

Slip-on Slip-off Wearable Body Temperature Compress Apparatus With Fan

Related Applications

[001] This patent application claims priority to Singapore patent application no. 10202001214V filed on 11 February 2020, the disclosure of which is incorporated in its entirety.

Field of Invention

[002] The present invention relates to a slip-on slip-off personal wearable body hot or cold compress apparatus. In one configuration, the apparatus is equipped two fan blowers.

Background

[003] Applicant has an invention on a wearable vest with cooling or heating mechanisms and is described in publication no. WO2017048198. Applicant has now worked on a personal wearable cold or hot compress apparatus that can be donned by slipping-on the apparatus over one's shoulders.

[004] In a hot environment, a cold compress is used to bring down the body temperature, for eg., to prevent heat stroke or to give thermal comfort; in a cold environment, a hot compress is used to warm up the body to provide thermal comfort. Wang, et al, published a paper entitled "The key local segments of human body for personalized heating and cooling" in Journal of Thermal Biology, volume 81 (2019), pages 118-127; Wang, et al, has identified the body parts that can be effectively cooled or warmed.

[005] There is a need to provide a personal wearable cooling or heating apparatus that effectively cools or warms one's body to provide thermal comfort. Preferably, the apparatus can be easily and quickly donned or removed, for eg, by slipping-on or slipping-off.

Summary

[006] The following presents a simplified summary to provide a basic understanding of the present invention. This summary is not an extensive overview of the invention, and is not intended to identify key features of the invention. Rather, it is to present some of the

inventive concepts of this invention in a generalised form as a prelude to the detailed description that is to follow.

[007] The present invention seeks to provide a compact, effective and easily wearable cold or hot compress apparatus. The small form-factor ensures this apparatus is unobtrusive to the user's movements. This body temperature compress apparatus is comfortable to wear, easy to operate control, and quiet in operation.

[008] In one embodiment, the present invention provides a wearable body temperature compress apparatus that is donned by slipping-on or slipping-off over a user's shoulders, the compress apparatus comprising: a housing that encloses a thermo-electric module (TEM), a heat-sink, a control board, a fan and a battery, with air-inlet vent located at an upper portion and an air-outlet vent formed on the housing; a front spreader connected to a front portion of the housing; a harness with a pair of U-shaped arms extending from a centre portion, where the centre portion is connected to a rear of the housing; and a rear spreader connected to a rear of the centre portion of the harness; so that when donned, the housing is in contact with the back of the user at an area between the shoulder blades and free ends of the pair of U-shaped harness arms are at the sternum area, and during operation, cool or warm heat is transmitted from the front spreader to the back of the user to provide thermal comfort.

[009] Preferably, the compress apparatus comprises a pair of batteries located at the free ends of the harness arms to allow hot-swapping of the battery one at a time. The compress apparatus also comprises non-slip materials disposed alongside the front spreader, near the ends of the harness arms that is in contact with the user's chest and at the rear surface of the fan blower casings. Preferably, the front face of the housing is contoured to give comfortable contact on the user, to allow freedom of movement and to prevent spot cooling or warming.

[0010] Preferably, the fan blowers are speed adjustable, and the associated inlet and exhaust vents formed on an annular ring allows rotational adjustment to direct moving air to user's neck and face.

Brief Description of the Drawings

[0011] This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

[0012] FIG. 1A illustrates a rear perspective view of a personal slip-on slip-off wearable body temperature compress apparatus according to an embodiment of the present invention, whilst FIG. 1B illustrates a front perspective view; FIG. 1C illustrates flexure in the X-axis of the harness arm shown in FIGs. 1A and 1B; whilst FIG. 1D illustrates possible attachment of additional cooling modules on the harness arms;

[0013] FIG. 2 illustrates an exploded view of the personal slip-on slip-off wearable body temperature compress apparatus configured for cooling;

[0014] FIG. 3 illustrates an exploded view of the personal slip-on slip-off wearable body temperature compress apparatus configured for warming;

[0015] FIG. 4 illustrates flow of air into and out of the housing of the body temperature compress apparatus;

[0016] FIG. 5A illustrates a rear view of a personal slip-on slip-off wearable body temperature compress apparatus according to another embodiment of the present invention, whilst FIG. 5B illustrates a front view, FIG. 5C illustrates a front perspective view and FIG. 5D illustrates a side view; and

[0017] FIGs. 6A and 6B illustrate a preferred manner of donning the above slip-on slip off wearable body temperature compress apparatus on a user's body.

Detailed Description

[0018] One or more specific and alternative embodiments of the present invention will now be described with reference to the attached drawings. It shall be apparent to one skilled in the art, however, that this invention may be practised without such specific details. Some of the details may not be described at length so as not to obscure the present invention. For

case of reference, common reference numerals or series of numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0019] FIGs. 1A and 1B show a personal slip-on slip-off wearable body temperature compress apparatus 100 (or simply a body temperature compress) according to an embodiment of the present invention. As shown, the body temperature compress 100 is made up of a harness 140 and a housing 110 mounted on a centre frame portion 142 of the harness 140. A front spreader 180 is attached on a front cover 130 of the housing 110 to conduct cool or warm energy to the back (ie. between the shoulder blades) of the user, whilst a rear spreader 185 is located at a rear of the housing 110. The effect of cool/warm energy conduction is made more effective by enlarging a surface area of the front spreader 180. The harness 140 has a centre frame portion 142 from which two separate U-shaped arms 141 extend out, so that the harness 140 is wearable comfortably over the shoulders of the user with the housing 110 located substantially on the user's back and the ends of the U-shaped arms 141 resting on the chest. Preferably, the harness 140 is made from a resilient material, so that the U-shaped arms 141 are springy and when worn on the user, internal springy forces locate the body temperature compress 100 comfortably over the shoulders, in particular, with the housing 110 being supported substantially by the trapezius shoulder muscles and the ends of the U-shaped arms 141 by the chest.

[0020] The U-shaped arms 141 of the harness 140 are flexure in the X- and Y-directions as seen in FIG. 1B; it may also be flexurable in the theta-Z direction. By being flexurable in multiple axes, the harness 140 is able to transfer loads to the trapezius muscles, and the weight of the body temperature compress 100 at the shoulder is not felt by the user. FIG. 1C shows flexure of one U-shaped arm 141 of the harness 140 in the X-direction. In addition, a pair of batteries 145 are fitted near the free ends of the harness U-shaped arms 141 to provide a balanced distribution of weights of the compress 100, besides extending the duration of use. As a pair of batteries 145 are provided, it allows the battery 145 to be hot-swapped, one at a time.

[0021] The springiness and weight of the harness 140 can be predetermined by balancing the material spring constant, a thickness of the harness and pattern of apertures 142 on the U-shaped arms 141. Preferably, the body temperature compress 100 is covered by a gel

material to enhance contact comfort to the user. Preferably, the shape and dimensions of the harness 140 are selected according to a predetermined percentile of anthropometric data of users in a target group, such as, Asian users or American/European users. In addition, the face of the front cover 130 in contact with the back of the user has a large area, which is also contoured to provide comfort of use.

[0022] FIG. 2 shows, at least, a fan 170, a control board 160, a heat sink 155 and a thermoelectric module (TEM) 150 are mounted inside the housing 110. The front cover 130 fits onto a front of the housing 110 to protect these components, whilst the rear cover or rear spreader 185 fits onto the rear. The body temperature compress 100 shown in FIG. 2 is configured to provide cool energy to the user, by connecting a supply voltage to the TEM 150 with appropriate polarity; when worn, the front spreader 180 is in contact with the body and provides cool energy. An air inlet vent 118 is formed on an upper part 116 of the housing 110, whilst an air outlet vent 122 is located on a lower part of the housing 110. In use, air is sucked in by the fan 170 through the inlet vent 118, blown over the heat sink 155 and is exhausted out through the outlet vent 122. The inlet and outlet vents are spaced apart and air currents flowing in and out are directed substantially away from each other so as to prevent the outlet air from recirculating or back-flowing to the inlet vent; directing the air currents away from each other also reduces air turbulence, as shown in FIG. 4; in addition, a fibre layer 190, such as, glass fibre or any heat insulator, is provided around the TEM 150 to separate the hot junction side from the cold junction side; in this way, heat at the hot junction of the TEM 150 is removed, temperature differential across the TEM 150 is maintained, and the cold junction of TEM 150 provides cool energy to the user. In one embodiment, the rear spreader 185 is metallic, which helps to improve heat dissipation.

[0023] In FIG. 3, the body temperature compress 100 is configured to provide warm energy to the user, by reversing the supply voltage polarity so that the front spreader 180 becomes warm and the rear spreader 185 becomes cold. In this configuration, air blowing over the heat sinks 155 maintains the cold side of the TEM 150, maintains the temperature differential across the TEM and sustains providing warm energy to the user.

[0024] In the above FIGs. 1A-4, the harness 140 is shown without any padding or covering. FIGs. 5A-6B show a slip-on slip-off wearable body temperature compress 200 according to another embodiment. The wearable compress 200 is similar to the above wearable

compress 100 except that the harness 240 is now shown with paddings or coverings and two fan blowers 300 are provided at the U-shaped arms 241. The other difference is the shape of the housing 210, which is substantially triangular, but the shape does not alter the functioning of the internal components, such as, the TEM, the heat sink, the fan and other components.

[0025] As seen in FIGs. 5A and 5B, each of the fan blower 300 has a low-profile casing and is controlled by a power on-off button 301. In addition, an annular adjustable ring 302 is provided at a front edge of the casing for controlling the speed of the fan blower 300. Air inlet vanes 318 are provided at the front face of the casing, in addition to side air-inlet vents 318a. The side air-inlet vents 318a are located substantially on lateral sides to the left and right of the user and behind the annular adjustable ring 302. Exhaust outlet vents 322 located behind the annular adjustable ring 302 are directed inwardly to the user's neck and face. In one embodiment, the side air-inlet vents 318a and exhaust outlet vents 322 are configured on a ring 323 located behind the annular adjustable ring 302; preferably, the ring 323 has a useful range of about 5-25 degrees rotatory adjustment.

[0026] Like the above compress apparatus 100, in FIG. 5A, air enters the inlet vent 218 and is exhausted through the outlet vent 222. As seen in FIG. 5A, the rear of the housing 210 has a light indicator 211 that is lighted up when the compress apparatus 200 is turned on. In FIG. 5D, a rain roof 219 is formed above the inlet vent 218; the rain roof 219 is to minimise or break any flow of rain or sweat from flowing into the inlet vent 218.

[0027] FIG. 6A and 6B show a manner of using the above slip-on slip-off wearable body temperature compress 100,200. As shown, the wearable body temperature compress 100,200 is slipped over the shoulders of a user so that the housing 110,210 rests on the user's back at an area in between the shoulder blades and the free ends of the harness 140,240 are positioned inwardly near the sternum. Preferably, the curved portions of the harness 140,240 are not in contact with the top of the shoulders, are spaced apart by a gap S of substantially 1- 3 fingers thickness but are in contact with the trapezius muscles. For eg., with the wearable compress 200, the fan blowers 300 are worn below the collar bones, as indicated by level line L, and the ring member 323 can be turned so that the air outlet vents 322 direct air flow to the neck and face regions of the user. As seen from FIGs. 5A-5D, attachment loops 348 are provided near the base of the housing 210 and attachment loops 349 are provided at the ends of the harness arms 141,241; these attachment loops 348,349

allow the user to secure the compress apparatus 100,200 to the user's uniform or vest, for eg, with use of webbing straps and Molle slots, webbing straps and fasteners; elastic straps, etc; with the compress apparatus 100,200 being secure, the user can perform more dynamic motions, such as, running, jumping or climbing. In addition, a non-slip material 235 is provided on the front cover 130 alongside the front spreader 180, at the rear of the fan blower 300 casing and near the ends of the U-shaped harness arms 241 that are in contact with the user's chest; the non-slip material 235 allows the housing 110,210 to sit more securely on the user's back, allows the fan blower 300 casings or the ends of the u-shaped harness arms to rest more securely near the sternum area. The wearable body temperature compress 100,200 is operated with an aid of an application running in a user's mobile device (such as, a smartphone), as described below; the advantages of using the above wearable body temperature compress 100,200 will thus become apparent:

[0028] The control board 160 (for both wearable compress 100, 200) includes a micro-controller, an array of temperature sensors (micro-climate, body temperature and ambient temperature sensors), PID temperature controller and wireless communication (including Bluetooth communication) to a smartphone (but is not shown in the figures). Active cooling or warming can thus be wireless controlled from the mobile device or smartphone. In addition, temperature control is achieved by PWM operation in the PID controller for temperature sensor's feedback control, to match and fine-tune cooling/warming comfort on-the-fly at low power consumption, which allows customisable cooling/warming to fit user's preferences. The fibre layer 190, preferably is a sculptured thermal insulator (separating the cold junction from parts associated with the hot junction of the TEM) coupled with a Thermal-flo process technology to direct air flow (carrying heat generated from all the components) through the outlet vent 122,222 to ensure continuous and effective TEM cooling or warming. At the same time, thermosiphon passive heat exchange, based on natural convection and aided by side vents 223 (shown in FIG. 5D), enhances heat dissipation inside the housing 110, 210 whilst keeping both the form-factor profile and noise level low; for eg., the noise level is substantially 40dB at a distance of about 7m.

[0029] An advantage of the above wearable body temperature compress 100,200 is that the apparatus can be worn without obtrusion, say over a user's uniform or vest or under a user's vest. In other words, with the ends of the U-shaped harness arms 141, 241 located

close to the sternum area, the compress apparatus 100,200 allows the user's arms to move with many degrees of freedom without feeling obstructed. In particular, this compress 100,200 caters to both male and female users (ie. unisex). The compress 100,200 gives comfortable thermal sensation by removing heat or warming the user accordingly. The contoured surface of the front cover 130,230 ensures comfortable contact on the user's back and the large area of contact prevents mechanical pressure points or prevents discomfort of spot cooling or heating. Additional cooling or heating modules or pads 146 can also be fitted into the apertures 142 located on the harness U-shaped arms 141, as shown in FIG. 1D; additional cooling or heating modules or pads 146 can also be tucked and secured underneath the U-shaped arms 141, 241.

[0030] Known cooling systems have advantages and disadvantages, as seen in the below comparison chart:

System	Mechanism	Advantages	Disadvantages
Fluid Cooled Garment (FCG)	Utilise motor-driven air, water or non-toxic aqueous solutions as coolant, through the tubing(s) in the garment for absorbing the wearer's heat	• Effective cooling performance • Non-dependence on climate	• Logistic management of bulky refrigerator unit • High continuous power supply • Non-precise control of cooling • Exhibit high noise signal
Evaporative Cooled Garment (ECG)	Leverage on the large latent heat of water evaporation, through the tubing(s) in the garment for absorbing the wearer's heat	• Acceptable cooling performance • Portable system due to small amount of water required	• Low cooling performance due to low flux from water evaporation • Logistic management of water unit • Bacterial/fungal contamination • Non-precise control of cooling • Utilisation of a pump which takes in power and exhibit noise signal
Phase Change Material (PCM) cooling vest	Utilise materials that absorb large amount of thermal energy when undergoing transition from one phase to another, in inner pockets of vest facing wearer's body	• Acceptable cooling performance system • Portable system due to acceptable weight of PCM	• Limited cooling capacities for a short time period • Long preparation duration • Logistic management of cooling activation equipment • No control of cooling

[0031] A summary of the advantages of using the above wearable temperature compress 100,200 is listed below:

Feature	Attained through	Description
Non-dependence on climate	Patented TEM & HCED design	Cooling is based on Peltier effect, which is not affected by humidity
Relief logistic burden	Adaptive closed-loop temperature controls system	Plug-and-play (connect battery to Active cooling module) cooling system
Immediate cooling activation	TEM cooling system	Peltier effect from the cooling system generate a rapid temperature gradient upon applied voltage from battery
Low noise signal	HCED	Less than 40dB in a 7m room (background is approximately 40dB)
Rugged	Mechanical design and structure	- System is operational after 1.22m drop on plywood (in accordance to MIL-STD) - System is operational after splash test

[0032] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations disclosed in the text and drawings thereof could be made to the present invention without departing from the scope of the present invention. For eg., the above wearable temperature compress can be used on a patient to treat heat-stroke in a medical facility, as first-aid in the field or to conduct medical screening in terms of body temperature response to heat or cold compress.