmet inserts. It can also be incorporated into the design of new crash helmets which would facilitate the maximization of the efficiency of the said cooling system.

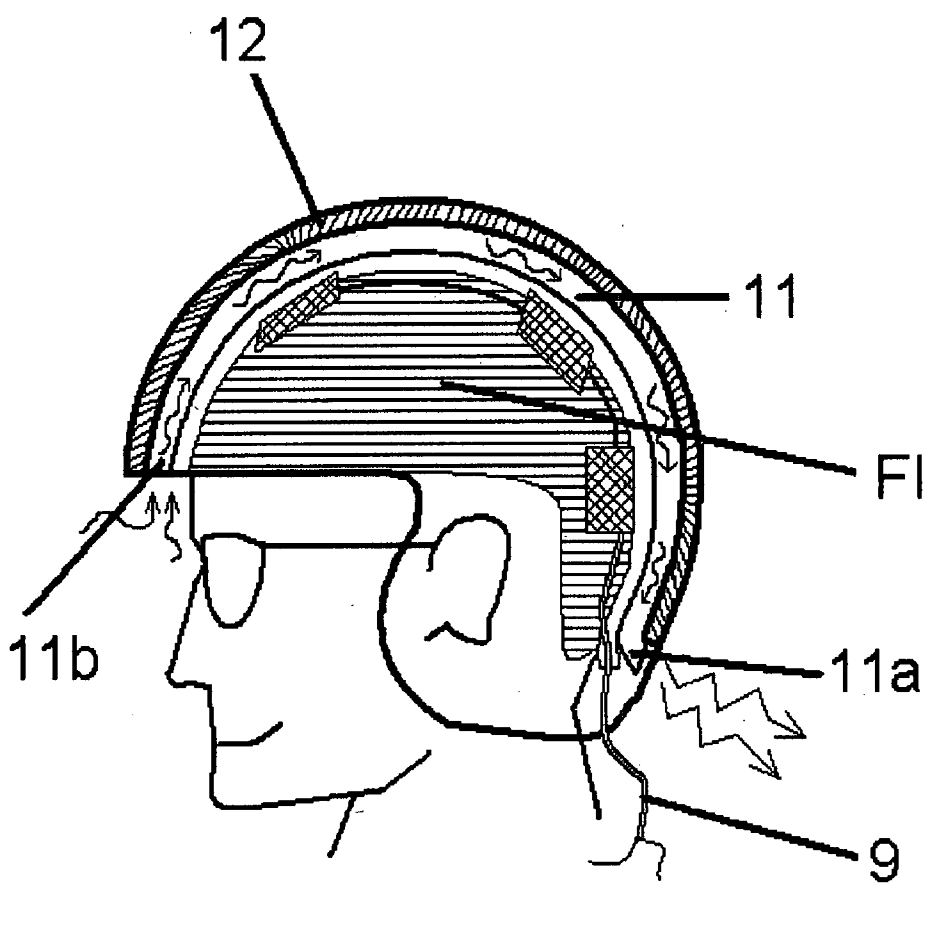

FIG. 4

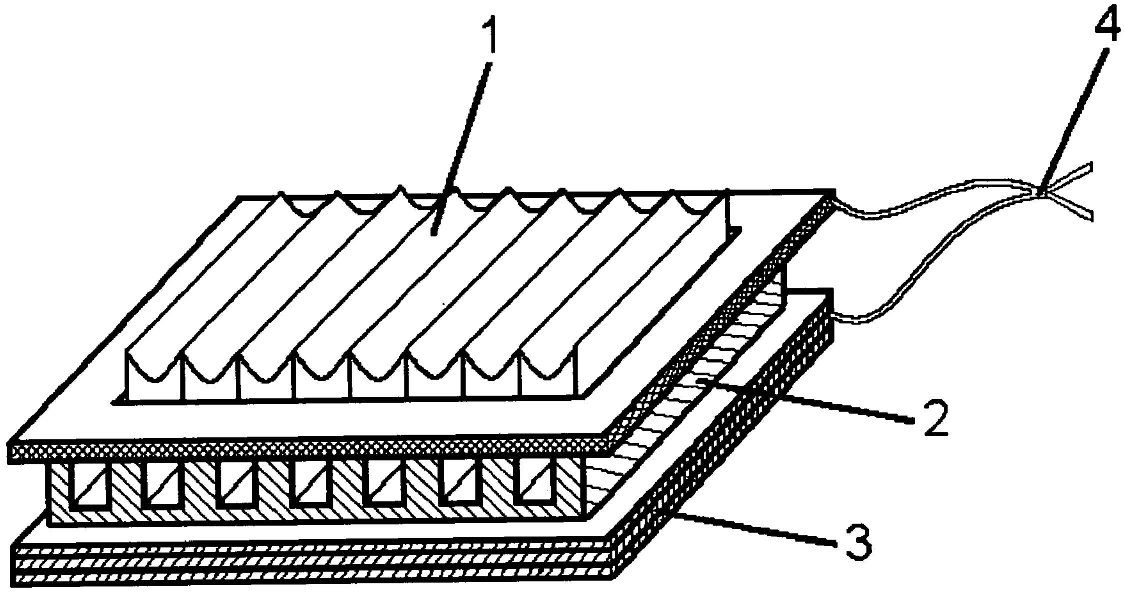

FIG. 1

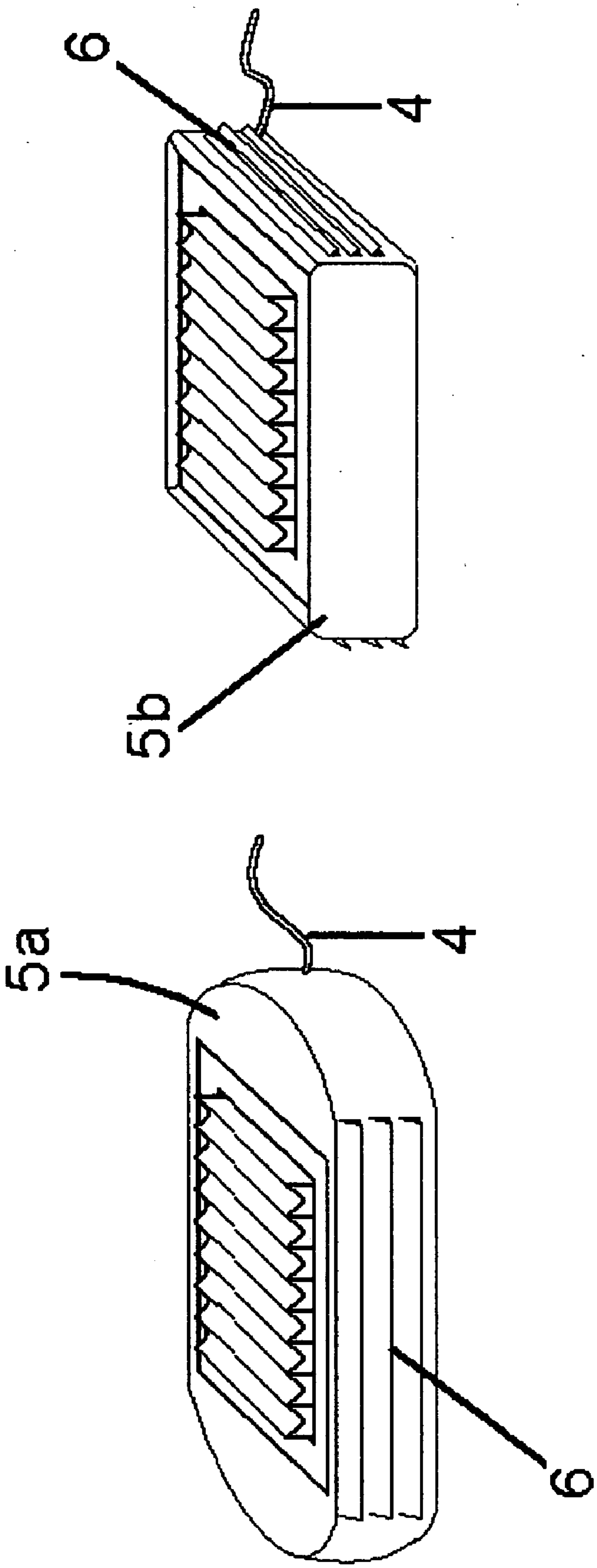

FIG. 2

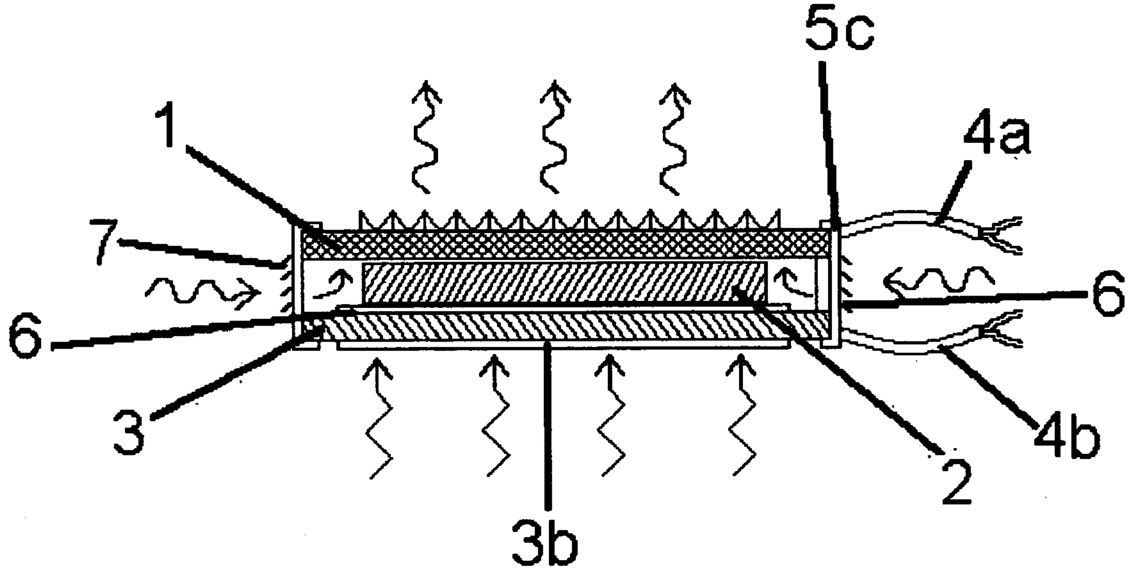

FIG. 3

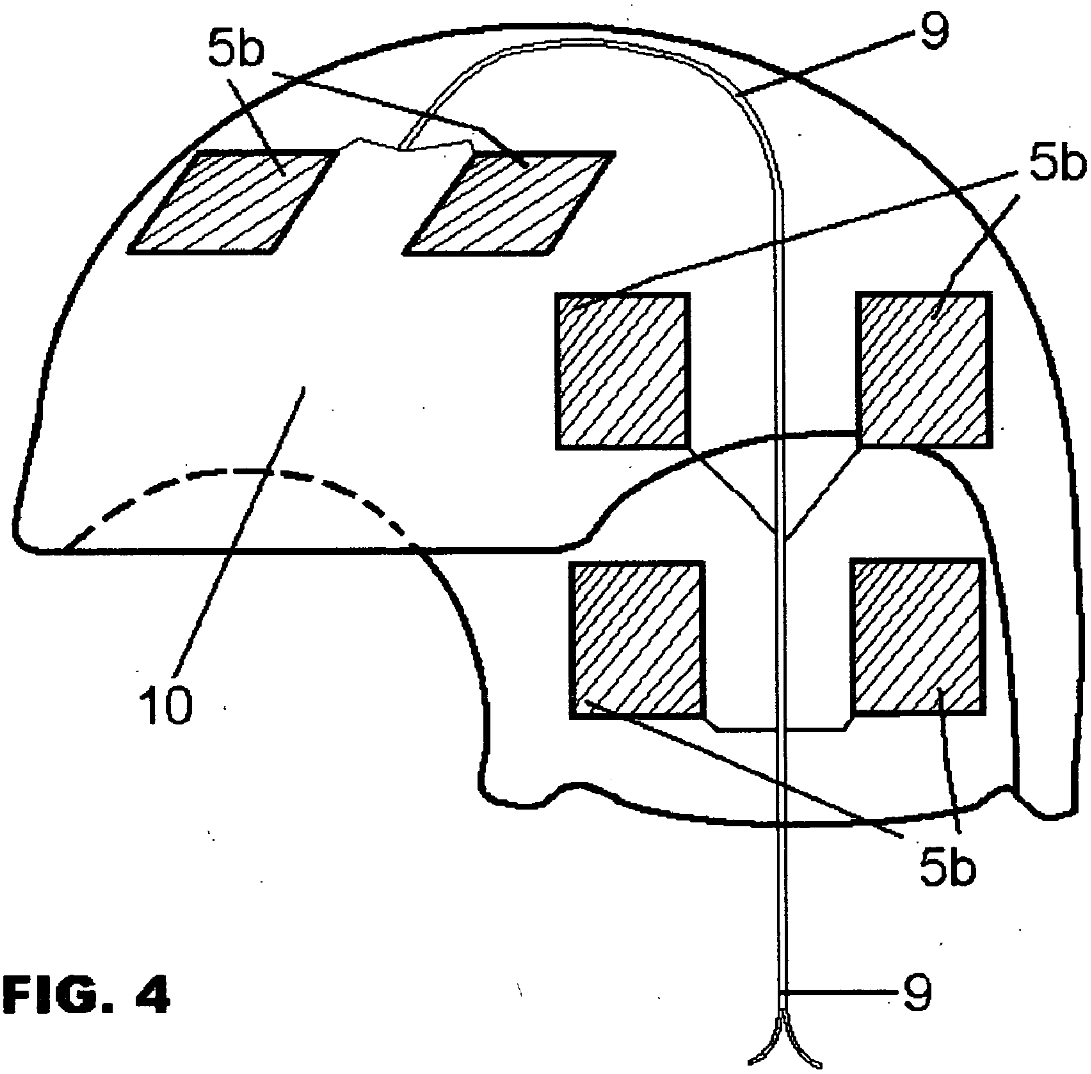

FIG. 4

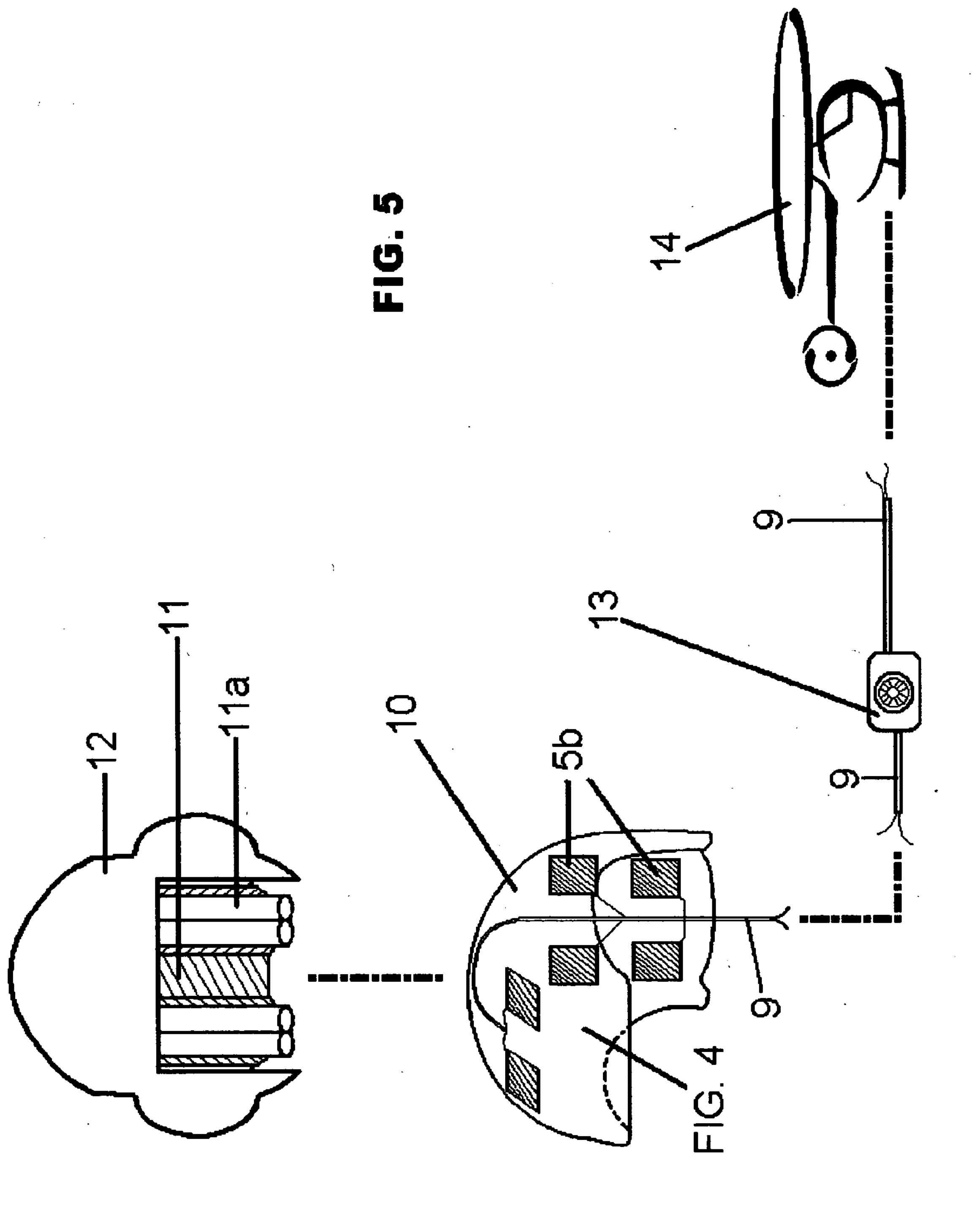

FIG. 5

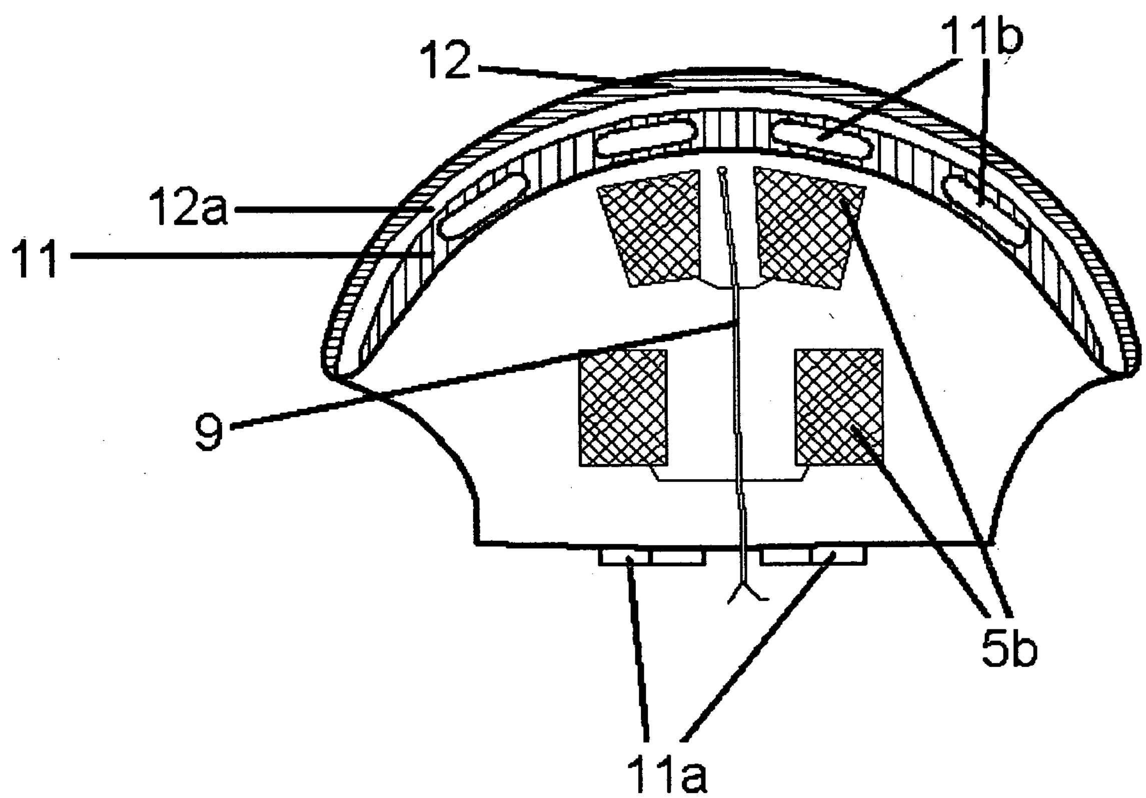

FIG. 6

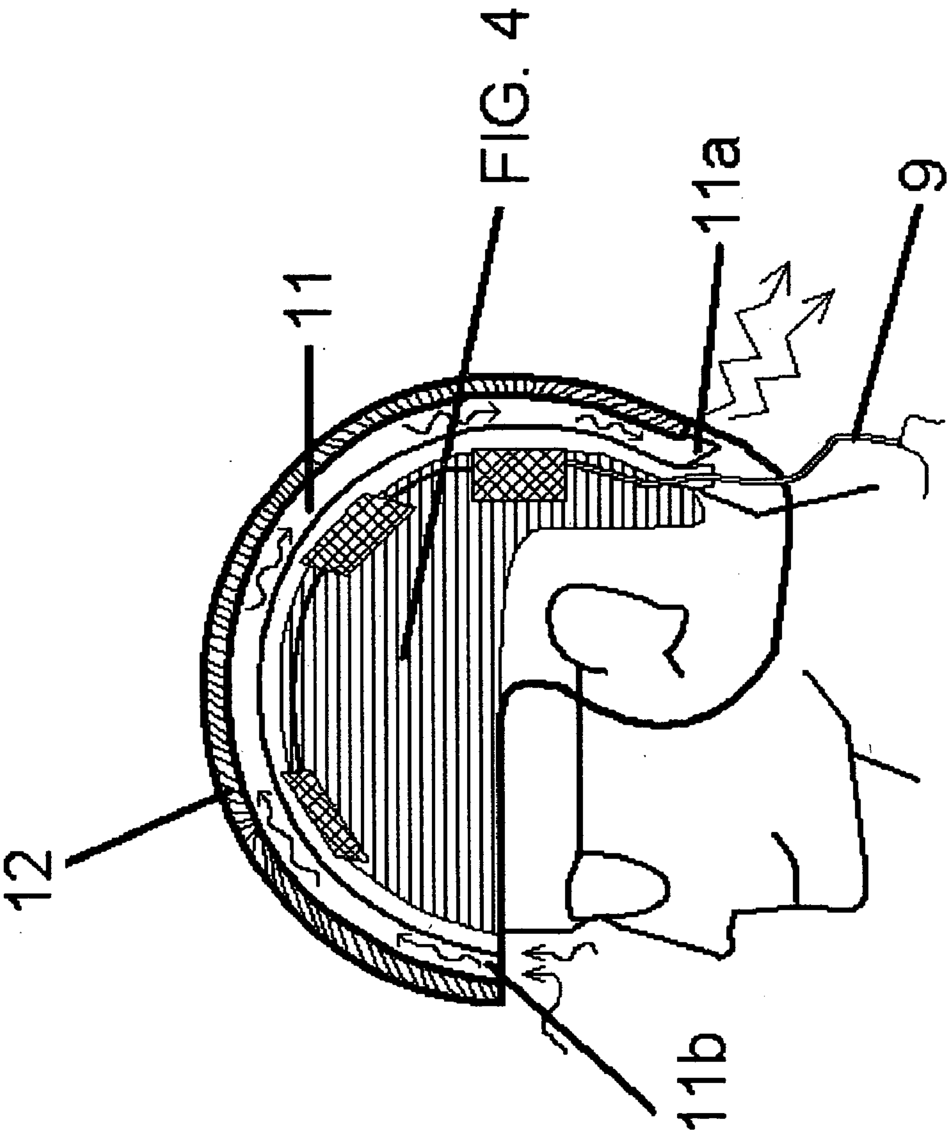

FIG. 7

THERMOELECTRIC CRASH HELMET COOLING SYSTEM WITH NO MECHANICALLY MOVING COMPONENTS OR FLUIDS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application hereby incorporates by reference and claims the priority and filing date of U.S. provisional patent application Ser. No. 61/134,398, entitled HELMET COOLING SYSTEM WITH NO MOVING MECHANICAL PARTS, David Vern Chaplin Inventor, filed Jul. 10, 2008.

BACKGROUND

[0002] 1. Field of the Invention

[0003] Protective helmets are widely used for various safety functions in a wide variety of industries from sports to aviation, but all types of existing crash helmets are known to cause heat discomfort to the user. The primary function of a crash helmet is to protect the wearer from impact or shock to the cranium. Thus, all crash helmets contain some type of shock absorbing material and a hard exterior shell to prevent injury from impact trauma. This shock absorbing material usually will also thermally insulate the user and cause increased heat discomfort. This discomfort is amplified when the physical activity of the user increases and as atmospheric or ambient temperature increases outside the crash helmet as well.

[0004] Particularly acute can be such discomforts experienced by pilots and race car drivers, whose exertions are regularly productive of high body and head temperatures, accompanied by perspiration, and amplified by high atmospheric temperatures.

[0005] Therefore it has been proposed in the general crash helmet to provide a cooling system inside the said crash helmet to provide the user maximized comfort while maintaining superior safety qualities. Several helmet cooling systems have been designed, but no current designs address same issues that the present invention relates to in regard to safety, reliability, and for specific use in aircraft. While the said invention can be incorporated into any type of crash helmet, the preferred embodiment includes but is not limited to designs specific for use in aviation crash helmets.

[0006] There is a clear need to design a cooling system for the interior of aviation crash helmets which contains no moving fluids, which would damage surround electronics if released into the aircraft; and no moving mechanical components, which create friction, resulting in a potentially higher rate of failure and noise generation which would disrupt the user's ability to communicate. Many users who wear crash helmets in vehicles also experience increased temperatures inside their helmets which correspond with reduced performance, user fatigue, and potential health hazards associated with heat exhaustion. No current design of any cooled crash helmet contains cooling systems or devices which do not incorporate fluids, refrigerants, chemicals, or mechanically moving components.

[0007] 2. Prior Art

[0008] The use of thermoelectric cooling elements in air conditioned crash helmets has been designed into past versions of prior art. Heat exchangers have also been widely used in similar cooled crash helmet designs. However, no past invention or prior art utilizes a solid state fan or electro-aerodynamic pump to circulate air through the interior of the helmet or to exhaust waste heat from the interior of the helmet to the exterior atmosphere. Additionally, no current design or prior art of any cooled crash helmet contains cooling systems or devices which do not incorporate some type of fluid, refrigerant, chemical, or mechanically moving components.

[0009] It is apparent in many past versions of similar cooled crash helmets or thermoelectric personal cooling systems that none combine the thermoelectric cooling element with a solid state fan or electro-aerodynamic pump in the same way that the present invention does. Some recent issued patents of submitted application contain similar function, like personal cooling, and contain similar components like thermoelectric cooling elements, but none combine the same components in the way my invention does to create a cooling system, designed for use in crash helmets, with no moving mechanical parts or fluids. Some of the patents and prior art investigated during my background research are as follows:

[0010] In U.S. Pat. No. 7,373,969, issued to Chambers in May, 2008; the inventor designed a garment for a personal cooling or warming system, but it requires the use of fluids and bladders which would not be same for use around sensitive electronics for safety and insurance reason.

[0011] In U.S. Pat. App. No. 2008/0077213 A1, submitted by Vickroy in September, 2007; the inventor designed an apparatus and method for adjusting body temperatures which can be incorporated into many different products which cool the human body. Vickroy's cooling system does not incorporate a thermoelectric cooling element or solid state fan to remove heat from the user.

[0012] In U.S. Pat. No. 7,302,808, issued to Teetzel et al. in December, 2007; the inventor designed a Cooling module and central shaft, hydration module and improved garment penetrator therefore. Teetzel's invention utilizes fluid circulated around the garment.

[0013] In U.S. Pat. No. 7,296,304, issued to Goldsborough in November, 2007; the inventor designed a crash helmet with thermoelectric cooling. Goldsborough's invention utilizes similar technologies as my present invention, including thermoelectric cooling elements and a customized ventilation system. Goldsborough's design is different in that it utilizes blower fans, which contain moving mechanical parts, unlike my present invention. This patent does not include the use of solid state fans or electro-aerodynamic pumps.

[0014] In U.S. Pat. App. No. US 2007/0250138 A1, submitted by Nofzinger in April, 2007; the inventor designed a head cooling system to treat neurological disorders. Nofzinger's cooling system is not intended for use in vehicles and also requires the circulation of fluids.

[0015] In U.S. Pat. App. No. US 2007/0174949 A1, submitted by Howells in January, 2007; the inventor designed a cooling which also does not require the incorporation of any mechanical moving parts or fluids. It does not however utilize thermoelectric cooling modules or electro-aerodynamic pumps. Howells's invention is also not intended for use in the same application, to cool the interior of a crash helmet.

[0016] In U.S. Pat. App. No. US 2007/0106351 A1, submitted by Ferguson et al. in October, 2006; the inventor designed a system and method for changing and/or stabilizing the temperature of certain body parts, including the head. Ferguson's invention does however differ from my invention because it requires a compressor, and also requires a gas to compress to achieve cooling. Also it was not designed for incorporation inside a vehicle crash helmet.

[0017] In U.S. Pat. App. No. US 2007/0113318, submitted by Weston in November, 2005; the inventor designed a helmet cooling system which similarly uses no mechanical moving parts, however, it does not include the use of thermoelectric cooling elements or pumping of air. Weston's invention uses forced air to provide circulation instead.

[0018] In U.S. Pat. No. RE36242, issued to Apisdorf in June, 1999; the inventor designed a helmet mounted air system for personal comfort. This was an amended patent which supplemented U.S. Pat. No. 5,193,347, issued to Apisdorf in March, 1993.Apisdorf's invention also includes the use of a thermoelectric cooling element. This design is different than my invention because it does not utilize a solid state fan or electro-aerodynamic pump. Also, this inventor designed the said cooling system to be mounted on top of the helmet, and mounted to the exterior of the helmet whereas my present invention was intended for use inside the crash helmet and does not require any components be mounted to the exterior f the helmet. My invention is specific for use inside aircraft where this inventors design could not be utilized in aircraft.

[0019] In U.S. Pat. No. H902, issued to Rousseau in January, 1989; the inventor designed an air cooled helmet, for specific use in aircraft. Rousseau's invention does not incorporate the use of thermoelectric cooling elements or solid state fans like my invention.

[0020] In U.S. Pat. No. 4,483,021, issued to McCall in November, 1984; the inventor develops a thermoelectric cooled motorcycle helmet. While this helmet design incorporates similar technologies like thermoelectric cooling elements, it uses a liquid to transfer heat from the heat exchanger, unlike my invention.

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[0022] After reviewing the prior art I have found several objects and advantages of my invention. My present invention's invention has the ability to cool or heat the interior of crash helmets without the need for fluids, refrigerants, or chemicals. Another aspect which separates the present invention from all other prior art is the incorporation of solid state fans, or electro-aerodynamic pumps, which circulate air through the ventilation ducts and passages without the use of any moving mechanical components. These differences provide for significant improvements in safety and performance for cooled crash helmet designs which have not been addressed in any prior art.

FIELD OF THE INVENTION

[0023] The present invention relates to a device and system that provides cooling to the interior of a crash helmet, and specifically provides cooling or heating to the interior of an aviation crash helmet without the use of fluids, refrigerants, chemicals or any mechanically moving components.

DESCRIPTION OF RELATED ART

[0024] FIG. **1** is a view of the thermoelectric pump module (TEP) assembly. It consists of three primary components; thermoelectric cooling element **3**, heat exchanger **2**, and a solid state fan or electro-aerodynamic pump **1**. Power is directly supplied to the components via DC power wiring **4**.

[0025] FIG. **2** is the same thermoelectric pump module (TEP) assembly in FIG. **1** surrounded by variations of external protective encasement, and insulation. The preferred embodiment is depicted in **5***a*, with a round shape, due to safety concerns. However, the shape seen throughout this patent application will be **5***b*. These protective cases, **5***a* and **5***b*, have integrated vents **6** in order to facilitate faster flow of incoming air. These protective cases are also used to create an air cavity for the TEP.

[0026] FIG. **3** shows the operational flow of the thermoelectric pump module (TEP) assembly as shown in FIG. **1**. The individual components are indicated here, similar to FIG. **1**; however, greater detail is offered to assist in the explanation of the operation of the TEP module. The thermoelectric cooling element **3** also illustrates the cold side **3***b* and the hot side **3***a* to better illustrate the intended flow of heat through the TEC. Additionally, a cross section of the TEP provides a functional view of the protective encasements vents **6**. The movement of incoming heat, from the users head, entering the TEP at **3***b*; and the circulation of air as it enters the vents **6** and moves through the heat exchanger **2** and out of the TEP via the solid state fan **1** is clearly illustrated with arrows.

[0027] FIG. **4** is a view of a modified helmet insert with integrated thermoelectric pump (TEP) modules FIG. **1** and a power cable **9** which delivers DC power to the individual TEP modules throughout the helmet insert. The Nomex™ fabric

10 used to house the TEP modules, and provide a customized fit for individual users is indicated as well.

[0028] FIG. **5** is a blueprint of the entire helmet cooling system. It depicts how the helmet cooling system is assembled and connected to the aircraft. The aircraft **14** delivers DC power through the wiring **9** power controller **13** into the helmet insert as seen in FIG. **4**, which contains integrated thermoelectric pump (TEP) modules **5***b* as seen in FIG. **2**. The helmet insert as shown in FIG. **4**, is inserted into a crash helmet outer shell **12**, which has been modified with a customized ventilation system **11**. The ventilation system, also shown in FIG. **6** and FIG. **7**, allows cool air to travel into the ventilation ducts **11***b* and into the TEP modules **5***b*. Inside the TEP modules **5***b* the air collects heat from the heat exchanger **2**, and is then forced out of the TEP through the solid state fan **1**, and into the exhaust ducts **11***a*, to be expelled out of the helmet into the exterior atmosphere.

[0029] FIG. **6** is a horizontal cross section view of the helmet, showing the front of the helmet and how it is constructed. The crash helmet outer shell **12** is shown separate from the Styrofoam liner **12***a* which typically is manufactured with the outer shell **12**. Under the manufactured shell **12** and Styrofoam **12***a* is the customized ventilation system **11**. The customized ventilation **11** is comprised of tubes or ducts, which physically connect the air intake **11***b* with the TEP module cavities **5***b* and then with the exhaust passage **11***a* so that the flow of air is consistently drawn from the front of the helmet, through the interior, and then exhausted out the rear of the helmet.

[0030] FIG. **7** is a vertical cross section of the crash helmet, with the present invention completely assembled, and a user wearing the entire assembly. Each component is identified separately, with the exception of the outer shell and Styrofoam liner, which are both consolidated under the same identifier, **12**. The air flow is also illustrated through the use of arrows as it enters the air intake **11***b* and moves through the customized ventilation tubes or ducts **11** and finally expelled from the helmet out the exhaust tubes or ducts **11***a*.

BRIEF SUMMARY OF THE INVENTION

[0031] The present invention was designed to provide further improvements to cooling systems integrated into crash helmets, such as those used for flight.

[0032] A further object of the invention is to provide such a cooling system having improved reliability through elimination of fluids, and mechanically moving components.

[0033] Another object of the said invention is to provide an improved modification of the assembly of the components which comprise the said cooling system. Components include, but not limited to, the thermoelectric cooling element, heat exchange device, and a solid state fan or electro-aerodynamic pump. All of the components in the said invention do not contain fluid, refrigerant gases, or any mechanically moving components.

[0034] These and other objects of the invention are achieved through a helmet interior cooling system for a helmet having an impact resistant shell, an interior which is defined as a head receiving cavity, a front region and a back region, and can accommodate thermoelectric pump (TEP) modules and an associated integrated ventilation system. The preferred embodiment depicts a flight helmet insert, which can be fitted inside any flight helmet.

[0035] As the preferred embodiment of the said cooling system was designed for use in aircraft, the preferred embodiment described will be subject to design specification inherent to aviation crash helmets specifically. A primary air intake is provided in the helmet Interior body, in the front of the helmet, the area closest to the user's face. As air is drawn into the helmet's ventilation system, the air moving over the users face and forehead assists in the cooling process through cooling naturally occurring perspiration. At least one solid state fan or electro-aerodynamic pump communicates with the air intake to draw air into the interior body of the helmet's customized ventilation system. The air will pass through at least one TEP (thermoelectric pump) module, where it will draw heat from the heat exchanger, and the resulting heated air will be exhausted out of the helmet into the atmosphere. A thermoelectric cooling element, located at the bottom of the TEP (thermoelectric pump) module assembly, will draw heat generated by the users head away from the user into the heat exchanger. The thermoelectric cooling element has a hot side and a cold side. The thermoelectric cooling element's cold side will be facing the user and the hot side will be in direct contact with a heat exchanger. As the users head will be closest to the cold side of the thermoelectric cooling element, heat will naturally leave the users head through conduction and be drawn into the thermoelectric cooling element. The said heat will move through the thermoelectric element, from the cold into the hot side, and then into the heat exchanger. The resulting heat is then removed from the heat exchanger by convection. Air entering the helmet from the front intake will be drawn into the TEP module cavity and will collect heat from the heat exchanger. The said heated air is then forced through the solid state fan or electro aerodynamic pump and the heated air then travels through the helmet's ventilation system and is finally exhausted out of the helmet into the atmosphere. The result is a continuous pumping of heat from the user's head into the atmosphere outside the helmet which provides a continuously cool crash helmet interior for the user, and will ultimately reduce heat related fatigue and any potential health problems associated with excessive heat inside the users crash helmet.

[0036] A DC power source is provided for the thermoelectric cooling element and solid state fan or electro-aerodynamic pump. The aircraft provides all the power necessary to keep all of the components operating continuously without interruption while the system is connected to the aircraft's available DC power supply.

[0037] Preferably the helmet interior has a Styrofoam liner installed by the manufacturer, to maintain the helmet's crash protection effectiveness. The ventilation system will be installed or inserted in direct contact with the Styrofoam liner. The said ventilation system is comprised of tubes or ducts, held together by fire resistant materials, which are designed to work in coordination with the helmet insert which contains TEP (thermoelectric pump) modules. These ventilation ducts provide a necessary path for incoming cool air and the exhausted hot air. As cool air enters the front of the helmet, via the intake, the cool air is forced through the interior of the helmet and into the cavity surrounding the TEP (thermoelectric pump) module. The air collects heat inside the TEP module's cavity, and is then forced through the solid state fan (electro-aerodynamic pump) out of the TEP module's cavity and into the exhaust ducts. These ducts are connected to all of the TEP modules inside the helmet which will continue to collect and transport heated air out of the helmet into the external environment. This ventilation system also provides additional crash impact protection by default as it improves the cushion between the user and the Styrofoam liner. The TEP modules are mounted to the flight helmet insert, which is designed to marry with the ventilation system once the helmet insert is installed into the flight helmet. The primary function of the helmet insert is to provide a customized fit for individual users and as a platform to hold the TEP modules in specific areas near the users head and to accommodate their necessary power supply cables. The helmet insert is comprised of several layers of Nomex™ and other fire resistant materials which are layered in a way to hold the TEP modules in position and provide insulation for the user.

[0038] The entire TEP (thermoelectric pump) module is supplied as a complete assembly, or kit, whereby a user could install these components in a stock crash helmet. The separate components of the TEP module are assembled and encased into an impact resistant and insulated shell. The said shell is necessary to provide protection to the user from any potential injuries that would result if the thermoelectric cooling element, heat exchanger, and solid state fan or electro-aerodynamic pump were to impact the user without protective casing. The said shell also protects from moisture causing damage to the electrical connections and to prevent electric shock to the user and provides a cavity for air to enter and circulate in order for it to collect as much heat as possible before exiting. The preferred embodiment of the said assembly of TEP module components is a round shape, versus a square shape, in order to eliminate any sharp edges to reduce possible damage that might occur in the event of an impact.

[0039] Additional objects, features, variants, and advantages will be detailed in the written description which follows.

DETAILED DESCRIPTION OF THE INVENTION

[0040] The following description, and the figures to which it refers, are provided for the purpose of describing example and specific embodiments of the present invention only and are not intended to exhaustively describe all of the possible embodiments of the invention.

[0041] The present invention includes, but is not limited to crash helmets, specifically helmets used for aviation. This invention incorporates several existing components combined in a unique way to provide a more comfortable and safe helmet cooling system. The present invention provides a method for cooling and/or heating the interior of a crash helmet. The said method can be utilized currently in stock crash helmets, by installing the TEP modules FIG. **1** into a customized helmet insert FIG. **4**, and the customized ventilation insert **11**, a user can effectively cool or heat the interior of a crash helmet based on their own personal level of self-comfort. While it would be more cost effective to modify current helmets, in the future it would be more beneficial to the functionality of the said invention to be designed into a crash helmet prior to its manufacture. This modified design to existing aviation crash helmets would include, but not be limited to, additional exhaust vents manufactured into the outer shell **12** of the crash helmet to facilitate ease of expulsion of heated air, and could also include better customized ventilation systems **11** and incorporation of helmet inserts FIG. **4** and TEP (thermoelectric pump) modules FIG. **1** with a permanent installation which could come from the manufacturer ready to operate.

[0042] The preferred embodiment of the present invention is intended for use in aviation crash helmets, but is not limited to aircraft crash helmets. The said invention can also be adapted to fit into any crash helmet, for any sport, job, or military activity. The preferred embodiment of the present invention includes, but is not limited to, a specific combination of components which enable a user to cool or heat the interior of an existing crash helmet, with components that do not require any liquid, refrigerant, motors, or components that contain mechanical moving parts. The complete cooling system is dependent upon an available power supply. The preferred embodiment of the present invention power derives DC power from the aircraft from which it is physically connected FIG. **5** via a power controller **13**. The said invention is not limited to receiving its power supply from an aircraft or vehicle; it can also be powered by batteries, solar power, thermoelectric power generators, and by any other available source of DC power. This unique system of cooling presents several benefits that are not realized through any past designs of cooled helmets or prior art of personal cooling methods or apparatus. A primary benefit to this system, which requires no mechanical moving components, is the fact that there is no friction, resulting in an elimination noise emission, and then components do not wear down or erode and fail over extended periods of time like traditional blower fans or liquid pumps. A reduction in total components also reduces possible potential failures. A secondary benefit to this unique air conditioning system is that it does not incorporate any liquids, refrigerants, or dangerous chemicals in the helmet cooling system which eliminates the possibility of the said liquids leaking out of the helmet onto sensitive electronics or the user, and eliminates the possibility of high pressure, or toxic gases, being accidentally released into a helmet and on the user while the user is working. This is the first crash helmet cooling system which utilizes components that do not mechanically move or travel in any way and does incorporate the use of any liquids, refrigerants, or chemicals to remove heat from the helmet. This helmet cooling system operates completely silent as well, which is very important when being utilized in all aircraft where pilots need to be able to hear radio communication clearly, without distortion, and also be able to hear noises generated from the aircrafts operation to ensure the aircraft is operating properly.

[0043] The key component to the present invention is the assembly of the TEP (thermoelectric pump) module, as represented in FIG. **1**, FIG. **2**, and FIG. **3**, which is comprised of three specific key components. The first component, the thermoelectric cooling element **3** (TEC), is a Peltier cooler which achieves heat transfer when DC power is applied to its power supply **4***b*. When the thermoelectric cooling element is applied to a DC power supply **9**, the cooling element, or plate; which consists of ceramic, silicone, and metal components, immediately begins to move heat from one side to the opposite side. The cooling or heating effect can be reversed if the polarity of the power supply **4***b* is reversed. When power is continuously applied to the thermoelectric cooling element it continues to transfer heat from one side to another without interruption. In the preferred embodiment of the present invention the cold side **3***b* of the TEC is placed facing the users head and the hot side **3***a* is directly connected to the heat exchanger **2**. The greater the disparity in temperature on either side of the thermoelectric cooling element, the greater the cooling or heating that can be achieved. The DC power supplied **9** to the thermoelectric cooling element **3** can be regulated through the power controller **13** which affords the user the ability to accurately control the desired level of cooling or heating based on their own personal level of comfort. The thermoelectric cooling elements **3** can be manufactured in several different shapes and sizes. The preferred embodiment of the said invention will utilize square shaped thermoelectric cooling elements **3** although round shapes are preferred. In the future this invention will incorporate thermoelectric cooling elements that are round, curved, or oval in shape. The round edges would provide safer physical dimensions in the event of an impact or crash and would reduce any potential impact trauma to the user. All thermoelectric cooling elements **3** will be housed in a protective and insulative casing as seen in FIG. **2** to prevent possible injuries from impact and to also prevent moisture from entering the TEP modules FIG. **2** so the moisture will not destroy the electronic components or wiring **4**, **9**, and **13**.

[0044] The second primary component of the TEP (thermoelectric pump) module FIG. **1** is the heat exchanger **2**. In the preferred embodiment of the present invention the heat exchange unit **2** is a heat sink constructed of a thermally conductive material like copper, aluminum, or a thermally conductive polymer. A thermally conductive polymer would be preferred in the construction of the TEP module FIG. **1** in the event of an impact, to reduce any potential damage to the user. While present heat sinks available on the market are typically constructed from the said metals and can be utilized effectively and safely, the preferred embodiment of the present invention requires the heat exchanger will have no moving mechanical parts or will not contain any fluids, refrigerants, or chemicals; therefore any heat sink material can be utilized. In the preferred embodiment of the present invention the heat exchanger **2** is constructed from copper. The heat exchanger **2** includes a heat sink, but is not limited to a heat sink, and could incorporate any type of heat exchanger which does not contain any mechanically moving parts or does not require the use of any fluids or chemicals.

[0045] The third primary component of the TEP module FIG. **1** is the solid state fan or electro-aerodynamic pump **1**. The solid state fan is, by definition, a pump which moves air when a DC current is applied to the power supply **4***a*. The solid state fan **1** incorporates a series of live wires that generate a micro-scale plasma reaction. The said series of live wires lie within uncharged conducting plates that are contoured into half-cylindrical shape to partially envelop the wires. The intense electric field that results from the plasma reaction creates ions which push neutral air molecules from the wire to the plate, generating a significant movement of air or a wind. This phenomenon is defined as a Corona wind. Through providing a constant DC power supply to the solid state fan **1** the TEP module FIG. **1** is able to continuously move or pump air through the heat exchanger **2**, causing the air to accumulate heat, and then pull the heated air away from the heat exchanger **2** and then push the heated air into the ventilation system **11** and then expel the heated air through the exhaust ducts **11***a*. The preferred embodiment of the present invention incorporates at least one solid state fan **1** for every thermoelectric cooling element **3** used in the TEP module assembly FIG. **1**.

[0046] The preferred embodiment the entire TEP (thermoelectric pump) module assembly FIG. **1** will be encased FIG. **2** for protection and increased safety for the user. Once the TEP module is encased in a protective case FIG. **2** it will be installed into a helmet insert FIG. **4** which will be constructed of Nomex™ and other fire resistant materials **10**. The said materials will be used to position the TEP modules around the head of the individual user. The number of TEP modules utilized, their physical layout within the helmet insert FIG. **4**, and the amount of insulation **10** used around the TEP modules will be determined on the user's intended application, working environment, and the physical design characteristics of each individual model of crash helmet. The present invention, a TEP module based cooling system, could be customized for an individual user on an individual basis or can be mass produced to solve a general problem or need. The preferred embodiment of the present invention will include, but not be limited to, a system which can be modified to fit into any existing stock aviation crash helmet.

[0047] Each TEP module installed in the helmet insert FIG. **4** will be connected to the aircraft's internal DC power supply **9** through its own power connecting wires **4**. When power is supplied to the TEP modules they immediately begin to move heat from the cold side **3***b* to the hot side **3***a* of the thermoelectric cooling element (TEC) **3**. As the electricity conducts heat from the cold side **3***b* to the hot side **3***a* of the TEC element, the said heat being transported is then transferred into the heat exchanger **2**. To facilitate faster heat absorption, the heat exchanger is connected to the hot side **3***a* of the thermoelectric cooling element with a thermally conductive adhesive. In the preferred embodiment of the present invention, Arctic Silver™ was used to attach the heat exchanger **2** to the hot side **3***a* of the thermoelectric cooling element **3**. The said heat then is dispersed throughout the heat exchangers many fins and then transferred into the cool air being drawn into the TEP module cavity from the air inlet **11***b*. As cool air is drawn into the TEP module cavity, it is circulated around the TEP module's heat exchanger **2**, which releases heat into the surrounding air circulated around the heat exchanger which is then pumped out of the TEC module cavity by the solid state fan **1**. The resulting heated waste air passes through the solid state fan **1** and is pushed into the exhaust ventilation ducts **11***a* where it is expelled into the atmosphere. This entire process is continuous providing DC power is continuously available to enable all the components of the TEP modules FIG. **1** to function properly.

[0048] The preferred embodiment and patent application describes the application of the TEP modules into a helmet insert and customized ventilation system which can be incorporated into any existing aircraft crash helmet, but the present invention is not limited to this embodiment. Future designs of aviation crash helmets could be modified prior to manufacture in order to facilitate the present invention's efficiency and increase its effectiveness through designing aviation crash helmets to have outer shells **12** which contain exhaust vents, and a interior Styrofoam **12***a* liner which is molded to better fit and insulate the ventilation system **11**. Helmets could also be designed and manufactured with heat exchangers mounted to the outer shell **12** of the helmet to better facilitate the expulsion of waste heat from the interior of the helmet.

What is claimed as new and desired to be secured by the Patent Letters of the United States is:

1. An air conditioned crash helmet containing no fluid or mechanical driven components comprising:

- an impact resistant body having an exterior shell;
- an interior which defines a head receiving cavity;
- a front region and having a back region which is located adjacent a lower edge of the helmet exterior shell body;
- a first opening in the helmet body located at the front region of the helmet, closest to the users forehead, the first opening defining an air intake passage for the intake of external air;

a plurality of ducts and/or ventilation passages where air can travel through the interior of the helmet, between the user and the exterior shell;

at least one solid state fan or electro-aerodynamic pump communicating with the air intake passage to draw air into the ventilation passage and forcing air from the front region of the helmet into the direction of the rear region thereof;

at least one thermoelectric cooling element located in the helmet body interior in communication with the intake passage, in contact with a heat exchanger, and upstream of the solid state fan or electro-aerodynamic pump, the thermoelectric element having a cold side and a hot side;

a DC power source for powering the thermoelectric cooling element and the solid state fan or electro-aerodynamic pump;

a heat exchanger connected to the thermoelectric cooling element which facilitates the movement of heat, via conduction, from the hot side of the thermoelectric cooling element into the heat exchanger; which facilitates the transfer of heat from the thermoelectric cooling element into the air inside the ventilation passages, where the solid state fan pushes the heated air out of the helmet through the exhaust passages.

2. The crash helmet of claim **1**, wherein the helmet interior has a ventilation system installed therein and wherein the ventilation liner has a plurality of air conditioning ducts formed therein in communication with an air intake passage, whereby air forced through the air conditioning ducts into the head receiving cavity in the interior of the helmet body.

3. The crash helmet of claim **2**, wherein the thermoelectric cooling element is a Peltier cooling element.

4. The crash helmet of claim **3**, wherein the heat exchanger is located in direct contact with the hot side of the thermoelectric cooling element, and the heat exchanger operates with no mechanically moving components and does not require or utilize any fluids, refrigerants, chemicals, or any disposable elements to function.

5. The crash helmet of claim **4**, wherein the solid state fan is an electro-aerodynamic pump and contains no mechanical moving components and draws heated air away from the heat exchanger and pushes it toward the rear region of the helmet wherein the exhaust passages expel hot air into the atmosphere.

6. The crash helmet of claim **5**, wherein the power source for the thermoelectric cooling element and the solid state fan is provided through the internal power source provided from the vehicle, which allows the said invention to be connected to any source of DC power.

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